



**PROJECT MANUAL  
VOLUME 1**

**FOR**

**MOBILE ARENA  
401 Civic Center Drive  
Mobile, Alabama 36602**

**Project No. AMOB230117**

**BID SET**

December 13, 2024



**City of Mobile  
Architectural Engineering Department  
Government Plaza  
205 Government Street, South Tower, 5th Floor  
Mobile, Alabama 36602**

**Bid Date:** \_\_\_\_\_

**Set Number:** \_\_\_\_\_

## **OWNERSHIP OF DOCUMENTS AND DISCLAIMER**

The Project Manual, Technical Specifications, Drawings, and all other documents relating to this project have been prepared for this individual and particular project, and for the exclusive use of the original Owner, developer or other party so indicated.

Actual project conditions and as-built conditions may vary significantly. Changes made during bidding, negotiations, construction, due to additions or deletions of portions of this project, and/or for other reasons, may not be indicated in these documents.

These documents may not be used or relied upon as a certification of information indicated, or used for any other project, by any third parties or other parties, for any purpose whatsoever, without the prior written consent of Goodwyn Mills Cawood, LLC, or prior to receipt of mutually agreed to compensation paid to Goodwyn Mills Cawood, LLC, therefore.

The ownership, copyrights, and all other rights to these documents, are reserved by Goodwyn Mills Cawood, LLC, including in part, all copies thereof in any form or media. Reproduction of the material contained in these documents or substantial quotation of their provisions without prior written permission of Goodwyn Mills Cawood, LLC, violates the copyright and common laws of the United States and will subject the violator to legal prosecution.

### **Goodwyn Mills Cawood, LLC**

11 N. Water Street

Suite 15250

Mobile, AL 36602

**SECTION 00 01 05 – PROJECT DIRECTORY**

**PROJECT DIRECTORY**

**OWNER:** **City of Mobile Architectural Engineering Department**  
Government Plaza 205 Government Street, South Tower, 5th  
Floor  
Mobile, Alabama 36602  
Phone: (251) 208-7492  
**Carleen Stout, Deputy Director, Real Estate  
and Asset Manager**

**ARCHITECT:** **GOODWYN MILLS CAWOOD, LLC**  
11 North Water Street  
Mobile, Alabama 36602  
Phone: (251) 460-4006  
**James R. Walker, AIA, Project Architect**  
**George Keith Parker, AIA, Project Manager**

**ARCHITECT:** **POPULOUS**  
4800 Main Street, Suite 300  
Kansas City, Missouri 64112  
Phone: (816) 221-1500  
**Aaron Bruckerhoff, AIA, Project Architect**

**CONSTRUCTION  
MANAGER:** **VOLKERT, INC**  
11 N Water Street, Suite 18290  
Mobile, AL 36602  
Phone: (864) 245-1917  
**Sam Matheny, Program Manager**

**STRUCTURAL  
ENGINEERS:** **WALTER P MOORE**  
1301 McKinney Drive, Suite 1100  
Houston, TX 77010  
Phone: (713) 630-7300  
**Erin Kueht, P.E., Structural**

**MECHANICAL/ELECTRICAL HENDERSON ENGINEERS  
PLUMBING/ FP ENGINEERS:** 1801 Main Street, Suite 300  
Kansas City, MO 64108  
Phone: (816) 663-8700  
**Tyler Johnson, P.E., Project Manager**  
**Evan O'Brien, P.E., Lead Mechanical**  
**Mike Fiser, P.E., Lead Electrical**

**CIVIL  
ENGINEERS:**

**DRIVEN ENGINEERING**  
805 Morris Hill Road  
Semmes, AL 36575-6445  
Phone: (251) 649-4011  
**Avalisha Fisher, P.E., Civil**



**SECTION 00 01 07 - PROFESSIONAL SEALS**

**THIS PAGE INTENTIONALLY LEFT BLANK**

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

## VOLUME 1

### SECTION 00 01 10 – TABLE OF CONTENTS

#### DIVISION 00 – PROCUREMENT & CONTRACTING REQUIREMENTS

00 01 00	COVER
00 01 05	DIRECTORY
00 01 07	PROFESSIONAL SEALS
00 01 10	TABLE OF CONTENTS
00 10 00	INVITATION TO BID
00 20 00	INSTRUCTIONS TO BIDDERS
00 22 00	SUPPLEMENTARY INSTRUCTIONS TO BIDDERS
00 24 00	PROPOSAL FORM
00 25 00	ATTACHMENT A TO PROPOSAL FORM
00 50 00	STANDARD FORM OF AGREEMENT OWNER/CONTRACTOR AIA A101-2017
00 72 00	GENERAL CONDITIONS OF THE CONTRACT AIA A201-2017
00 73 00	SUPPLEMENTARY PROJECT CONDITIONS

#### DIVISION 01 – GENERAL REQUIREMENTS

01 10 00	SUMMARY
01 23 00	ALTERNATES
01 25 00	SUBSTITUTION PROCEDURES
01 26 00	CONTRACT MODIFICATION PROCEDURES
01 29 00	PAYMENT PROCEDURES
01 31 00	PROJECT MANAGEMENT AND COORDINATION
01 32 00	CONSTRUCTION PROGRESS DOCUMENTATION
01 33 00	SUBMITTAL PROCEDURES
01 35 16	ALTERATION PROJECT PROCEDURES
01 40 00	QUALITY REQUIREMENTS
01 42 00	REFERENCES
01 43 39	MOCKUPS
01 45 29	STRUCTURAL TESTING AND INSPECTIONS
01 50 00	TEMPORARY FACILITIES AND CONTROLS
01 60 00	PRODUCT REQUIREMENTS
01 73 00	EXECUTION
01 77 00	CLOSEOUT PROCEDURES
01 78 23	OPERATION AND MAINTENANCE DATA
01 78 39	PROJECT RECORD DOCUMENTS
01 79 00	DEMONSTRATION AND TRAINING

#### DIVISION 02 – EXISTING CONDITIONS

NOT ISSUED

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 03 – CONCRETE**

03 10 00	CONCRETE FORMING AND ACCESSORIES		
03 20 00	CONCRETE REINFORCING		
03 30 00	CAST IN PLACE CONCRETE		
03 35 43	POLISHED CONCRETE FINISHING		
03 41 34	PRECAST PRETENSIONED CONCRETE SEATING UNITS		
03 45 00	PRECAST ARCHITECTURAL CONCRETE		

**DIVISION 04 – MASONRY**

04 20 00	UNIT MASONRY		
04 21 13.23	ADHERED BRICK VENEER		

**DIVISION 05 – METALS**

05 12 00	STRUCTURAL STEEL FRAMING		
05 31 00	STEEL DECKING		
05 40 00	COLD-FORMED METAL FRAMING		
05 45 00	METAL SUPPORT ASSEMBLIES		
05 50 00	METAL FABRICATIONS		
05 51 13	METAL PAN STAIRS		
05 51 16	METAL FLOOR PLATE STAIRS		
05 51 19	METAL GRATING STAIRS		
05 52 13	PIPE AND TUBE RAILINGS		
05 53 13	BAR GRATINGS		
05 70 00	DECORATIVE METAL		
05 70 10	VISION BARRIERS		
05 73 13	GLAZED DECORATIVE METAL RAILINGS		
05 75 00	DECORATIVE FORMED METAL		

**DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES**

06 10 00	ROUGH CARPENTRY		
06 20 00	FINISH CARPENTRY		
06 40 00	ARCHITECTURAL WOODWORK		
06 42 16	FLUSH WOOD PANELING		
06 65 00	SOLID SURFACE FABRICATIONS		

**DIVISION 07 – MOISTURE PROTECTION**

07 11 13	BITUMINOUS DAMPROOFING		
07 13 26	SHEET WATERPROOFING		
07 18 00	TRAFFIC COATINGS		
07 21 00	THERMAL INSULATION		
07 26 16	BELOW-GRADE VAPOR RETARDERS		
07 27 26	FLUID-APPLIED MEMBRANE AIR BARRIERS		

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
07 42 13	INSULATED METAL WALL PANELS		
07 42 93	SOFFIT PANELS		
07 46 46	FIBER-CEMENT SIDING		
07 54 19	PVC MEMBRANE ROOFING		
07 62 00	SHEET METAL FLASHING AND TRIM		
07 71 00	ROOF SPECIALTIES		
07 72 00	ROOF ACCESSORIES		
07 76 00	ROOF PAVER AND PEDESTAL SYSTEM		
07 81 00	APPLIED FIRE PROTECTION		
07 81 23	INTUMESCENT FIRE PROTECTION		
07 82 00	BOARD FIRE PROTECTION		
07 84 13	PENETRATION FIRESTOPPING		
07 84 43	JOINT FIRESTOPPING		
07 91 00	PREFORMED PRECAST SEATING BOWL JOINT TREATMENTS		
07 92 00	JOINT SEALANTS		
07 95 00	EXPANSION CONTROL		

**DIVISION 08 – OPENINGS**

08 11 13	HOLLOW METAL DOORS AND FRAMES
08 14 16	FLUSH WOOD DOORS
08 31 13	ACCESS DOORS AND FRAMES
08 33 13	COILING COUNTER SHUTTERS
08 33 23	OVERHEAD COILING DOORS
08 41 13	ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
08 44 13	GLAZED ALUMINUM CURTAIN WALLS
08 51 13	ALUMINUM WINDOWS
08 56 53	SECURITY WINDOWS

**VOLUME 2**

08 71 00	DOOR HARDWARE
08 80 00	GLAZING
08 81 13	DECORATIVE GLASS GLAZING
08 83 00	MIRRORS
08 88 53	SECURITY GLAZING
08 91 19	FIXED LOUVERS

**DIVISION 09 – FINISHES**

09 21 16.23	GYPSUM BOARD SHAFT WALL ASSEMBLIES
09 22 16	NON-STRUCTURAL METAL FRAMING
09 29 00	GYPSUM BOARD
09 30 13	TILE
09 51 00	SUSPENDED CEILING SYSTEMS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
09 61 13	FLOOR SEALERS		
09 61 23	HAZARD STRIPING		
09 65 13	RESILIENT BASE AND ACCESSORIES		
09 65 16	RESILIENT SHEET FLOORING		
09 65 19	RESILIENT TILE FLOORING		
09 66 23	RESINOUS MATRIX TERRAZZO FLOORING		
09 67 23	RESINOUS FLOORING		
09 68 00	CARPETING		
09 69 00	ACCESS FLOORING		
09 72 00	WALL COVERINGS		
09 72 19	GRAPHICS WALL COVERINGS		
09 84 33	SOUND-ABSORBING WALL UNITS		
09 84 36	SOUND-ABSORBING CEILING UNITS		
09 91 13	EXTERIOR PAINTING		
09 91 23	INTERIOR PAINTING		
09 93 00	STAINING AND TRANSPARENT FINISHING		
09 96 00	HIGH-PERFORMANCE COATINGS		

**DIVISION 10 – SPECIALTIES**

10 11 00	VISUAL DISPLAY UNITS
10 12 00	DISPLAY CASES
10 14 00	SIGNAGE
10 21 13.14	STAINLESS STEEL TOILET COMPARTMENTS
10 21 16	SHOWER AND DRESSING COMPARTMENTS
10 22 26.13	ACCORDION FOLDING PARTITIONS
10 22 29	UPFOLDING PANEL PARTITIONS
10 22 39	FOLDING PANEL PARTITIONS
10 26 00	WALL AND DOOR PROTECTION
10 28 00	TOILET, BATH, AND LAUNDRY ACCESSORIES
10 28 19	TUB AND SHOWER ENCLOSURES
10 35 00	FLAGPOLES
10 43 13	DEFIBRILLATOR CABINETS
10 43 14	AUTOMATED EXTERNAL DEFIBRILLATORS
10 44 13	FIRE PROTECTION CABINETS
10 44 16	FIRE EXTINGUISHERS
10 51 13	METAL LOCKERS
10 51 19	PHENOLIC LOCKERS
10 51 20	CUSTOM WOOD LOCKERS
10 53 00	WALKWAY COVERS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 11 – EQUIPMENT**

11 13 13	LOADING DOCK BUMPERS
11 13 16	LOADING DOCK SEALS AND SHELTERS
11 13 19	STATIONARY LOADING DOCK EQUIPMENT
11 23 00	COMMERCIAL LAUNDRY EQUIPMENT
11 31 00	RESIDENTIAL APPLIANCES
11 40 00	FOOD SERVICE EQUIPMENT
11 47 00	ICE MACHINES
11 61 00	THEATER AND STAGE EQUIPMENT
11 61 43	STAGE CURTAINS
11 61 44	HALF-HOUSE CURTAINS
11 61 53	ARENA CURTAINS
11 82 26	FACILITY WASTE COMPACTORS

**DIVISION 12 – FURNISHINGS**

12 22 00	CURTAINS AND DRAPES
12 36 16	METAL COUNTERTOPS
12 48 13	ENTRANCE FLOOR MATS AND FRAMES
12 63 26	ARENA SEATS
12 66 00	TELESCOPING STANDS
12 66 23	PORTABLE PLATFORMS

**DIVISION 13 – SPECIAL CONSTRUCTION**

13 17 00	HYDROTHERAPY EQUIPMENT, POOLS, AND TUBS
13 18 11	ICE RINK GENERAL REQUIREMENTS
13 18 12	ICE RINK REFRIGERATION SYSTEM
13 18 13	ICE RINK FLOOR SYSTEM
13 18 14	ICE RINK PIPING, VALVES, AND ACCESSORIES
13 18 15	ICE RINK WASTE HEAT RECOVERY SYSTEM
13 18 16	ICE RINK DASHER BOARD SYSTEM AND ACCESSORIES

**VOLUME 3**

13 18 17	ICE RINK CENTRAL CONTROL SYSTEM
13 18 19	ICE RINK WATER TREATMENT SYSTEM
13 28 16	HOCKEY SAFETY NETTING SYSTEM

**DIVISION 14 – CONVEYING SYSTEMS**

14 21 00	GEARLESS MACHINE ROOM LESS TRACTION ELEVATORS
14 22 00	ELECTRIC TRACTION FREIGHT ELEVATORS
14 31 00	ESCALATORS
14 42 00	WHEELCHAIR LIFTS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 21 – FIRE SUPPRESSION**

21 00 00	TABLE OF CONTENTS AND SEAL		
21 00 10	GENERAL FIRE SUPPRESSION REQUIREMENTS		
21 05 00	COMMON WORK RESULTS FOR FIRE SUPPRESSION		
21 05 15	BASIC FIRE SUPPRESSION PIPING METHODS AND MATERIALS		
21 05 53	IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT		
21 11 00	FIRE SUPPRESSION WATER SERVICE PIPING		
21 12 00	FIRE SUPPRESSION STANDPIPES		
21 13 13	WATER BASED FIRE SUPPRESSION SYSTEMS		
21 31 13	ELECTRIC DRIVE CENTRIFUGAL PUMPS		

**DIVISION 22 – PLUMBING**

22 00 00	TABLE OF CONTENTS AND SEAL		
22 00 10	GENERAL PLUMBING REQUIREMENTS		
22 00 15	COORDINATION		
22 05 10	COMMON WORK RESULTS FOR PLUMBING		
22 05 13	COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT		
22 05 15	BASIC PIPING MATERIALS AND METHODS		
22 05 19	METERS AND GAUGES FOR PLUMBING PIPING		
22 05 23	GENERAL DUTY VALVES FOR PLUMBING PIPING		
22 05 29	HANGERS AND SUPPORTS FOR PLUMBING PIPING		
22 05 33	HEAT TRACING FOR PLUMBING PIPING		
22 05 50	VIBRATION ISOLATION FOR PLUMBING PIPING AND EQUIPMENT		
22 05 53	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT		
22 07 00	PLUMBING INSULATION		
22 11 00	WATER DISTRIBUTION PIPING AND SPECIALTIES		
22 11 11	MECHANICALLY JOINED PLUMBING PIPING SYSTEMS		
22 11 14	STAINLESS STEEL WATER DISTRIBUTION PIPING & SPECIALTIES		
22 11 23	DOMESTIC WATER PUMPS		
22 13 00	SANITARY DRAINAGE AND VENT PIPING & SPECIALTIES		
22 13 28	CONDENSATE PUMPS FOR HVAC EQUIPMENT		
22 14 00	STORM DRAINAGE PIPING AND SPECIALTIES		
22 14 89	SUMP PUMPS		
22 34 00	FUEL FIRED DOMESTIC WATER HEATERS		
22 40 00	PLUMBING FIXTURES		
22 70 00	NATURAL GAS SYSTEMS		

**DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING**

23 00 00	TABLE OF CONTENTS AND SEAL		
23 00 10	GENERAL MECHANICAL REQUIREMENTS		
23 00 15	ELECTRICAL COORDINATION FOR MECHANICAL EQUIPMENT		

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------



23 05 00	COMMON WORK RESULTS FOR HVAC
23 05 10	BASIC PIPING MATERIALS AND METHODS
23 05 13	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
23 05 14	VARIABLE FREQUENCY DRIVES
23 05 16	EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING
23 05 19	METERS AND GAUGES FOR HVAC PIPING
23 05 23	GENERAL DUTY VALVES FOR HVAC PIPING
23 05 29	HANGERS AND SUPPORTS FOR HVAC PIPING & EQUIPMENT
23 05 50	VIBRATION ISOLATION FOR HVAC
23 05 53	IDENTIFICATION FOR HVAC PIPING & EQUIPMENT
23 05 93	TESTING, ADJUSTING AND BALANCING FOR HVAC
23 07 00	HVAC INSULATION
23 08 00	COMMISSIONING OF HVAC SYSTEMS
23 09 13	INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
23 09 14	REFRIGERANT MONITORING SYSTEMS
23 09 23	DIRECT-DIGITAL CONTROL FOR HVAC
23 21 13	HYDRONIC PIPING
23 21 13.13	BURIED HYDRONIC AND STEAM PIPING
23 21 13.23	MECHANICALLY JOINED HYDRONIC PIPING SYSTEMS
23 21 14	HYDRONIC SPECIALTIES
23 21 23	HYDRONIC PUMPS
23 25 00	HVAC WATER TREATMENT
23 31 13	METAL DUCTS
23 33 00	AIR DUCT ACCESSORIES
23 34 23	HVAC POWER VENTILATORS
23 34 33	AIR CURTAINS
23 36 00	AIR TERMINAL UNITS
23 37 13	DIFFUSERS, REGISTERS AND GRILLES
23 51 00	BREECHES, CHIMNEYS AND STACKS
23 51 13	DRAFT CONTROL DEVICES
23 52 16	CONDENSING BOILERS
23 53 23	BOILER ACCESSORIES
23 64 16	CENTRIFUGAL WATER CHILLERS
23 65 00	COOLING TOWERS
23 72 00	AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

#### **VOLUME 4**

23 73 13	CENTRAL STATION AIR HANDLING UNITS
23 82 00	TERMINAL HEATING AND COOLING UNITS
23 84 14	SELF CONTAINED HUMIDIFIERS
23 84 17	DESICCANT WHEEL UNITS
23 84 19	HYDROTHERAPY AIR HANDLING UNITS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 26 – ELECTRICAL**

26 00 00	TABLE OF CONTENTS AND SEAL		
26 00 10	GENERAL ELECTRICAL REQUIREMENTS		
26 05 00	COMMON WORK RESULTS FOR ELECTRICAL		
26 05 02	EQUIPMENT WIRING SYSTEMS		
26 05 04	PROVISIONS FOR ELECTRIC UTILITY SERVICE		
26 05 19	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES		
26 05 26	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS		
26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS		
26 05 33	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS		
26 05 43	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS		
26 05 53	IDENTIFICATION FOR ELECTRICAL SYSTEMS		
26 05 73	POWER SYSTEM STUDIES		
26 09 10	CENTRALIZED DIMMING SYSTEM		
26 09 23	LIGHTING CONTROL DEVICES		
26 22 00	LOW-VOLTAGE TRANSFORMERS		
26 24 13	SWITCHBOARDS		
26 24 16	PANELBOARDS		
26 27 26	WIRING DEVICES		
26 28 13	FUSES		
26 28 16	ENCLOSED SWITCHES AND CIRCUIT BREAKERS		
26 32 13	PACKAGED ENGINE-DRIVEN GENERATORS		
26 33 53	STATIC UNINTERRUPTIBLE POWER SUPPLIES		
26 36 00	TRANSFER SWITCHES		
26 41 13	LIGHTNING PROTECTION FOR STRUCTURES		
26 43 13	SURGE PROTECTIVE DEVICES		
26 51 00	INTERIOR LIGHTING		
26 53 00	INDOOR ARENA LIGHTING		
26 56 00	EXTERIOR AREA LIGHTING		

**DIVISION 27 – COMMUNICATIONS (TECHNOLOGY)**

27 00 00	TABLE OF CONTENTS - COMMUNICATIONS		
27 05 00	COMMONWORK RESULTS FOR COMMUNICATIONS		
27 05 26	GROUNDING AND BONDING FOR COMMUNICATIONS		
27 05 28	PATHWAYS FOR COMMUNICATIONS		
27 05 43	UNDERGROUND PATHWAYS & STRUCTURES FOR COMMUNICATIONS SYSTEMS		
27 05 53	IDENTIFICATIONS FOR COMMUNICATIONS		
27 11 00	COMMUNICATIONS EQUIPMENT ROOM FITTINGS		
27 13 00	COMMUNICATIONS BACKBONE CABLING		
27 15 00	COMMUNICATIONS HORIZONTAL CABLING		
27 31 24	IP TELEPHONE SYSTEM		
27 32 44	EMERGENCY RESPONDER TESTING		

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
27 35 23	EMERGENCY RESPONDER RADIO COVERAGE		
27 60 00	NETWORK ELECTRONICS		
27 62 00	WIRELESS NETWORK SYSTEMS		

**DIVISION 27 – COMMUNICATIONS (AUDIO – VIDEO)**

27 00 01	TABLE OF CONTENTS AND SEAL – AUDIO-VIDEO
27 00 11	GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO - VIDEO
27 05 01	COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO - VIDEO
27 41 00	AUDIO VIDEO SYSTEMS
27 41 16	AUDIO VIDEO SYSTEMS EQUIPMENT
27 41 22	LARGE FORMAT DISPLAY SYSTEMS
27 41 33	TELEVISION DISTRIBUTION SYSTEM
27 41 51	BROADCAST SYSTEMS PRE-WIRE

**DIVISION 28 – ELECTRONIC SAFETY AND SECURITY**

28 00 00	TABLE OF CONTENTS (SECURITY)
28 05 00	BASIC SECURITY REQUIREMENTS
28 05 20	BASIC SECURITY MATERIALS AND METHODS
28 05 26	GROUNDING AND BONDING FOR SECURITY SYSTEMS
28 05 28	SECURITY SYSTEMS PATHWAYS AND SUPPORT EQUIPMENT
28 13 00	ACCESS CONTROL SOFTWARE AND DATABASE MANAGEMENT
28 15 00	ACCESS CONTROL HARDWARE DEVICES
28 15 23	INTERCOM ENTRY SYSTEM
28 23 00	VIDEO SURVEILLANCE CAMERA SYSTEMS
28 41 10	SECURITY CONTROL ROOM EQUIPMENT
28 45 00	TABLE OF CONTENTS AND SEAL (FIRE ALARM)
28 46 00	FIRE DETECTION AND ALARM

**VOLUME 5****DIVISION 31 – EARTHWORK**

02 06 13	GEOTECHNICAL REPORT - SEE APPENDIX
31 00 00	TABLE OF CONTENTS AND SEAL
31 00 00	EARTHWORK
31 11 00	CLEARING, GRUBBING AND DEMOLITION
31 22 00	SITE GRADING
31 23 23 23	SOIL COMPACTION CONTROL
31 40 00	SHORING AND UNDERPINNING
31 63 29	DRILL DISPLACEMENT CAST-IN-PLACE PILES
32 12 16	ASPHALT PAVING
32 13 13	CONCRETE PAVING, CURBS, AND WALKS
32 90 00	PLANTING
33 14 11	WATER SERVICE PIPING
33 30 00	SANITARY SEWERAGE

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
33 31 00	SANITARY SEWER COLLECTION SYSTEM		
33 40 00	STORMWATER UTILITIES		

**DIVISION 32 – EXTERIOR IMPROVEMENTS**

32 00 00	TABLE OF CONTENTS AND SEAL
32 13 13	CONCRETE PAVING
32 13 16	DECORATIVE CONCRETE PAVING
32 13 73	CONCRETE PAVING JOINT SEALANTS
32 14 00	UNIT PAVING
32 17 26	TACTILE WARNING SURFACING
32 31 16	WELDED WIRE FENCES AND GATES
32 31 19	DECORATIVE METAL FENCES AND GATES
32 31 19.53	DECORATIVE METAL SECURITY FENCES AND GATES
32 32 23	SEGMENTAL RETAINING WALLS
32 33 00	SITE FURNISHINGS
32 84 00	PLANTING IRRIGATION
32 84 23	IRRIGATION WORK
32 90 00	PLANTING (LANDSCAPE WORK)
32 90 05	LANDSCAPE MAINTENANCE
32 91 13	SOIL PREPARATION
32 92 00	TURF AND GRASSES
32 92 23	SODDING
32 93 00	PLANTS

**DIVISION 33 – UTILITIES**

REFER TO DIVISION 31 ABOVE

**APPENDIX**

GEOTECHNICAL REPORT DATED AUGUST 16, 2024 (from Geotechnical Engineering Testing, Inc.)  
AVAILABLE UPON REQUEST

END OF SECTION

**SECTION 00 10 00 – INVITATION TO BID****INVITATION TO BID**

You are invited to submit a sealed bid for construction of the following facility:

PROJECT NAME: Mobile Arena.  
PROJECT LOCATION: 401 Civic Center Drive, Mobile, Alabama 36602  
GMC PROJECT NUMBER: AMOB230117  
CITY OF MOBILE PROJECT NUMBER: CC-034A-22

**1. BID DATE:**

- A. Sealed bids will be received from Pre-qualified Bidders only.
- B. Sealed Bids will be received and clocked in until 2:15 PM local time, **February 7, 2024** in the office of the City Clerk, Government Plaza, 9<sup>th</sup> Floor South Administrative Tower, 205 Government Street, Mobile, Alabama 36602.
- C. All Bids not clocked in at the City Clerk's Office prior to the time specified, or Bids received after the specified time, will be automatically rejected and returned unopened.
- D. Bids will be publicly opened and read at **3:00 PM** local time, in the Government Plaza Atrium Lobby **located at 205 Government St., Mobile, Alabama 36602.**

**2. SPECIFICATIONS AND DRAWINGS:**

- A. Specifications and Drawings are on file and may be examined and obtained from the following location: <https://www.cityofmobile.org/bids/>
- B. Bidders shall use complete sets of Bid Documents in preparing their bid. Neither the Owner nor Architect/Engineer assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bid Documents.
- C. All Addenda will be posted to the following location:  
<https://www.cityofmobile.org/bids/>
- D. This is a tax-exempt project and shall be certified by the requirements of the Alabama Department of Revenue. Bidders shall NOT include sales and use taxes with their bid amounts. Bidders shall complete the Sales Tax Form C-3A and include it as an attachment to their Bid Form.
- E. Bidder questions shall be submitted electronically to [sam.matheny@volkert.com](mailto:sam.matheny@volkert.com) and [keith.parker@gmcnetwork.com](mailto:keith.parker@gmcnetwork.com) no later than January 27, 2025.

**3. BID SURETY: Required on Bids \$10,000.00 or more**

- A. A Cashier's Check drawn on a bank registered to do business in the State of Alabama and which is a member of the Federal Deposit Insurance Corporation, or a Bid Bond payable to Owner, City of Mobile, in the amount of 5% of the Base Bid, but in no event more than \$10,000.00 is required to accompany Bid.
- B. Bid Bond must be issued by a Surety licensed to do business in the State of Alabama. Bidder shall require the attorney in fact who executes the required bonds on behalf of the surety to affix to the bond a certified and current copy of the power of attorney.
- C. No Bid may be modified, withdrawn, or canceled for a period of Ninety (90) days after the time designated above for receipt of bids.

The City of Mobile will have Ninety (90) days from the bid opening date to award contract.

4. SURETY QUALIFICATIONS:

- A. A Surety authorized to do business in the State of Alabama must issue Bonds.
- B. If the Base Bid is \$50,000 or more, the Surety must have a minimum rating of A/Class VI as reported by the latest issue of Best Key Rating Guide Property-Casualty published by Alfred M. Best Company, Inc.

5. IRREGULARITIES AND REJECTION:

- A. The City of Mobile reserves the right to waive irregularities in the Bid and in Bidding, and to reject any or all Bids.

6. BIDDER QUALIFICATIONS:

- A. Bidders shall be pre-qualified in order to submit a bid.
- B. Bids for Work costing \$50,000 or more must be licensed pursuant to current Alabama law and of classifications compliant with the State of Alabama Licensing Board for General Contractors. Note that if the contract amount is \$10,000 or greater, both a Performance Bond and a Labor and Material Payment Bond shall be required. Before Bidding, Contractor shall verify their license classification of their General Contractors license with the State of Alabama Licensing Board for General Contractors to verify classification is acceptable to perform 51% of the Scope of Work.
- C. In case of a joint venture of two or more Contractors, the amount for the bid shall be within the maximum bid limitations as set by the State of Alabama Licensing Board for General Contractors of at least one of the partners to the joint venture.

7. NON-RESIDENT CONTRACTORS:

- A. Except for contracts funded in whole or part with funds received from a federal agency, preference shall be given to resident Contractors on the same basis as the nonresident Contractor's state awards contracts to Alabama Contractors bidding in similar circumstances.

- B. Nonresident Bidders shall, prior to submitting a bid, be registered with the Alabama Secretary of State and the Alabama Department of Revenue. Provide the Secretary of State Business "Entity ID Number" on the Bid Form in the space provided.
8. PRE-BID CONFERENCE:
- A. **A Mandatory Pre-Bid Conference shall be held on January 8, 2025 at 9:00 AM local time at the National Maritime Museum located at 155 Water Street, Mobile, Alabama 36602.** The conference will begin with an informal introductory meet and greet of the pre-qualified Prime Contractors to Small Business Subcontractor/Suppliers who wish to attend the meeting. This will be followed by the formal pre-bid conference. The pre-bid conference will be followed by a walkthrough of the site location with Pre-qualified Prime Contractors only.
- B. The Pre-bid conference will be open to potential subcontractors and suppliers.
- C. Minutes of this conference will be issued as an Addendum to the bid documents.
9. BID SUBMITTAL:
- A. Bids must be submitted on copies of the Bid Forms furnished in the bidding documents.
- B. Bid, with Bid Security, Sales Tax Form C-3A and other supporting data specified, shall be contained in a sealed, opaque envelope, approximately 9x12 inches or larger and be marked on the outside with the words "**SEALED BID FOR MOBILE ARENA - PROJECT NUMBER: CC-034-22.**"
- C. The Bid envelope shall be clearly addressed to the Owner as indicated on the Bid Form and include the bid date, the name, address and State License number and classification of the Bidder issued by the State of Alabama Licensing Board for General Contractors.
- D. All Bids of \$50,000 or more must include the bidder's State of Alabama General Contractor's License information written on the outside of the bid envelope. Any bid submitted without such license information may be rejected and returned to the bidder unopened.
- E. In addition, in large letters on both front and back of envelope, write the following: DO NOT OPEN UNTIL **THREE PM, February 7, 2025**\_\_\_\_\_.
- F. For a bid to be valid it shall be delivered at designated location prior to time and date for receipt of Bids indicated in INVITATION TO BID, or prior to any extension thereof issued to Bidders. After that time no Bid will be received or withdrawn.
- G. When sent by mail, preferably special delivery, express service, or registered mail, the sealed Bid, marked as indicated above, shall be enclosed in another envelope for mailing such that the exterior mailing container or envelope may be opened without revealing the contents of the Bid. It is the Contractors responsibility to assure delivery of the bid to the City Clerk's Office prior the time and date established.

## 10. EQUAL OPPORTUNITY:

- A. The City of Mobile, Alabama is an Equal Opportunity Employer and requires that all Contractors comply with the Equal Employment Opportunity laws and the provisions of the Bid Documents in this regard.
- B. The City of Mobile also encourages and supports the utilization of Minority Business Enterprises on these and all other publicly solicited Bids, and shall be in compliance with the City of Mobile's Minority Utilization Plan as adopted by the City Council.
- C. Contractor shall provide an appropriately completed copy of the "City of Mobile Subcontracting and Major Supplier Plan" in the envelope with their Bid Form. Form shall document DBE Subcontractors participating in the project. The total % of DBE participation shall be equal to or greater than 15% of the total bid price. During construction, contractors are required to submit a "DBE Utilization Report" with every Pay Application.
- D. Contractors should contact the City of Mobile, Supplier Diversity Manager for assistance with DBE Subcontractor information and any questions regarding the DBE Compliance Forms. Contact Archnique Kidd at 251-208-7967.

## 11. ADDITIONAL BIDDING PROCEDURES:

- A. Refer to the complete information in the Bid Documents prior to submitting a bid. Additional Bidding Procedure information is contained therein, particularly in the specification Section 00 20 00 "Instructions to Bidders - AIA Document A701" and in the specification Section 00 22 00 "Supplementary Instructions to Bidders".

## 12. STATE OF ALABAMA IMMIGRATION ACT

"The State of Alabama, under the Beason-Hammon Alabama Taxpayer and Citizen Protection Act, Act No. 2011-535, Alabama Code Section 31-13-1, et. Seq., requires:

- A. That the Contractor shall be enrolled in the E-Verify Program, shall participate in that Program during the performance of the contract, and shall verify the immigration status of every employee who is required to be verified, according to the applicable federal rules and regulations; and
- B. That it will attach to the contract the company's documentation of enrollment in E-Verify.
- C. Subcontractors must also enroll in the E-Verify Program prior to performing any work on the contract and shall attach to its sworn affidavit documentation establishing that the subcontractor is enrolled in the E-Verify Program.

## 13. PUBLIC CONTRACTS WITH ENTITIES ENGAGING IN CERTAIN BOYCOTT ACTIVITIES

- A. By signing this contract, Contractor further represents and agrees that it is not currently engaged in, nor will it engage in, any boycott of a person or entity based in or doing business with a jurisdiction with which the State of Alabama can enjoy open trade.



END OF SECTION

DRAFT COPY

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 00 20 00 - INSTRUCTIONS TO BIDDERS**

**PART 1 – GENERAL**

- A. This section includes the INSTRUCTIONS TO BIDDERS, AIA Document A701-2018 edition, to be utilized with the Owner's most recent modifications and which shall be used in conjunction with the entire Bid Documents and Section 00 22 00 – SUPPLEMENTARY INSTRUCTIONS TO BIDDERS for this Project.

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 00 22 00 - SUPPLEMENTARY INSTRUCTIONS TO BIDDERS****THE ATTENTION OF ALL BIDDERS IS CALLED TO THE FOLLOWING INSTRUCTIONS AND CONDITIONS:****1. BIDDING DOCUMENTS**

- A. Bidders may obtain complete sets of Bid Documents and Specifications (Project Manual) from the Department of Architectural Engineering as listed in the Invitation to Bid.
- B. Bidders shall use the complete set of documents in preparing their bid. The City of Mobile assumes no responsibility for errors or misinterpretations resulting from use of an incomplete set of documents.

**2. INTERPRETATION OF BID DOCUMENTS:**

- A. Bidders shall carefully study and compare the Bidding Documents and compare various components of the Bidding Documents with each other, shall examine the site and local conditions and shall at once report to the Project Manager any errors, inconsistencies or ambiguities discovered.
- B. Bidders requiring clarification or interpretation of the Bidding Documents shall make a written request to the Project Manager by 12:00 January 27, 2025. E-mail requests are required and should be addressed to [sam.matheny@volkert.com](mailto:sam.matheny@volkert.com) and [keith.parker@gmcnetwork.com](mailto:keith.parker@gmcnetwork.com).
- C. Interpretations, corrections, and changes to the Bidding Documents will be made by a formal, written Addendum. Interpretations, corrections, and changes to the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely on them.
- D. Any discrepancy not resolved prior to Bidding shall be bid by the Contractor to provide for the costliest and/or restrictive interpretation of the documents.

**3. BIDDING PROCEDURES:**

- A. No Bid will be considered unless made out and submitted on a copy of the Bid Form as set forth by the Bid Documents.
- B. All blanks on the Bid Form shall be legibly executed in a non-erasable medium.
- C. Sums shall be expressed in both words and figures. In case of discrepancy, the amount written in words shall govern.
- D. Interlineations, alterations, and erasures must be initialed by the signer of the Bid.

- E. All requested Alternates, Unit Prices and Allowances shall be bid as indicated on the Bid Form and the Bid Documents.
- F. Addenda shall be considered as a part of the Bid Documents and those issued prior to the opening of Bids shall be acknowledged on the Bid Form and any adjustment in cost shall be included in the Contract Sum.

**4. BID SECURITY:**

- A. A Cashier's Check drawn on a bank registered to do business in the State of Alabama and which is a member of the Federal Deposit Insurance Corporation, or Bid Bond payable to Owner, City of Mobile, in the amount of 5% of the Base Bid, but in no event more than \$10,000.00, must accompany bid. By submitting a Bid Security, the Bidder pledges to enter into a Contract with the City of Mobile on the terms stated in the Bid, and will, if required, furnish bonds covering faithful performance of the Contract and required insurance certificate. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds or insurance or any other required document, the amount of the Bid security shall be forfeited to the Owner as liquidated damages, not as a penalty.
- B. Bid Bond shall be valid for a minimum of ninety (90) days from the date of the Bid. The Owner reserves the right to retain the security of all Bidders until the successful Bidder enters into the Contract or until (90) days after Bid opening, whichever is sooner.
- C. Bonds must be issued by a Surety licensed to do business in the State of Alabama. If the project cost is more than \$50,000.00 the Surety must have a minimum rating of A/Class VI as reported by the latest issue of Best's Key Rating Guide Property- Casualty published by Alfred M. Best Company, Inc.
- D. Power of Attorney is required for all Bonds.
- E. The Surety company shall be required to execute AIA Document G-707, "Consent of Surety to Final Payment" prior to Final Payment of retainage being made to the Contractor.

**5. EXAMINATION OF DOCUMENTS AND SITE WORK:**

- A. Before submitting a Bid, Bidders should carefully examine the Bid Documents, visit the site of the Work, including attendance at the Pre-Bid conference, fully inform themselves as to existing conditions and limitations, and include in the Bid a sum to cover the cost of all items included in the Contract and necessary to perform the Work. The submission of a Bid will be considered as conclusive evidence that the Bidder has made such examination.

**6. SUBMISSION OF BIDS:**

- A. Bid, with Bid Security, Sales Tax Form C-3A, and other supporting data specified, shall be contained in a sealed, opaque envelope, approximately 9x12 inches or larger and be marked on the outside with the words "**SEALED BID FOR MOBILE ARENA, PROJECT NUMBER: CC-034-22**", the Bid Date, and Contractor's name, address, and City of Mobile Business License number. And, if bidding in an amount \$50,000 or greater, the State of Alabama General Contractor's License number and classification of the Bidder issued by the State of Alabama Licensing Board for General Contractors shall be written on the envelope.
- B. Bids shall be deposited at the designated location prior to the time and date for receipt of Bids. Bids received after the time and date specified in the Invitation to Bid, or as modified by Addendum, will not be considered. Late Bids will be returned to the Bidder unopened.
- C. The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.
- D. Oral, telephonic, facsimile, or other electronically transmitted bids will not be considered.

#### **7. MODIFICATION OR WITHDRAWAL OF BIDS:**

- A. A Bid may not be modified, withdrawn, or canceled by the Bidder for a period of ninety (90) days following the time and date designated for receipt of bids, and each Bidder so agrees in submitting a Bid.

#### **8. CONSIDERATION AND AWARD OF BIDS:**

- A. At the discretion of the City, the properly identified Bids received on time will be publicly opened and will be read aloud.
- B. The City shall have the right to reject all Bids. A Bid not accompanied by a required Bid security or a Bid which is in any way incomplete, or irregular is subject to rejection.
- C. It is the intent of the City to award a Contract to the lowest qualified Bidder provided the Bid has been submitted in accordance with the requirements of the Bidding Documents and does not exceed the funds available. The City shall have the right to waive informalities and irregularities in a Bid received and to accept the Bid which, in the City's judgment, is in the City's best interest.
- D. The award shall be based on the lowest Total Bid for the Base Bid and any allowances, plus any alternates and/or options that may be accepted, as listed on the Bid Form.

#### **9. PROOF OF COMPETENCY OF BIDDER:**

- A. Bidders have been prequalified. All prequalified bidders are considered to have sufficient means and experience in the types of work called for to assure the completion of the Contract in a satisfactory manner.

**10. SIGNING OF CONTRACT:**

- A. The Standard Agreement between the City of Mobile and the Contractor, included herein, shall serve as the Agreement between the City and the Contractor.
- B. The Bidder to whom the Contract is awarded shall, within ten (10) calendar days of the Bid opening, properly execute and deliver to the Owner, the signed Agreement (AIA Document A101 with A201 attached thereto).
- C. The Bidder to whom the Contract is awarded shall properly execute and deliver to the Owner, within five (5) calendar days of the Owner's execution of the Agreement, the following items:
  - (1). Performance Bond and Labor and Material Payment Bond (originals);
  - (2). Certificate of Insurance (original) with endorsements to City of Mobile;
  - (3). Evidence of enrollment in the E-Verify program.
  - (4). Other documentation as required by the Contract Documents.
- D. Failure or refusal to sign the Agreement or to provide Certificates of Insurance in a form satisfactory to the City of Mobile, E-Verify verification, or other required documentation, shall subject the Bidder to immediate forfeiture of Bid Security.
- E. On all documents: City of Mobile Business License, the Alabama Secretary of State Business Identity, the Alabama Secretary of State Certificate of Authority (out of state contractors), E-verify documentation, and ACORD Insurance Form, the Contractor's name shall be EXACTLY the same.

**11. NONDISCRIMINATION:**

- A. Contractor shall comply with all Federal, State and local laws concerning nondiscrimination, including but not limited to City of Mobile Ordinance No. 14-034 which requires, inter alia, that all contractors performing work for the City of Mobile not discriminate on the basis of race, creed, color, national origin or disability, require that all subcontractors they engage do the same, and make every reasonable effort to assure that fifteen percent of the work performed under contract be awarded to socially and economically disadvantaged individuals and business entities.

**12. AMERICANS WITH DISABILITIES ACT (ADA):**

- A. Bidders shall comply with the provisions of the Americans with Disabilities Act (ADA) of 1990 which prohibits discrimination against individuals with disabilities.

**13. USE OF DOMESTIC PRODUCTS:**

- A. Section 39-3-1, Alabama Code, 1975, provides that the Contractor agree, in the execution of this Contract, to use materials, supplies and products manufactured, mined, processed or otherwise produced in the United States or its territories, if available at reasonable prices, and that breach of this Agreement by the Contractor shall result in the assessment of liquidated damages in an amount not less than \$500.00 nor more than twenty (20) percent of gross amount of the Contract Price.



**14. NON-RESIDENT (OUT OF STATE) CONTRACTORS:**

- A. Preference to Resident Contractors: Section 39-3-5, Code of Alabama, 1975, provides that a non-resident (out of State) bidder domiciled in a state which grants a preference to local Contractors is to be awarded a public contract on the same basis as the non-resident bidder's state awards contracts to Alabama bidders. Alabama bidders are given a preference to the same extent that a non-resident bidder receives a preference in his home state. A non-resident bidder must include with any written bid documents a written opinion of an attorney licensed to practice in the non-resident bidder's state declaring what preferences, if any, exists in the non-resident's state.
- B. Certificate of Authority: All non-resident (out of State) bidders shall be registered with the Alabama Secretary of State and the Alabama Department of Revenue prior to submitting a Bid. Provide the Secretary of State Business "Entity ID Number" on the Bid Form in the space provided.

**15. ALABAMA IMMIGRATION ACT:**

- A. The State of Alabama Immigration Law (Act No. 2011-535 as amended by Act No. 2012-491), requires that Contractors not violate federal immigration law or knowingly employ, hire for employment, or continue to employ an unauthorized alien within the State of Alabama. In addition, Contractors are required to enroll in the federal E-Verify program and submit verification of enrollment to the City of Mobile within ten (10) days of receiving the contract forms (see Section 00 60 00).

**16. CITY OF MOBILE BUSINESS LICENSE:**

- A. A City of Mobile Business License is required and must be current at time of contract award and throughout contract period.

**17. CITY OF MOBILE CONTRACTOR'S BUSINESS LICENSE:**

- A. A City of Mobile Contractor's Business License is required and must be current when contractor signs the contract and throughout contract period.
- B. Contractor must qualify and post a \$10,000 surety bond with the Land Use/Code Administration Department before a Contractor's Business License will be issued by the Revenue Department. Information on the City Contractor's License may be obtained by writing or calling:

Land Use/Code Administration  
P.O. Box 1827  
Mobile, Alabama 36633-1827  
Phone: 251-208-7421

Revenue Department  
P.O. Box 1827  
Mobile, Alabama 36633-1827  
Phone: 251-208-7461

**18. CITY OF MOBILE BUILDING PERMIT:**

- A. A City of Mobile Building Permit, City of Mobile Land Disturbance Permit AND City of Mobile Historic Development Commission Certificate of Appropriateness (COA) are required for this project.

The Building Permit and Land Disturbance Permit applications have been submitted to the City of Mobile by the Architect. Once approved the permits will be transferred to the Contractor and copies shall be posted on site.

The COA has been issued. The Contractor shall post a copy of the COA on site.

- B. Contractor is responsible for ensuring that all inspections are successfully performed in accordance with City of Mobile regulations.

**19. CONSTRUCTION SCHEDULE AND ACCESS:**

- A. **The project shall be** substantially complete and accepted by the City of Mobile for its intended use **within** Six Hundred Forty-two **(642) calendar days from the date of Contract Award.**

- B. Contractor shall have access to the site as approved by the Owner, but typically **seven days a week, 24 Hours per day.** Contractor is directed to coordinate all areas of work and scheduling with the Owner. After hours work will require prior approval of the Project Manager. Normal work hours are considered to be 6:00 am until 6:00 pm Monday through Friday excluding holidays. Work outside of normal hours shall require approval of the Program Manager. Approval of the Program Manager does not relieve the bidder from complying with any and all City of Mobile ordinances regarding noise, light, or other nuisances.

The Contractor shall account for potential disruptions to the work that may result from Mardi Gras. Any such disruptions shall be considered by the Contractor and included in the bid and shall not be a basis for a claim for additional compensation or time extension. Civic Center Drive, Claiborne Street, Canal Street, and Lawrence Street are utilized for staging of Mardi Gras parades and shall remain open to public traffic at all times on parade days.

Construction traffic to include, but not limited to, heavy equipment delivery and pick up, haul trucks, and material delivery shall not be permitted on Lawrence Street.

- C. The Contractor may be allowed additional construction days due to inclement conditions as detailed in Article 15.1.6 of the General Conditions of the Contract for Construction (AIA Document A201).

**20. SITE CONSIDERATIONS:**

- A. It is the Contractor's responsibility to carefully remove and store any items not permanently installed within the work areas. It is recommended that the Contractor photograph, videotape or in some manner document any features to be removed and their condition, prior to removal.
- B. Noise and strong smells shall be isolated or kept to a minimum when adjacent portions of the site are occupied.
- C. Contractor shall be responsible to leave the work area and adjacent site clear of equipment and debris, etc. at the end of each workday. All final cleaning is the responsibility of the Contractor and shall be executed prior to acceptance for reuse of any portion of the site.
- D. A dumpster and lay down area for Contractor materials and staging may be located at the site and located per the direction of the Owner. The Contractor is responsible for the removal of the dumpster, any storage containers and any security fencing, temporary erosion control (BMPs), etc. as soon as practical after their use by the Contractor or the work is complete.

**21. SALES AND USE TAX EXEMPTION:**

- A. As per the State of Alabama ACT 2013-205, the Alabama Department of Revenue (ADOR) has been granted the authority to issue a "Certificate of Exemption from Sales and Use Tax for Governmental Entities" on construction projects. Therefore, this project shall qualify for State of Alabama Sales and Use Tax Exemptions under this ACT. It is the responsibility of the Bidder to confirm the potential tax-exempt status of their bid with the ADOR and include any such savings in their bid, as well as accounting for same on their bid form attachment Sales Tax Form C-3A.
- B. The full text of ACT 2013-205 is available on the State of Alabama Building Commission website at [www.bc.alabama.gov](http://www.bc.alabama.gov).

**22. SUBMISSION OF LIEN WAIVERS:**

- A. At each monthly Application for Payment submitted to the owner, the Contractor shall provide completed lien waivers, including those from Subcontractors and material suppliers.

**23. NOTICE OF COMPLETION:**

- A. For Contracts \$50,000 or greater:  
Contractor shall provide proof of publication of Advertisement of Completion for four consecutive weeks in a local newspaper, as required in the Title 39, Section 39-1-1,

Subsection (f), of the Code of Alabama. This Advertisement shall not begin until the Project has been accepted by the City of Mobile.

- B. Notice of Completion advertisement shall read as

follows: STATE OF ALABAMA

COUNTY OF MOBILE

NOTICE OF COMPLETION

In accordance with Chapter 1, Title 39, Code of Alabama, 1975, NOTICE IS HEREBY given that (COMPANY NAME) has completed the contract for Mobile Civic Center– Parking Facility- CC-085-22, Mobile, Alabama 36602. All persons having any claims for labor, material or otherwise in connection with this project should immediately notify the Architectural Engineering Department, City of Mobile, P.O. Box 1827, Mobile, Alabama 36633-1827.

- C. Advertisement shall not begin until the Project has been accepted by the City of Mobile as Substantially Complete.

#### 24. CONTRACTOR WARRANTY AND CERTIFICATION:

- A. Upon completion of the contract, the Contractor shall certify under oath that all bills have been paid in full.
- B. Contractor shall provide a one-year Labor and Materials Warranty on company letterhead in addition to other warranties required by the Bid Documents.

#### 25. LIQUIDATED DAMAGES:

- A. A time charge equal to **Five Thousand and 00/100 Dollars (\$5,000.00)** per calendar day will be made against the Contractor for each calendar day following the **date specified for the Substantial Completion of the Work** continuing until the issuance of a Certificate of Substantial Completion by the Owner, the amount of which shall be deducted by the owner, and shall be retained by the Owner out of monies otherwise due the Contractor in the final payment, not as a penalty, but as liquidated damages sustained.
- B. The submittal of a Bid and/or Proposal by any Contractor and their Subcontractors shall be construed as, in part, acknowledgment and acceptance of these provisions.

**END OF SECTION**

**SECTION 00 24 00 – BID FORM**

**PROPOSAL FORM**

To: **The City of Mobile**

Date: \_\_\_\_\_

In compliance with your Advertisement for Bids and subject to all conditions thereof, the undersigned,

\_\_\_\_\_  
(Legal Name of Bidder)

hereby proposes to furnish all labor and materials and perform all work required for the construction of

**WORK:**                    **The City of Mobile, Alabama**  
**Mobile Arena**  
**401 Civic Center Drive, Mobile, AL 36602**  
**Project Number: CC-034A-22**

in accordance with Drawings and Specifications, dated December 13, 2024, prepared by Goodwyn, Mills and Cawood, LLC.

The Bidder, which is organized and existing under the laws of the State of \_\_\_\_\_,

having its principal offices in the City of \_\_\_\_\_,

is      a Corporation      a Partnership      an individual      (other) \_\_\_\_\_

**LISTING OF PARTNERS OR OFFICERS:** If Bidder is a Partnership, list all partners and their addresses; if Bidder is a Corporation, list the names, titles, and business addresses of its officers:

\_\_\_\_\_  
\_\_\_\_\_

**BIDDER’S REPRESENTATION:** The Bidder declares that it has examined the site of the Work, having become fully informed regarding all pertinent conditions, and that it has examined the Drawings and Specifications (including all Addenda received) for the Work and the other Bid and Contract Documents relative thereto, and that it has satisfied itself relative to the Work to be performed.

**ADDENDA:** The Bidder acknowledges receipt of Addenda Nos. \_\_\_\_\_ through \_\_\_\_\_ inclusively.

**BASE BID:** For construction complete as shown and specified, the sum of \_\_\_\_\_ Dollars (\$ \_\_\_\_\_ )

**BREAKDOWN OF BID**

Base Bid: \$ \_\_\_\_\_

**Contingency Allowance:** \$ \_\_\_\_\_ \$15,000,000.00

Total Bid with Allowances: \$ \_\_\_\_\_

**ALTERNATES:**

Alternate No. 01: \$ \_\_\_\_\_

Alternate No. 02: \$ \_\_\_\_\_

Alternate No. 03: \$ \_\_\_\_\_

Alternate No. 04: \$ \_\_\_\_\_

Alternate No. 05: \$ \_\_\_\_\_

Alternate No. 06: \$ \_\_\_\_\_

Alternate No. 07: \$ \_\_\_\_\_

Alternate No. 08: \$ \_\_\_\_\_

Alternate No. 09: \$ \_\_\_\_\_

Alternate No. 10: \$ \_\_\_\_\_

Alternate No. 11: \$ \_\_\_\_\_

Alternate No. 12: \$ \_\_\_\_\_

Alternate No. 13: \$ \_\_\_\_\_

Alternate No. 14: \$ \_\_\_\_\_

Alternate No. 15: \$ \_\_\_\_\_

Alternate No. 16: \$ \_\_\_\_\_

Alternate No. 17: \$ \_\_\_\_\_

**UNIT PRICES – (See Attachment) (if required)**

**BID SECURITY:** The undersigned agrees to enter into a Construction Contract and furnish the prescribed Performance and Payment Bonds and evidence of insurance within fifteen (15) calendar days, or such other period stated in the Bid Documents, after the contract forms have been presented for signature, provided such presentation is made within 30 calendar days after the opening of bids, or such other period stated in the Bid Documents. As security for this condition, the undersigned further agrees that the funds represented by the Bid Bond (or cashier’s check) attached hereto may be called and paid into the account of the Awarding Authority as liquidated damages for failure to so comply.

Attached hereto is a: *(Mark the appropriate box and provide the applicable information.)*

- Bid Bond, executed by \_\_\_\_\_ as Surety,
- a cashier’s check on the \_\_\_\_\_ Bank of \_\_\_\_\_  
for the sum of \_\_\_\_\_ Dollars  
(\$ \_\_\_\_\_) made payable to the Awarding Authority.

**BIDDER’S ALABAMA LICENSE:**

State License for General Contracting: \_\_\_\_\_  
License Number Bid Limit

---

Classification

**CERTIFICATIONS:** The undersigned certifies that he or she is authorized to execute contracts on behalf of the Bidder as legally named, that this proposal is submitted in good faith without fraud or collusion with any other bidder, that the information indicated in this document is true and complete, and that the bid is made in full accord with State law. Notice of acceptance may be sent to the undersigned at the address set forth below.

**AMERICANS WITH DISABILITIES ACT (ADA):** The undersigned Bidder agrees to fully comply with all requirements of the Americans with Disabilities Act of 1990 and the Amendment Act.

**NONDISCRIMINATION:** Contractor shall comply with all Federal, State and local laws concerning nondiscrimination, including but not limited to City of Mobile Ordinance No. 14-034 which requires, inter alia, that all contractors performing work for the City of Mobile not discriminate on the basis of race, creed, color, national origin or disability, require that all subcontractors they engage do the

same, and make every reasonable effort to assure that fifteen percent of the work performed under contract be awarded to socially and economically disadvantaged individuals and business entities.

**SIGNATURE:** If the undersigned Bidder is incorporated, the entire legal title of the company followed by "a corporation" should be used. If Bidder is an individual, then that individual's full legal name followed by doing business as (d/b/a) and name of firm, if any, should be used. If Bidder is a partnership, then full name of each partner should be listed followed by "d/b/a" and name of firm, if any.

Ensure that name and exact arrangement thereof is the same on all forms submitted with this Bid. If a word is abbreviated in the official company name, such as "Co.", then use that abbreviation. If not abbreviated in the official name, spell out.

Bidder agrees not to revoke or withdraw this Bid until ninety (90) calendar days following the time and date for receipt of bids. If notified in writing of the acceptance of this Bid within this time period, Bidder agrees to execute a Contract based on this Bid on the proscribed form within ten (10) calendar days of said notification and to furnish Performance Bond and Materials and Payment Bond as specified.

The Bidder also declares that a list of all proposed major subcontractors and suppliers will be submitted at a time subsequent to the receipt of bids as established by the Owner in the Bid Documents but in no event shall this time exceed twenty-four (24) hours after receipt of bids.

**Legal Name of Bidder** \_\_\_\_\_

Mailing Address \_\_\_\_\_

**\* By (Legal Signature)** \_\_\_\_\_

\* Name (type or print) \_\_\_\_\_ (Seal)

\* Title \_\_\_\_\_

Telephone Number \_\_\_\_\_.

\* If other than the individual proprietor, or an above named member of the Partnership, or the above named president, vice-president, or secretary of the Corporation, attach written authority to bind the Bidder. Any modification to a bid shall be over the initials of the person signing the bid, or of an authorized representative.

**END OF PROPOSAL FORM**



**SECTION 00 25 00 – ATTACHMENT A****ATTACHMENT A  
TO PROPOSAL FORM****1.1 UNIT PRICES:**

- A. The following items of work are anticipated during the performance of this contract; however the exact quantity of each work item may not be determinable prior to bidding. The Contractor shall therefore, include in his Lump Sum Base Bid, an allowance for the following items in the quantities indicated. These Allowance Unit Prices include all charges for labor and materials, installation, shoring, fee, layout, supervision (field and home office), general expenses, taxes, insurance, overhead and profit, but not limited to, for the accomplishment of the Allowance item(s) installed in place. Where quantities of same items of work are defined and are quantified in the bid documents, the allowance quantities indicated hereinafter shall be in addition to those that are indicated. (Example: If the site grading plan indicated new and existing grades, the bidder shall compute the quantity of earthwork required and include that quantity of work in the bid the same as if no “allowance” quantity were specified. If an additional allowance quantity of earthwork is stipulated that stipulated allowance quantity of work shall also be included in addition to the quantity computed from the bidders earthwork “takeoff”)

The following Unit Prices Quoted are for increases or decreases in the above quantities included in the Lump Sum Base Bid. These Unit Prices include all charges for labor, material, installation, and equipment, shoring, layout, supervision (field and home office), general expenses, taxes, insurance, overhead and profit, but not limited for the accomplishment of the Allowance item completely installed in place.

Clarification Note: The Unit Prices quoted by the Contractor shall apply to increases (additive change orders) and to decreases (deductive change orders). This requirement shall supplement the requirements of the General Conditions and Instruction to Bidders. Changes in the Contract amount that are computed using the Stated Allowances and Unit Prices shall be figured at the same unit price whether additive or deductive.

- B. Submit the following Unit Prices with the Proposal Form on Bid Date.

NO.	ITEM NAME	UNIT	UNIT PRICE
1	Mass Earth Excavation	CY	\$
2	Trench Earth Excavation	CY	\$
3	Hand Earth Excavation	CY	\$
4	Topsoil	CY	\$
5	General or Open Site Areas	CY	\$
6	Trench Backfill	CY	\$
7	Select Fill	CY	\$
8	Sod	SY	\$
9	Fine Grading	SY	\$
10	Grading – Cut and Export	CY	\$
11	Excavation and Disposal of Unsuitable Soils	CY	\$

NO.	ITEM NAME	UNIT	UNIT PRICE
12	Seeding and Mulching	SY	\$
13	Silt Fencing	LF	\$
14	Temporary Construction Fencing	LF	\$
15			
16			

(\*) Legend to "Unit" quantity abbreviations:

SY	Square Yards	CY	Cubic Yards
LF	Linear Foot	SF	Square Foot
EA	Each	LBS	Pounds

Note: Failure to complete and submit this attachment with proposal shall be grounds for rejections of bid.

**END OF ATTACHMENT A TO PROPOSAL FORM**



# AIA® Document A101® – 2017

## Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

**AGREEMENT** made as of the \_\_\_\_\_ day of \_\_\_\_\_ in the year \_\_\_\_\_  
*(In words, indicate day, month and year.)*

**BETWEEN** the Owner:  
*(Name, legal status, address and other information)*

City of Mobile  
P. O. Box 1827  
Mobile, Alabama 36633-1827

and the Contractor:  
*(Name, legal status, address and other information)*

NAME.  
ADDRESS  
ADDRESS

City of Mobile Business License Number:  
Secretary of State Registration Number:

for the following Project:  
*(Name, location and detailed description)*

Mobile Arena Construction  
401 Civic Center Drive  
Mobile, AL 36602  
Project Number CC-034-22

The Architect:  
*(Name, legal status, address and other information)*

Goodwyn Mills Cawood  
11 North Water Street  
Mobile, AL 36602

The Owner and Contractor agree as follows.

Init.

/

## TABLE OF ARTICLES

1	THE CONTRACT DOCUMENTS
2	THE WORK OF THIS CONTRACT
3	DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
4	CONTRACT SUM
5	PAYMENTS
6	DISPUTE RESOLUTION
7	TERMINATION OR SUSPENSION
8	MISCELLANEOUS PROVISIONS
9	ENUMERATION OF CONTRACT DOCUMENTS, INSURANCE AND BONDS

### ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

### ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

### ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:

*(Paragraphs deleted)*

No later than Fourteen (14) calendar days from the date of Contract award and as set forth in a Notice to Proceed issued by the Owner.

*(Paragraphs deleted)*

§ 3.2 The Contract Time shall be measured from the date of Contract award.

#### § 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:

Not later than Six Hundred Forty-two (642) calendar days from the date of Contract Award.

*(Table deleted)*

*(Paragraph deleted)*

Init.

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

#### ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be 00/100 Dollars (\$ 0.00), subject to additions and deductions as provided in the Contract Documents.

Base Bid:	\$0.00
Contingency Allowance:	\$1,000,000.00
Alternates	\$0.00
Total Bid:	\$0.00

#### § 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price
	\$0.00

*(Table deleted)*

*(Paragraphs deleted)*

§ 4.3 Allowances, if any, included in the Contract Sum:

*(Identify each allowance.)*

*(Row deleted)*

Contingency Allowance:	One Million and 00/100 Dollars (\$1,000,000.00)
------------------------	---

- A. Contingency Allowance shall cover cost of material, labor, overhead, profit and other expenses for complete installation of items of additional work as required for a complete, functional project.
- B. Contingency Allowance shall be used for unforeseen conditions not covered in the construction documents.
- C. All extra work under this section must be authorized by the Owner, in writing, prior to materials or undertaking work.
- D. Upon completion of the Work, the unused portion of the Allowance shall be credited back to the Owner in the form of a Change Order.
- E. Allowances are subject to the same provision of AIA 201 Article 7.3.7.

§ 4.4 Unit prices, if any:

*(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)*

Item	Units and Limitations	Price per Unit (\$0.00)
1.		

§ 4.5 Liquidated damages:

*(Insert terms and conditions for liquidated damages, if any.)*

A time charge equal to Five Thousand and 00/100 Dollars (\$5,000.00) per calendar day will be made against the Contractor for each calendar day following the date specified for the Substantial Completion of the Work continuing until the issuance of a Certificate of Substantial Completion by the Owner, the amount of which shall be deducted by the owner, and shall be retained by the Owner out of monies otherwise due the Contractor in the final payment, not as a penalty, but as liquidated damages sustained.

*(Paragraphs deleted)*

Init.

## ARTICLE 5 PAYMENTS

### § 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the 25th of the month.

§ 5.1.3 Provided that an Application for Payment in acceptable format is received by the Architect not later than the first 1st day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the tenth 10th day of the following month. If an Application for Payment in acceptable format is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than forty (40) days after the Architect receives the Application for Payment.  
*(Federal, state or local laws may require payment within a certain period of time.)*

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This accepted schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201, General Conditions of the Contract for Construction (including Owner's then-current modifications), and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

- .1 That portion of the Contract Sum properly allocable to completed Work;
- .2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing and insured as specified;
- .3 Completed work shall be determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

- .1 The aggregate of any amounts previously paid by the Owner;
- .2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201-2017;
- .3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
- .4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201-2017; and
- .5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.6.3 Any Progress Payment shall include partial release of liens for material and labor for previous application for payment amount approved and paid. The DBE Utilization Report shall be included with the pay application.

### § 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:

*(Paragraph deleted)*

Init.

/

Five percent (5%) of the first fifty percent (50%) of the completed work and after fifty percent (50%) completion has been accomplished, no further retainage shall be held from the original Contract Sum. Increases in the contract sum by Change Order shall also be subject to retainage. The net amount of the Retainage shall be equal to two and one half percent (2.5%) of the total Contract Sum, as increased or decreased by Change Order.

*(Paragraphs deleted)*

**§ 5.1.7.2**

*(Paragraphs deleted)*

Except as set forth in this Section 5.1.7.2, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage.

*(Paragraphs deleted)*

**§ 5.1.8** If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201.

**§ 5.1.9** Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

**§ 5.2 Final Payment**

**§ 5.2.1** Final monthly progress payment, constituting the entire unpaid balance of the Contract Sum, less retainage, shall be made by the Owner to the Contractor when

- .1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201 (including Owner's then-current modifications which may be obtained from the Owner or, alternatively, a copy of which is incorporated in the Project Manual and incorporated by reference herein as a part thereof), and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a Certificate of Substantial Completion has been issued by the Architect/Owner and the project accepted.

**§ 5.2.2** The Owner's final payment to the Contractor of retainage shall be made as follows:

The final two and one half percent (2.5%) of the total Contract Sum retained will not be paid until proof of publication is submitted and all written claims paid in full. Contractor to submit the following:

- Contractor's Affidavit of Payment of Debts and Claims (AIA form G706, included in contract documents) with
  - a.) Contractor's Release or Waiver of Liens
  - b.) Releases or Waivers of Liens from Subcontractors and Material and Equipment Suppliers;
- Contractor's Affidavit of Release of Liens (AIA form G706A, included in contract documents);
- Consent of Surety, if any, to final payment (AIA form G707, included in contract documents);
- Any additional close out requirements per the contract documents; and
- Notarized Affidavit of Notice of Completion advertisement from publisher.

Contractor shall provide proof of publication of Notice of Completion in a local newspaper once per week for four (4) consecutive weeks, as required in the Title 39, Section 39-1-1, Subsection (f), of the Code of Alabama quoted below. "The Contractor shall, immediately after the completion of the contract, give notice of Completion by an advertisement in a newspaper of general circulation published within the city or county in which the work has been done, for a period of four (4) consecutive weeks. A final settlement shall not be made upon the contract until the expiration of thirty (30) days after the completion of the notice. Proof of publication of the notice shall be made by the contractor to the authority by whom the contract was made by affidavit of the publisher and a printed copy of the notice published. If no newspaper is published in the county in which the work is done, the notice may be given by the contract." (Acts 1927, No. 39, 9.37; Acts 1935, No. 39, 9. 70; Code 1940, T. 50, Section 16; Acts 1983, No. 83-737, 9.1203; Acts 1989, No. 89-650m 9. 1284, Section 1; Acts 1994, No. 94-207, p. 270, Section 1; Acts 1997, No. 97-225, p. 348, Section 1.)

The Notice of Completion shall read as follows:

STATE OF ALABAMA  
COUNTY OF MOBILE  
NOTICE OF COMPLETION

In accordance with Chapter I, Title 39, Code of Alabama, 1975, NOTICE IS HEREBY given that (Contractor) has completed the contract for \_\_\_\_\_ All persons having any claims for labor, material or otherwise in connection with this project should immediately notify the Architectural Engineering Department, City of Mobile, P. O. Box 1827, Mobile, Alabama 36633-1827.

Publication of the Notice of Completion shall not begin until the Project has been accepted as Substantially Complete by the City of Mobile.

*(Paragraphs deleted)*

**ARTICLE 6 DISPUTE RESOLUTION**

**§ 6.1 Initial Decision Maker**

The Engineer will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.

Sam Matheny, Program Manager, Volkert Inc.  
11 N Water Street, Suite 18290  
Mobile, Alabama 36602  
Sam.matheny@volkert.com

**§ 6.2 Binding Dispute Resolution**

For any Claim, the method of binding dispute resolution shall be as follows:

*(Check the appropriate box.)*

*(Paragraph deleted)*

[  ] Litigation in a court of competent jurisdiction

**§ 6.3 Governing Law and Venue**

*(Paragraph deleted)*

This Agreement shall be governed by the laws of the State of Alabama, and the appropriate venue of any actions arising out of this Agreement shall be a court of proper jurisdiction in Mobile, Alabama.

**ARTICLE 7 TERMINATION OR SUSPENSION**

**§ 7.1** The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201, General Conditions of the Contract for Construction, including Owner's then-current modifications, a copy of which is incorporated in the contract documents and incorporated by reference herein as a part thereof.

*(Paragraphs deleted)*

**§ 7.2** The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201, General Conditions of the Contract for Construction, including Owner's then-current modifications, a copy of which is incorporated in the contract documents and incorporated by reference herein as a part thereof.

**ARTICLE 8 MISCELLANEOUS PROVISIONS**

**§ 8.1** Where reference is made in this Agreement to a provision of AIA Document A201 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents. A copy of such amended, revised or supplemental provision is incorporated in the contract documents and hereby incorporated by reference herein as a part thereof.

**§ 8.2** The Owner's representative:

Init.



Sam Matheny, Program Manager, Volkert Inc.  
11 N Water Street, Suite 18290  
Mobile, Alabama 36602  
Sam.matheny@volkert.com

**§ 8.3** The Contractor's representative:  
(Name, address, email address, and other information)

**§ 8.4** Neither the Owner's nor the Contractor's representative shall be changed without ten (10) days' prior notice to the other party.

**§ 8.5 Insurance and Bonds**

**§ 8.5.1** The Owner and the Contractor shall purchase and maintain insurance as set forth below:  
The Contractor shall purchase and maintain from a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

- .1 Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;
- .2 Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;
- .3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
- .4 Claims for damages insured by usual personal injury liability coverage;
- .5 Claims for damages, because of injury to or destruction of tangible property, including loss of use resulting therefrom;
- .6 Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;
- .7 Claims for bodily injury or property damage arising out of completed operations; and
- .8 Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18 of the General Conditions of the Contract for Construction.

The Contractor shall take out and maintain during the life of the Contract no less than the following amounts of insurance with the City of Mobile named as an additional insured. Contractor shall submit a Certificate of Insurance. Insurance companies listed as the "Companies Affording Coverage" shall be authorized by the Secretary of the State of Alabama. Insurance produced out of the State of Alabama must be signed or counter signed by a licensed Agent of Alabama, with the Agent's name, address and telephone number typed or printed on the face of the Certificate of Insurance.

- .1 Workmen's Compensation Insurance: - Statutory-amount and coverage as required by all applicable laws, rules or regulations of the State of Alabama and the United States of America.
- .2 Employee's Liability Insurance shall be provided for limits of liability not less than:

A.	Bodily Injury by Accident	\$1,000,000 each accident
B.	Bodily Injury by Disease	\$1,000,000 each employee
C.	Bodily Injury by Disease	\$1,000,000 each policy
- .3 The Contractor shall provide Broad Form (commonly termed Comprehensive) General Liability Insurance (including premises-product-completed operations, independent contractors, and blanket

Init.

/

contractual liability), specifically covering the obligations assumed by the Contractor for limits of liability not less than:

- A. Bodily Injury \$1,000,000 each person  
\$1,000,000 each occurrence
- B. Property Damage \$1,000,000 each occurrence; or
- C. Bodily Injury and Property Damage \$1,000,000 combined single limit

.4 Such comprehensive policy shall include the following:

- A. All liability of the Contractor, for the Contractor's Direct Operations.
- B. Subcontractor's Operations.
- C. Completed Operations Cover, thereby meaning any loss which shall occur after the contract has been completed, but which can be traced back to the Contract.
- D. General Aggregate Limit of \$2,000,000 shall apply on a "Per Project" Basis.
- E. Contractual Liability, meaning thereby; any risk assumed by the Contractor under Hold Harmless Agreements or any other assumption of liability, but specifically items 11.1.1.8.3G herein below
- F. Broad Form Property damage Coverage, including Completed Operations.
- G. Personal Injury Liability, with employee's exclusions removed.
- H. Explosion and Collapse Hazard:  
Included or  Not Applicable.
- I. Underground Hazard:  
Included or  Not Applicable.

.5 The Contractor shall carry for himself and shall require that all Subcontractors and all Owners of Automobiles or trucks rented or hired on the contract carry, until the Contracts is completed, Comprehensive Automobile Liability Coverage for Bodily Injury and property. Damage for any auto in amounts not less than the minimum amounts as indicated. The Contractor and Subcontractor shall also carry for themselves insurance for all non-owned and hired automobile at the limits of liability as indicated below:

- A. Bodily Injury \$1,000,000 each person  
\$1,000,000 each occurrence
- B. Property damage \$1,000,000 each occurrence; or,
- C. Bodily Injury and Property damage \$1,000,000 combined single limit

.6 Umbrella/Excess Liability: \$2,000,000 combined single limit each occurrence for bodily injury and/or property damage

.7 Builder's Risk Coverage (Property Insurance): The Contractor shall carry for the Owner, himself, and all Subcontractors a Builder's Risk Policy to cover the full amount of the Contract during construction, fabrication or erection of any equipment.

.8 A Surety authorized to do business in the State of Alabama shall furnish the required Insurance.

.9 The standard ACORD™ format shall be provided. The ACORD™ Certificate must be signed or countersigned by a Licensed Resident Agent of the State of Alabama and the agent's name, address and telephone number must appear on the face of the certificate.

.10 The Surety must have a minimum rating of A/Class VI as reported in the latest issue of Best's Key Rating Guide Property-Casualty, published by Alfred M. Best Company, Inc. if the bid price exceeds \$50,000.00.

Init.

.11 "In Rem" endorsement.

The insurance shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

Certificates of insurance acceptable to the Owner shall be filed with the Owner within ten (10) calendar days from date of issuance of contract forms for execution. Contractor shall deliver to the City of Mobile, certificates of insurance certifying the existence and limits of the insurance coverages along with separate policy endorsements. Contractor shall also be responsible for delivering policy renewal certificates to the City of Mobile, and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies shall contain a provision that coverages afforded under the policies will not be cancelled subject to non-renewal nor material change, or allowed to expire without at least thirty (30) days' (except ten (10) days from non-payment) prior written notice has been given to the Owner. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment and thereafter upon renewal or replacement of such coverage until the expiration of the time. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

All policies of insurance, except worker's compensation, shall be endorsed to provide that all such insurances are primary and non-contributing with any other insurance maintained by the City of Mobile and endorsed to waive rights of subrogation in favor of the City of Mobile.

The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the Architect and the Architect's Consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

**§ 8.5.2** The Contractor shall provide bonds as set forth below:

Contractor shall furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder.

Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

The Labor and Material Payment Bond and the Performance Bond shall each be for one hundred percent (100%) of the Contract Sum.

1. Bond shall be submitted with the executed agreement on provided form(s).
2. Power of Attorney is required for both bonds.
3. A Surety authorized to do business in the State of Alabama shall furnish both bonds.
4. A Surety licensed to do business in the State of Alabama must execute the bonds.
5. The Surety must have a minimum rating of A/Class VI as reported in the latest issue of Best's Key Rating Guide Property-Casualty, published by Alfred M. Best Company, Inc., if the bid price exceeds \$50,000.00.

6. The Surety company shall be required to execute AIA Document G-707, "Consent of Surety to Final Payment" prior to Final Payment being made to the Contractor.

**§ 8.6**

*(Paragraphs deleted)*

Indemnification:

The Contractor shall indemnify, defend and hold harmless City and its officers, elected officials, agents, representatives, and employees in respect of any and all claims, injuries, losses, diminution in value, damages, liabilities, whether or not currently due, and related expenses (including without limitation, settlement costs and any legal or other expenses for investigating or defending any actions or threatened actions) arising from or in connection with the contractor's performance under this agreement, including but not limited to, environmental laws, regulations, orders and decrees of whatever character or nature and damage or injury to persons or property. Contractor hereby confirms and agrees that Contractor is not a 'design professional' as defined in Alabama Act 2021-318, and not required to carry professional liability insurance for the performance or obligations of this contract.

**§ 8.7 Other Provisions:**

Contractor shall provide certificates of disposal or other appropriate form of documentation certifying that all demolition materials have been disposed of in accordance with all local, state, and federal laws and regulations. The Owner shall withhold final payment to Contractor until Owner receives acceptable documentation of material disposal from Contractor.

**§ 8.8 Force Majeure:**

In the event that either party hereto shall be delayed or hindered in or prevented from the performance of any act required hereunder by reason of strikes, lockouts, labor troubles, inability to procure materials, failure of power, restrictive governmental laws or regulations, riots, insurrection, war, Act of God, or other reason of a like nature not the fault of the party delayed in performing work or doing acts required under the terms of this Agreement, then performance of such act shall be excused for the period of the delay and the period for the performance of any such act shall be extended for a period equivalent to the period of such delay.

**ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS**

**§ 9.1** This Agreement is comprised of the following documents:

- .1 AIA Document A101™-2017, Standard Form of Agreement Between Owner and Contractor
- .2 AIA Document A201, General Conditions of the Contract for

*(Paragraphs deleted)*

Construction, including Owner's then-current modifications, a copy of which is incorporated in the contract documents and incorporated by reference herein as a part thereof.

- .3 Drawings

Project Manual for Mobile Arena Construction dated June XX, 2024 and Addendums X through X.

- .4 Specifications

Project Manual for Mobile Arena Construction dated June XX, 2024 and Addendums X through X.

*(Paragraph deleted)*

- .5 Addenda, if any:

**Number**

**Date**

Init.

/

**User Notes:**

(1215644715)

(Paragraphs deleted)

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

- .6 Other Exhibits:  
(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

(Paragraphs deleted)

**§ 9.2**

(Paragraph deleted)

Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages
NONE			

**§ 9.2.1** Other documents, if any, listed below:

*(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™-2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)*

Project Manual for Mobile Arena Construction dated June XX, 2024 and Addendums X through X.

**§ 9.2.2** Best Management Practices (BMPs):

The Contractor shall be responsible for providing, implementing and maintaining BMPs for sediment and erosion control in full compliance with all applicable Local, State and Federal Codes and Ordinances throughout the contract period. All Work shall be in accordance with the Clean Water Act; the Alabama Water Pollution Control Act; the current version of the Alabama Handbook for Erosion Control, Sediment Control Stormwater Management on Construction sites and Urban Areas; and the current version of the Mobile, Alabama City Code Chapter 17 Stormwater Management and Flood Control. All Waste water with oils, grease, paint, mortar, etc., shall be properly contained and disposed of.

**§ 9.2.3** Contractor shall comply with all Federal, State and local laws concerning nondiscrimination, including but not limited to City of Mobile Ordinance No. 14-034 which requires, *inter alia*, that all contractors performing work for the City of Mobile not discriminate on the basis of race, creed, color, national origin or disability, require that all subcontractors they engage do the same, and make every reasonable effort to assure that fifteen percent of the work performed under contract be awarded to socially and economically disadvantaged individuals and business entities.

**§ 9.2.4** By signing this contract, the contracting parties affirm, for the duration of the agreement, that they will not violate federal immigration law or knowingly employ, hire for employment, or continue to employ an unauthorized alien within the State of Alabama. Furthermore, a contracting party found to be in violation of this provision shall be deemed in breach of the agreement and shall be responsible for all damages resulting therefrom.

**§ 9.2.5** Public Contracts with Entities Engaging in certain Boycott Activities:

By signing this contract, the Contractor further represents and agrees that it is not currently engaged in, nor will it engage in, any boycott of a person or entity based in or doing business with a jurisdiction with which the State of Alabama can enjoy open trade.

**§ 9.2.6** Severability Clause:

In case any one or more of the provisions contained in this Agreement shall for any reason be held to be invalid, illegal or unenforceable in any respect, such invalidity, illegality or unenforceability shall not affect

Init.

any other provisions of this Agreement, but this Agreement shall be construed as if such invalid or illegal or unenforceable provision had never been contained herein. Upon such determination that any term or other provision is invalid, illegal or unenforceable, the court or other tribunal making such determination is authorized and instructed to modify this Agreement so as to effect the original intent of the parties as closely as possible so that the transactions and agreements contemplated herein are consummated as originally contemplated to the fullest extent possible.

**§ 9.2.7 Non-Agency Clause:**

Contractor, in the performance of its operations and obligations hereunder, shall not be deemed to be an agent of City but shall be deemed to be an independent Contractor in every respect and shall take all steps at its own expense, as City may from time to time request, to indicate that it is an independent Contractor. City does not and will not assume any responsibility for the means by which or the manner in which the services by Contractor provided for herein are performed, but on the contrary, Contractor shall be wholly responsible therefore.

**REMAINDER OF PAGE INTENTIONALLY LEFT BLANK**

This Agreement entered into as of the day and year first written above.

City of Mobile

Legal Name of Party to Contract:  
Contractor:

\_\_\_\_\_  
**OWNER** *(Signature)*

\_\_\_\_\_  
**CONTRACTOR** *(By Signature)*

William S. Stimpson, Mayor

\_\_\_\_\_  
*(Rows deleted)*  
*(Printed name and title)*

\_\_\_\_\_  
*(Printed name and title)*

ATTEST:

\_\_\_\_\_  
City Clerk

STATE OF ALABAMA  
COUNTY OF MOBILE

Before me, the undersigned a Notary Public in and for said County and State, personally appeared  
as President of \_\_\_\_\_, Inc. and after being  
duly sworn, did depose and say that he, as such officer and with full authority, signed the above and  
foregoing voluntarily as the act of said corporation on the day the same bears date.  
Sworn to and subscribed for me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

\_\_\_\_\_  
NOTARY PUBLIC

My Commission Expires: \_\_\_\_\_

**THIS PAGE INTENTIONALLY LEFT BLANK**





# AIA® Document A201® – 2017

## General Conditions of the Contract for Construction

### for the following PROJECT:

Mobile Arena Construction  
401 Civic Center Drive  
Mobile, AL 36602  
Project Number CC-034-22

### THE OWNER:

City of Mobile  
P. O. Box 1827  
Mobile, Alabama 36633-1827

### THE ARCHITECT:

Goodwyn Mills Cawood  
11 North Water Street  
Mobile, AL 36602

### TABLE OF ARTICLES

1	GENERAL PROVISIONS
2	OWNER
3	CONTRACTOR
4	ARCHITECT
5	SUBCONTRACTORS
6	CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
7	CHANGES IN THE WORK
8	TIME
9	PAYMENTS AND COMPLETION
10	PROTECTION OF PERSONS AND PROPERTY
11	INSURANCE AND BONDS
12	UNCOVERING AND CORRECTION OF WORK
13	MISCELLANEOUS PROVISIONS
14	TERMINATION OR SUSPENSION OF THE CONTRACT
15	CLAIMS AND DISPUTES

Init.

/

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This document was produced at 12:37:47 ET on 12/12/2024 under Order No.3104238820 which expires on 12/27/2024, is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiaccontracts.com.

User Notes:

(2021085017)

## INDEX

(Topics and numbers in bold are Section headings.)

### Acceptance of Nonconforming Work

9.6.6, 9.9.3, **12.3**

Acceptance of Work

9.6.6, 9.8.2, 9.9.3, 9.10.1, 9.10.3, **12.3**

### Access to Work

**3.16**, 6.2.1, 12.1

Accident Prevention

10

Acts and Omissions

3.2, 3.3.2, 3.12.8, 3.18, 4.2.3, 8.3.1, 9.5.1, 10.2.5,

10.2.8, 13.3.2, 14.1, 15.1.2, 15.2

Addenda

1.1.1

Additional Costs, Claims for

3.7.4, 3.7.5, 10.3.2, 15.1.5

### Additional Inspections and Testing

9.4.2, 9.8.3, 12.2.1, **13.4**

### Additional Time, Claims for

3.2.4, 3.7.4, 3.7.5, 3.10.2, 8.3.2, **15.1.6**

### Administration of the Contract

3.1.3, **4.2**, 9.4, 9.5

Advertisement or Invitation to Bid

1.1.1

Aesthetic Effect

4.2.13

### Allowances

**3.8**

### Applications for Payment

4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5.1, 9.5.4, 9.6.3, 9.7, 9.10

Approvals

2.1.1, 2.3.1, 2.5, 3.1.3, 3.10.2, 3.12.8, 3.12.9,

3.12.10.1, 4.2.7, 9.3.2, 13.4.1

### Arbitration

8.3.1, 15.3.2, **15.4**

## ARCHITECT

**4**

Architect, Definition of

**4.1.1**

Architect, Extent of Authority

2.5, 3.12.7, 4.1.2, 4.2, 5.2, 6.3, 7.1.2, 7.3.4, 7.4, 9.2,  
9.3.1, 9.4, 9.5, 9.6.3, 9.8, 9.10.1, 9.10.3, 12.1, 12.2.1,  
13.4.1, 13.4.2, 14.2.2, 14.2.4, 15.1.4, 15.2.1

Architect, Limitations of Authority and Responsibility

2.1.1, 3.12.4, 3.12.8, 3.12.10, 4.1.2, 4.2.1, 4.2.2, 4.2.3,  
4.2.6, 4.2.7, 4.2.10, 4.2.12, 4.2.13, 5.2.1, 7.4, 9.4.2,  
9.5.4, 9.6.4, 15.1.4, 15.2

Architect's Additional Services and Expenses

2.5, 12.2.1, 13.4.2, 13.4.3, 14.2.4

Architect's Administration of the Contract

3.1.3, 3.7.4, 15.2, 9.4.1, 9.5

Architect's Approvals

2.5, 3.1.3, 3.5, 3.10.2, 4.2.7

Architect's Authority to Reject Work

3.5, 4.2.6, 12.1.2, 12.2.1

Architect's Copyright

1.1.7, 1.5

Architect's Decisions

3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 4.2.14, 6.3,  
7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4.1, 9.5, 9.8.4, 9.9.1,  
13.4.2, 15.2

Architect's Inspections

3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 13.4

Architect's Instructions

3.2.4, 3.3.1, 4.2.6, 4.2.7, 13.4.2

Architect's Interpretations

4.2.11, 4.2.12

Architect's Project Representative

4.2.10

Architect's Relationship with Contractor

1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2,  
3.5, 3.7.4, 3.7.5, 3.9.2, 3.9.3, 3.10, 3.11, 3.12, 3.16,  
3.18, 4.1.2, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5,  
9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3, 12, 13.3.2, 13.4, 15.2

Architect's Relationship with Subcontractors

1.1.2, 4.2.3, 4.2.4, 4.2.6, 9.6.3, 9.6.4, 11.3

Architect's Representations

9.4.2, 9.5.1, 9.10.1

Architect's Site Visits

3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4

Asbestos

10.3.1

Attorneys' Fees

3.18.1, 9.6.8, 9.10.2, 10.3.3

Award of Separate Contracts

6.1.1, 6.1.2

### Award of Subcontracts and Other Contracts for Portions of the Work

**5.2**

### Basic Definitions

**1.1**

Bidding Requirements

1.1.1

Binding Dispute Resolution

8.3.1, 9.7, 11.5, 13.1, 15.1.2, 15.1.3, 15.2.1, 15.2.5,  
15.2.6.1, 15.3.1, 15.3.2, 15.3.3, 15.4.1

Bonds, Lien

7.3.4.4, 9.6.8, 9.10.2, 9.10.3

### Bonds, Performance, and Payment

7.3.4.4, 9.6.7, 9.10.3, **11.1.2**, 11.1.3, **11.5**

### Building Information Models Use and Reliance

**1.8**

Building Permit

3.7.1

### Capitalization

**1.3**

Certificate of Substantial Completion

9.8.3, 9.8.4, 9.8.5

Init.

/

## **Certificates for Payment**

4.2.1, 4.2.5, 4.2.9, 9.3.3, **9.4**, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4, 15.1.4

Certificates of Inspection, Testing or Approval  
13.4.4

Certificates of Insurance  
9.10.2

## **Change Orders**

1.1.1, 3.4.2, 3.7.4, 3.8.2.3, 3.11, 3.12.8, 4.2.8, 5.2.3, 7.1.2, 7.1.3, **7.2**, 7.3.2, 7.3.7, 7.3.9, 7.3.10, 8.3.1, 9.3.1.1, 9.10.3, 10.3.2, 11.2, 11.5, 12.1.2

**Change Orders**, Definition of

### **7.2.1**

## **CHANGES IN THE WORK**

2.2.2, 3.11, 4.2.8, **7**, 7.2.1, 7.3.1, 7.4, 8.3.1, 9.3.1.1, 11.5

**Claims**, Definition of

### **15.1.1**

Claims, Notice of  
1.6.2, 15.1.3

## **CLAIMS AND DISPUTES**

3.2.4, 6.1.1, 6.3, 7.3.9, 9.3.3, 9.10.4, 10.3.3, **15**, 15.4  
Claims and Timely Assertion of Claims  
15.4.1

### **Claims for Additional Cost**

3.2.4, 3.3.1, 3.7.4, 7.3.9, 9.5.2, 10.2.5, 10.3.2, **15.1.5**

### **Claims for Additional Time**

3.2.4, 3.3.1, 3.7.4, 6.1.1, 8.3.2, 9.5.2, 10.3.2, **15.1.6**

### **Concealed or Unknown Conditions, Claims for**

**3.7.4**

Claims for Damages  
3.2.4, 3.18, 8.3.3, 9.5.1, 9.6.7, 10.2.5, 10.3.3, 11.3, 11.3.2, 14.2.4, 15.1.7

Claims Subject to Arbitration  
15.4.1

## **Cleaning Up**

**3.15**, 6.3

Commencement of the Work, Conditions Relating to  
2.2.1, 3.2.2, 3.4.1, 3.7.1, 3.10.1, 3.12.6, 5.2.1, 5.2.3, 6.2.2, 8.1.2, 8.2.2, 8.3.1, 11.1, 11.2, **15.1.5**

### **Commencement of the Work**, Definition of

#### **8.1.2**

## **Communications**

3.9.1, **4.2.4**  
Completion, Conditions Relating to  
3.4.1, 3.11, 3.15, 4.2.2, 4.2.9, 8.2, 9.4.2, 9.8, 9.9.1, 9.10, 12.2, 14.1.2, 15.1.2

## **COMPLETION, PAYMENTS AND**

### **9**

Completion, Substantial  
3.10.1, 4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, 9.8, 9.9.1, 9.10.3, 12.2, 15.1.2  
Compliance with Laws  
2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14.1.1, 14.2.1.3, 15.2.8, 15.4.2, 15.4.3

## **Concealed or Unknown Conditions**

3.7.4, 4.2.8, 8.3.1, 10.3

## **Conditions of the Contract**

1.1.1, 6.1.1, 6.1.4

### **Consent, Written**

3.4.2, 3.14.2, 4.1.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3, 13.2, 15.4.4.2

## **Consolidation or Joinder**

### **15.4.4**

## **CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS**

1.1.4, **6**

### **Construction Change Directive**, Definition of

#### **7.3.1**

### **Construction Change Directives**

1.1.1, 3.4.2, 3.11, 3.12.8, 4.2.8, 7.1.1, 7.1.2, 7.1.3, **7.3**, 9.3.1.1

Construction Schedules, Contractor's

3.10, 3.11, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2

### **Contingent Assignment of Subcontracts**

**5.4**, 14.2.2.2

### **Continuing Contract Performance**

#### **15.1.4**

**Contract**, Definition of

#### **1.1.2**

## **CONTRACT, TERMINATION OR SUSPENSION OF THE**

5.4.1.1, 5.4.2, 11.5, **14**

Contract Administration

3.1.3, 4, 9.4, 9.5

Contract Award and Execution, Conditions Relating to

3.7.1, 3.10, 5.2, 6.1

Contract Documents, Copies Furnished and Use of  
1.5.2, 2.3.6, 5.3

**Contract Documents**, Definition of

#### **1.1.1**

### **Contract Sum**

2.2.2, 2.2.4, 3.7.4, 3.7.5, 3.8, 3.10.2, 5.2.3, 7.3, 7.4, **9.1**, 9.2, 9.4.2, 9.5.1.4, 9.6.7, 9.7, 10.3.2, 11.5, 12.1.2, 12.3, 14.2.4, 14.3.2, 15.1.4.2, **15.1.5**, **15.2.5**

**Contract Sum**, Definition of

#### **9.1**

Contract Time

1.1.4, 2.2.1, 2.2.2, 3.7.4, 3.7.5, 3.10.2, 5.2.3, 6.1.5, 7.2.1.3, 7.3.1, 7.3.5, 7.3.6, 7, 7, 7.3.10, 7.4, 8.1.1, 8.2.1, 8.2.3, 8.3.1, 9.5.1, 9.7, 10.3.2, 12.1.1, 12.1.2, 14.3.2, 15.1.4.2, 15.1.6.1, 15.2.5

**Contract Time**, Definition of

#### **8.1.1**

## **CONTRACTOR**

### **3**

Contractor, Definition of

#### **3.1**, **6.1.2**

### **Contractor's Construction and Submittal Schedules**

**3.10**, 3.12.1, 3.12.2, 4.2.3, 6.1.3, 15.1.6.2

Contractor's Employees  
2.2.4, 3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2,  
10.3, 11.3, 14.1, 14.2.1.1

### **Contractor's Liability Insurance**

#### **11.1**

Contractor's Relationship with Separate Contractors  
and Owner's Forces

3.12.5, 3.14.2, 4.2.4, 6, 11.3, 12.2.4

Contractor's Relationship with Subcontractors

1.2.2, 2.2.4, 3.3.2, 3.18.1, 3.18.2, 4.2.4, 5, 9.6.2, 9.6.7,  
9.10.2, 11.2, 11.3, 11.4

Contractor's Relationship with the Architect

1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2,  
3.5.1, 3.7.4, 3.10, 3.11, 3.12, 3.16, 3.18, 4.2, 5.2, 6.2.2,  
7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3,  
11.3, 12, 13.4, 15.1.3, 15.2.1

Contractor's Representations

3.2.1, 3.2.2, 3.5, 3.12.6, 6.2.2, 8.2.1, 9.3.3, 9.8.2

Contractor's Responsibility for Those Performing the  
Work

3.3.2, 3.18, 5.3, 6.1.3, 6.2, 9.5.1, 10.2.8

Contractor's Review of Contract Documents

3.2

Contractor's Right to Stop the Work

2.2.2, 9.7

Contractor's Right to Terminate the Contract

14.1

Contractor's Submittals

3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 9.2, 9.3, 9.8.2,  
9.8.3, 9.9.1, 9.10.2, 9.10.3

Contractor's Superintendent

3.9, 10.2.6

Contractor's Supervision and Construction

Procedures

1.2.2, 3.3, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3,  
7.3.4, 7.3.6, 8.2, 10, 12, 14, 15.1.4

Coordination and Correlation

1.2, 3.2.1, 3.3.1, 3.10, 3.12.6, 6.1.3, 6.2.1

Copies Furnished of Drawings and Specifications

1.5, 2.3.6, 3.11

Copyrights

1.5, **3.17**

Correction of Work

2.5, 3.7.3, 9.4.2, 9.8.2, 9.8.3, 9.9.1, 12.1.2, **12.2**, 12.3,  
15.1.3.1, 15.1.3.2, 15.2.1

**Correlation and Intent of the Contract Documents**

#### **1.2**

**Cost**, Definition of

#### **7.3.4**

Costs

2.5, 3.2.4, 3.7.3, 3.8.2, 3.15.2, 5.4.2, 6.1.1, 6.2.3,  
7.3.3.3, 7.3.4, 7.3.8, 7.3.9, 9.10.2, 10.3.2, 10.3.6, 11.2,  
12.1.2, 12.2.1, 12.2.4, 13.4, 14

**Cutting and Patching**

**3.14**, 6.2.5

Damage to Construction of Owner or Separate  
Contractors

3.14.2, 6.2.4, 10.2.1.2, 10.2.5, 10.4, 12.2.4

Damage to the Work

3.14.2, 9.9.1, 10.2.1.2, 10.2.5, 10.4, 12.2.4

Damages, Claims for

3.2.4, 3.18, 6.1.1, 8.3.3, 9.5.1, 9.6.7, 10.3.3, 11.3.2,  
11.3, 14.2.4, 15.1.7

Damages for Delay

6.2.3, 8.3.3, 9.5.1.6, 9.7, 10.3.2, 14.3.2

**Date of Commencement of the Work**, Definition of

#### **8.1.2**

**Date of Substantial Completion**, Definition of

#### **8.1.3**

**Day**, Definition of

#### **8.1.4**

Decisions of the Architect

3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 6.3, 7.3.4,  
7.3.9, 8.1.3, 8.3.1, 9.2, 9.4, 9.5.1, 9.8.4, 9.9.1, 13.4.2,  
14.2.2, 14.2.4, 15.1, 15.2

**Decisions to Withhold Certification**

9.4.1, **9.5**, 9.7, 14.1.1.3

Defective or Nonconforming Work, Acceptance,  
Rejection and Correction of

2.5, 3.5, 4.2.6, 6.2.3, 9.5.1, 9.5.3, 9.6.6, 9.8.2, 9.9.3,  
9.10.4, 12.2.1

Definitions

1.1, 2.1.1, 3.1.1, 3.5, 3.12.1, 3.12.2, 3.12.3, 4.1.1, 5.1,  
6.1.2, 7.2.1, 7.3.1, 8.1, 9.1, 9.8.1, 15.1.1

**Delays and Extensions of Time**

**3.2**, **3.7.4**, 5.2.3, 7.2.1, 7.3.1, **7.4**, **8.3**, 9.5.1, **9.7**,  
10.3.2, **10.4**, 14.3.2, **15.1.6**, 15.2.5

**Digital Data Use and Transmission**

#### **1.7**

Disputes

6.3, 7.3.9, 15.1, 15.2

**Documents and Samples at the Site**

#### **3.11**

**Drawings**, Definition of

#### **1.1.5**

Drawings and Specifications, Use and Ownership of

3.11

Effective Date of Insurance

8.2.2

**Emergencies**

**10.4**, 14.1.1.2, **15.1.5**

Employees, Contractor's

3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2,  
10.3.3, 11.3, 14.1, 14.2.1.1

Equipment, Labor, or Materials

1.1.3, 1.1.6, 3.4, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1,  
4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3,  
9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2

Execution and Progress of the Work

1.1.3, 1.2.1, 1.2.2, 2.3.4, 2.3.6, 3.1, 3.3.1, 3.4.1, 3.7.1,  
3.10.1, 3.12, 3.14, 4.2, 6.2.2, 7.1.3, 7.3.6, 8.2, 9.5.1,  
9.9.1, 10.2, 10.3, 12.1, 12.2, 14.2, 14.3.1, 15.1.4

Extensions of Time  
3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3, 7.4, 9.5.1, 9.7, 10.3.2,  
10.4, 14.3, 15.1.6, **15.2.5**

#### **Failure of Payment**

9.5.1.3, **9.7**, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2

#### **Faulty Work**

(See Defective or Nonconforming Work)

#### **Final Completion and Final Payment**

4.2.1, 4.2.9, 9.8.2, **9.10**, 12.3, 14.2.4, 14.4.3

#### **Financial Arrangements, Owner's**

2.2.1, 13.2.2, 14.1.1.4

### **GENERAL PROVISIONS**

#### **1**

#### **Governing Law**

##### **13.1**

Guarantees (See Warranty)

#### **Hazardous Materials and Substances**

10.2.4, **10.3**

#### **Identification of Subcontractors and Suppliers**

5.2.1

#### **Indemnification**

3.17, **3.18**, 9.6.8, 9.10.2, 10.3.3, 11.3

#### **Information and Services Required of the Owner**

2.1.2, **2.2**, 2.3, 3.2.2, 3.12.10.1, 6.1.3, 6.1.4, 6.2.5,  
9.6.1, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2,  
14.1.1.4, 14.1.4, 15.1.4

#### **Initial Decision**

##### **15.2**

#### **Initial Decision Maker, Definition of**

1.1.8

#### **Initial Decision Maker, Decisions**

14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5

#### **Initial Decision Maker, Extent of Authority**

14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5

#### **Injury or Damage to Person or Property**

**10.2.8**, 10.4

#### **Inspections**

3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3,  
9.9.2, 9.10.1, 12.2.1, 13.4

#### **Instructions to Bidders**

1.1.1

#### **Instructions to the Contractor**

3.2.4, 3.3.1, 3.8.1, 5.2.1, 7, 8.2.2, 12, 13.4.2

#### **Instruments of Service, Definition of**

##### **1.1.7**

#### **Insurance**

6.1.1, 7.3.4, 8.2.2, 9.3.2, 9.8.4, 9.9.1, 9.10.2, 10.2.5, **11**

#### **Insurance, Notice of Cancellation or Expiration**

11.1.4, 11.2.3

#### **Insurance, Contractor's Liability**

##### **11.1**

Insurance, Effective Date of  
8.2.2, 14.4.2

#### **Insurance, Owner's Liability**

##### **11.2**

#### **Insurance, Property**

**10.2.5**, 11.2, 11.4, 11.5

#### **Insurance, Stored Materials**

9.3.2

### **INSURANCE AND BONDS**

#### **11**

#### **Insurance Companies, Consent to Partial Occupancy**

9.9.1

#### **Insured loss, Adjustment and Settlement of**

11.5

#### **Intent of the Contract Documents**

1.2.1, 4.2.7, 4.2.12, 4.2.13

#### **Interest**

##### **13.5**

#### **Interpretation**

1.1.8, 1.2.3, **1.4**, 4.1.1, 5.1, 6.1.2, 15.1.1

#### **Interpretations, Written**

4.2.11, 4.2.12

#### **Judgment on Final Award**

15.4.2

#### **Labor and Materials, Equipment**

1.1.3, 1.1.6, **3.4**, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1,  
5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1,  
10.2.4, 14.2.1.1, 14.2.1.2

#### **Labor Disputes**

8.3.1

#### **Laws and Regulations**

1.5, 2.3.2, 3.2.3, 3.2.4, 3.6, 3.7, 3.12.10, 3.13, 9.6.4,  
9.9.1, 10.2.2, 13.1, 13.3.1, 13.4.2, 13.5, 14, 15.2.8,  
15.4

#### **Liens**

2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8

#### **Limitations, Statutes of**

12.2.5, 15.1.2, 15.4.1.1

#### **Limitations of Liability**

3.2.2, 3.5, 3.12.10, 3.12.10.1, 3.17, 3.18.1, 4.2.6,  
4.2.7, 6.2.2, 9.4.2, 9.6.4, 9.6.7, 9.6.8, 10.2.5, 10.3.3,  
11.3, 12.2.5, 13.3.1

#### **Limitations of Time**

2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2.7,  
5.2, 5.3, 5.4.1, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3,  
9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15,  
15.1.2, 15.1.3, 15.1.5

#### **Materials, Hazardous**

10.2.4, **10.3**

#### **Materials, Labor, Equipment and**

1.1.3, 1.1.6, 3.4.1, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1,  
5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2,  
10.2.1.2, 10.2.4, 14.2.1.1, 14.2.1.2

#### **Means, Methods, Techniques, Sequences and Procedures of Construction**

3.3.1, 3.12.10, 4.2.2, 4.2.7, 9.4.2

#### **Mechanic's Lien**

2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8

#### **Mediation**

8.3.1, 15.1.3.2, 15.2.1, 15.2.5, 15.2.6, **15.3**, 15.4.1,  
15.4.1.1

#### **Minor Changes in the Work**

1.1.1, 3.4.2, 3.12.8, 4.2.8, 7.1, **7.4**

## MISCELLANEOUS PROVISIONS

### 13

#### Modifications, Definition of

##### 1.1.1

#### Modifications to the Contract

1.1.1, 1.1.2, 2.5, 3.11, 4.1.2, 4.2.1, 5.2.3, 7, 8.3.1, 9.7, 10.3.2

#### Mutual Responsibility

### 6.2

#### Nonconforming Work, Acceptance of

9.6.6, 9.9.3, **12.3**

Nonconforming Work, Rejection and Correction of  
2.4, 2.5, 3.5, 4.2.6, 6.2.4, 9.5.1, 9.8.2, 9.9.3, 9.10.4, 12.2

#### Notice

**1.6**, 1.6.1, 1.6.2, 2.1.2, 2.2.2., 2.2.3, 2.2.4, 2.5, 3.2.4, 3.3.1, 3.7.4, 3.7.5, 3.9.2, 3.12.9, 3.12.10, 5.2.1, 7.4, 8.2.2, 9.6.8, 9.7, 9.10.1, 10.2.8, 10.3.2, 11.5, 12.2.2.1, 13.4.1, 13.4.2, 14.1, 14.2.2, 14.4.2, 15.1.3, 15.1.5, 15.1.6, 15.4.1

#### Notice of Cancellation or Expiration of Insurance

11.1.4, 11.2.3

#### Notice of Claims

1.6.2, 2.1.2, 3.7.4, 9.6.8, 10.2.8, **15.1.3**, 15.1.5, 15.1.6, 15.2.8, 15.3.2, 15.4.1

#### Notice of Testing and Inspections

13.4.1, 13.4.2

#### Observations, Contractor's

3.2, 3.7.4

#### Occupancy

2.3.1, 9.6.6, 9.8

#### Orders, Written

1.1.1, 2.4, 3.9.2, 7, 8.2.2, 11.5, 12.1, 12.2.2.1, 13.4.2, 14.3.1

## OWNER

### 2

#### Owner, Definition of

##### 2.1.1

#### Owner, Evidence of Financial Arrangements

**2.2**, 13.2.2, 14.1.1.4

#### Owner, Information and Services Required of the

2.1.2, **2.2**, 2.3, 3.2.2, 3.12.10, 6.1.3, 6.1.4, 6.2.5, 9.3.2, 9.6.1, 9.6.4, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2, 14.1.1.4, 14.1.4, 15.1.4

#### Owner's Authority

1.5, 2.1.1, 2.3.32.4, 2.5, 3.4.2, 3.8.1, 3.12.10, 3.14.2, 4.1.2, 4.2.4, 4.2.9, 5.2.1, 5.2.4, 5.4.1, 6.1, 6.3, 7.2.1, 7.3.1, 8.2.2, 8.3.1, 9.3.2, 9.5.1, 9.6.4, 9.9.1, 9.10.2, 10.3.2, 11.4, 11.5, 12.2.2, 12.3, 13.2.2, 14.3, 14.4, 15.2.7

#### Owner's Insurance

### 11.2

#### Owner's Relationship with Subcontractors

1.1.2, 5.2, 5.3, 5.4, 9.6.4, 9.10.2, 14.2.2

#### Owner's Right to Carry Out the Work

**2.5**, 14.2.2

#### Owner's Right to Clean Up

### 6.3

#### Owner's Right to Perform Construction and to Award Separate Contracts

### 6.1

#### Owner's Right to Stop the Work

### 2.4

#### Owner's Right to Suspend the Work

14.3

#### Owner's Right to Terminate the Contract

14.2, 14.4

#### Ownership and Use of Drawings, Specifications and Other Instruments of Service

1.1.1, 1.1.6, 1.1.7, **1.5**, 2.3.6, 3.2.2, 3.11, 3.17, 4.2.12, 5.3

#### Partial Occupancy or Use

9.6.6, **9.9**

#### Patching, Cutting and

**3.14**, 6.2.5

#### Patents

3.17

#### Payment, Applications for

4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5, 9.6.3, 9.7, 9.8.5, 9.10.1, 14.2.3, 14.2.4, 14.4.3

#### Payment, Certificates for

4.2.5, 4.2.9, 9.3.3, **9.4**, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4

#### Payment, Failure of

9.5.1.3, **9.7**, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2

#### Payment, Final

4.2.1, 4.2.9, **9.10**, 12.3, 14.2.4, 14.4.3

#### Payment Bond, Performance Bond and

7.3.4.4, 9.6.7, 9.10.3, **11.1.2**

#### Payments, Progress

9.3, **9.6**, 9.8.5, 9.10.3, 14.2.3, 15.1.4

## PAYMENTS AND COMPLETION

### 9

#### Payments to Subcontractors

5.4.2, 9.5.1.3, 9.6.2, 9.6.3, 9.6.4, 9.6.7, 14.2.1.2

#### PCB

10.3.1

#### Performance Bond and Payment Bond

7.3.4.4, 9.6.7, 9.10.3, **11.1.2**

#### Permits, Fees, Notices and Compliance with Laws

2.3.1, **3.7**, 3.13, 7.3.4.4, 10.2.2

## PERSONS AND PROPERTY, PROTECTION OF

### 10

#### Polychlorinated Biphenyl

10.3.1

#### Product Data, Definition of

### 3.12.2

#### Product Data and Samples, Shop Drawings

3.11, **3.12**, 4.2.7

#### Progress and Completion

4.2.2, **8.2**, 9.8, 9.9.1, 14.1.4, 15.1.4

#### Progress Payments

9.3, **9.6**, 9.8.5, 9.10.3, 14.2.3, 15.1.4

**Project, Definition of**  
**1.1.4**  
Project Representatives  
4.2.10  
**Property Insurance**  
10.2.5, **11.2**  
**Proposal Requirements**  
1.1.1  
**PROTECTION OF PERSONS AND PROPERTY**  
**10**  
Regulations and Laws  
1.5, 2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 9.9.1,  
10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14, 15.2.8, 15.4  
Rejection of Work  
4.2.6, 12.2.1  
Releases and Waivers of Liens  
9.3.1, 9.10.2  
Representations  
3.2.1, 3.5, 3.12.6, 8.2.1, 9.3.3, 9.4.2, 9.5.1, 9.10.1  
Representatives  
2.1.1, 3.1.1, 3.9, 4.1.1, 4.2.10, 13.2.1  
Responsibility for Those Performing the Work  
3.3.2, 3.18, 4.2.2, 4.2.3, 5.3, 6.1.3, 6.2, 6.3, 9.5.1, 10  
Retainage  
9.3.1, 9.6.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3  
**Review of Contract Documents and Field**  
**Conditions by Contractor**  
**3.2**, 3.12.7, 6.1.3  
Review of Contractor's Submittals by Owner and  
Architect  
3.10.1, 3.10.2, 3.11, 3.12, 4.2, 5.2, 6.1.3, 9.2, 9.8.2  
Review of Shop Drawings, Product Data and Samples  
by Contractor  
3.12  
**Rights and Remedies**  
1.1.2, 2.4, 2.5, 3.5, 3.7.4, 3.15.2, 4.2.6, 5.3, 5.4, 6.1,  
6.3, 7.3.1, 8.3, 9.5.1, 9.7, 10.2.5, 10.3, 12.2.1, 12.2.2,  
12.2.4, **13.3**, 14, 15.4  
**Royalties, Patents and Copyrights**  
**3.17**  
Rules and Notices for Arbitration  
15.4.1  
**Safety of Persons and Property**  
**10.2**, 10.4  
**Safety Precautions and Programs**  
3.3.1, 4.2.2, 4.2.7, 5.3, **10.1**, 10.2, 10.4  
**Samples, Definition of**  
**3.12.3**  
**Samples, Shop Drawings, Product Data and**  
3.11, **3.12**, 4.2.7  
**Samples at the Site, Documents and**  
**3.11**  
**Schedule of Values**  
**9.2**, 9.3.1  
Schedules, Construction  
3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2

Separate Contracts and Contractors  
1.1.4, 3.12.5, 3.14.2, 4.2.4, 4.2.7, 6, 8.3.1, 12.1.2  
**Separate Contractors, Definition of**  
**6.1.1**  
**Shop Drawings, Definition of**  
**3.12.1**  
**Shop Drawings, Product Data and Samples**  
3.11, **3.12**, 4.2.7  
**Site, Use of**  
**3.13**, 6.1.1, 6.2.1  
Site Inspections  
3.2.2, 3.3.3, 3.7.1, 3.7.4, 4.2, 9.9.2, 9.4.2, 9.10.1, 13.4  
Site Visits, Architect's  
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4  
Special Inspections and Testing  
4.2.6, 12.2.1, 13.4  
**Specifications, Definition of**  
**1.1.6**  
**Specifications**  
1.1.1, **1.1.6**, 1.2.2, 1.5, 3.12.10, 3.17, 4.2.14  
Statute of Limitations  
15.1.2, 15.4.1.1  
Stopping the Work  
2.2.2, 2.4, 9.7, 10.3, 14.1  
Stored Materials  
6.2.1, 9.3.2, 10.2.1.2, 10.2.4  
**Subcontractor, Definition of**  
**5.1.1**  
**SUBCONTRACTORS**  
**5**  
Subcontractors, Work by  
1.2.2, 3.3.2, 3.12.1, 3.18, 4.2.3, 5.2.3, 5.3, 5.4, 9.3.1.2,  
9.6.7  
**Subcontractual Relations**  
**5.3**, 5.4, 9.3.1.2, 9.6, 9.10, 10.2.1, 14.1, 14.2.1  
Submittals  
3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 7.3.4, 9.2, 9.3, 9.8,  
9.9.1, 9.10.2, 9.10.3  
Submittal Schedule  
3.10.2, 3.12.5, 4.2.7  
**Subrogation, Waivers of**  
6.1.1, **11.3**  
**Substances, Hazardous**  
**10.3**  
**Substantial Completion**  
4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, **9.8**, 9.9.1, 9.10.3, 12.2,  
15.1.2  
**Substantial Completion, Definition of**  
**9.8.1**  
Substitution of Subcontractors  
5.2.3, 5.2.4  
Substitution of Architect  
2.3.3  
Substitutions of Materials  
3.4.2, 3.5, 7.3.8  
**Sub-subcontractor, Definition of**  
**5.1.2**

Subsurface Conditions  
3.7.4

**Successors and Assigns**  
**13.2**

**Superintendent**  
**3.9, 10.2.6**

**Supervision and Construction Procedures**  
1.2.2, **3.3**, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3,  
7.3.4, 8.2, 8.3.1, 9.4.2, 10, 12, 14, 15.1.4

Suppliers  
1.5, 3.12.1, 4.2.4, 4.2.6, 5.2.1, 9.3, 9.4.2, 9.5.4, 9.6,  
9.10.5, 14.2.1

Surety  
5.4.1.2, 9.6.8, 9.8.5, 9.10.2, 9.10.3, 11.1.2, 14.2.2,  
15.2.7

Surety, Consent of  
9.8.5, 9.10.2, 9.10.3

Surveys  
1.1.7, 2.3.4

**Suspension by the Owner for Convenience**  
**14.3**

Suspension of the Work  
3.7.5, 5.4.2, 14.3

Suspension or Termination of the Contract  
5.4.1.1, 14

**Taxes**  
3.6, 3.8.2.1, 7.3.4.4

**Termination by the Contractor**  
**14.1, 15.1.7**

**Termination by the Owner for Cause**  
5.4.1.1, **14.2**, 15.1.7

**Termination by the Owner for Convenience**  
**14.4**

Termination of the Architect  
2.3.3

Termination of the Contractor Employment  
14.2.2

**TERMINATION OR SUSPENSION OF THE CONTRACT**

**14**

**Tests and Inspections**  
3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3,  
9.9.2, 9.10.1, 10.3.2, 12.2.1, **13.4**

**TIME**  
**8**

**Time, Delays and Extensions of**  
3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3.1, 7.4, **8.3**, 9.5.1, 9.7,  
10.3.2, 10.4, 14.3.2, 15.1.6, 15.2.5

**Time Limits**

2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2,  
5.2, 5.3, 5.4, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1,  
9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15.1.2,  
15.1.3, 15.4

**Time Limits on Claims**

3.7.4, 10.2.8, 15.1.2, 15.1.3

Title to Work

9.3.2, 9.3.3

**UNCOVERING AND CORRECTION OF WORK**  
**12**

**Uncovering of Work**  
**12.1**

Unforeseen Conditions, Concealed or Unknown  
3.7.4, 8.3.1, 10.3

Unit Prices

7.3.3.2, 9.1.2

Use of Documents

1.1.1, 1.5, 2.3.6, 3.12.6, 5.3

**Use of Site**

**3.13**, 6.1.1, 6.2.1

**Values, Schedule of**  
**9.2, 9.3.1**

Waiver of Claims by the Architect  
13.3.2

Waiver of Claims by the Contractor  
9.10.5, 13.3.2, **15.1.7**

Waiver of Claims by the Owner  
9.9.3, 9.10.3, 9.10.4, 12.2.2.1, 13.3.2, 14.2.4, **15.1.7**

Waiver of Consequential Damages  
14.2.4, 15.1.7

Waiver of Liens  
9.3, 9.10.2, 9.10.4

**Waivers of Subrogation**  
6.1.1, **11.3**

**Warranty**  
**3.5**, 4.2.9, 9.3.3, 9.8.4, 9.9.1, 9.10.2, 9.10.4, 12.2.2,  
15.1.2

Weather Delays  
8.3, 15.1.6.2

**Work, Definition of**  
**1.1.3**

Written Consent  
1.5.2, 3.4.2, 3.7.4, 3.12.8, 3.14.2, 4.1.2, 9.3.2, 9.10.3,  
13.2, 13.3.2, 15.4.4.2

Written Interpretations  
4.2.11, 4.2.12

Written Orders

1.1.1, 2.4, 3.9, 7, 8.2.2, 12.1, 12.2, 13.4.2, 14.3.1



## ARTICLE 1 GENERAL PROVISIONS

### § 1.1 Basic Definitions

#### § 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

#### § 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

#### § 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

#### § 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

#### § 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

#### § 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

#### § 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, **Project Manual**, specifications, and other similar materials.

#### § 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

### § 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

### § 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

### § 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

### § 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

### § 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

*(Paragraphs deleted)*

## ARTICLE 2 OWNER

### § 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

*(Paragraph deleted)*

## **§ 2.2 Evidence of the Owner's Financial Arrangements**

**§ 2.2.1** Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

**§ 2.2.2** Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

**§ 2.2.3** After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

**§ 2.2.4** Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

## **§ 2.3 Information and Services Required of the Owner**

**§ 2.3.1** Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

**§ 2.3.2** The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

**§ 2.3.3** If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

**§ 2.3.4** The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

**§ 2.3.5** The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

#### § 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

#### § 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

### ARTICLE 3 CONTRACTOR

#### § 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

#### § 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall

promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

**§ 3.2.4** If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

### **§ 3.3 Supervision and Construction Procedures**

**§ 3.3.1** The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

**§ 3.3.2** The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

**§ 3.3.3** The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

### **§ 3.4 Labor and Materials**

**§ 3.4.1** Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

**§ 3.4.2** Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

**§ 3.4.3** The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

**§ 3.4.4** The Contractor's or his/her Subcontractor's supervisors and workmen engaged on special work or skilled Work in any supervisory position or trade shall be qualified and have had sufficient education, training, and experience as a recognized professional or master mechanic in such Work to perform it properly and satisfactorily as prescribed in the Contract Documents.

**§ 3.4.5** Any project manager, superintendent, engineer, foreman, or workman employed by the Contractor or by a Subcontractor who, in the sole opinion of the Program Manager, does not perform his/her Work in a proper and skillful manner or becomes party to disrespectful, intemperate, disorderly, intoxicated, or dishonest behavior, or uses

foul language, fights, commits criminal act(s), falsifies records and construction, covers-up faulty Work or materials, does not comprehend or follow instructions, does not get along with the Architect or Program Manager, or is otherwise objectionable, shall at the written request by the Program Manager, be discharged within 24 hours by the Contractor or Subcontractor employing such project manager, superintendent, engineer, foreman or workman, and shall not be employed again on any portion of the Work without the written consent of the Program Manager.

**§ 3.4.6** Should the Contractor fail to remove such person or persons specified in Article 3.4.5 hereinabove or fail to furnish suitable and sufficient machinery, equipment, materials or qualified labor force for the proper execution of the Work, the Owner may withhold all payments which are or may become due to the Contractor or may suspend the Work until such orders are complied with.

**§ 3.4.7** Contractor shall abide by provisions of Section 14.1 and Section 14.2, Code of the City of Mobile, originally adopted December 10, 1991. Prohibiting Discrimination in Employment by Contractors, Subcontractors, and Vendors performing Work and providing materials and supplies for the City of Mobile. Certification of compliance with this requirement shall be made for all persons involved in the Work by the Contractor's signing of the Contract.

### **§ 3.5 Warranty**

**§ 3.5.1** The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

**§ 3.5.2** All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

### **§ 3.6 Taxes**

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

### **§ 3.7 Permits, Fees, Notices and Compliance with Laws**

**§ 3.7.1** Unless otherwise provided in the Contract Documents, the Contractor shall secure all required City of Mobile permits without cost, and shall secure and pay for other permits, fees, licenses, and inspections by other agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

**§ 3.7.2** The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

**§ 3.7.3** If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

### **§ 3.7.4 Concealed or Unknown Conditions**

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or

Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

**§ 3.7.5** If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

### **§ 3.8 Allowances**

**§ 3.8.1** The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

**§ 3.8.2** Unless otherwise provided in the Contract Documents,

- .1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- .3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

**§ 3.8.3** Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

### **§ 3.9 Superintendent**

**§ 3.9.1** The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

**§ 3.9.2** The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

**§ 3.9.3** The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

### **§ 3.10 Contractor's Construction and Submittal Schedules**

**§ 3.10.1** The Contractor, within ten (10) business days after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

**§ 3.10.2** The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's

Init.

/

construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

**§ 3.10.3** The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

**§ 3.11 Documents and Samples at the Site**

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

**§ 3.12 Shop Drawings, Product Data and Samples**

**§ 3.12.1** Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

**§ 3.12.2** Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

**§ 3.12.3** Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

**§ 3.12.4** Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

**§ 3.12.5** The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors. Submittals which are not marked as reviewed for compliance with the Contract Documents and approved by the Contractor may be returned by the Architect without action. Wherever Shop Drawings are required in these Specifications, Shop Drawings shall be submitted for approval before materials are fabricated. Drawings shall show complete details. The General Contractor shall check and approve them either in writing or by stamp prior to submittal to the Architect.

**§ 3.12.6** By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

**§ 3.12.7** The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

**§ 3.12.8** The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect



of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

**§ 3.12.9** The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

**§ 3.12.10** The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

**§ 3.12.10.1** If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

**§ 3.12.10.2** If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

### **§ 3.13 Use of Site**

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

### **§ 3.14 Cutting and Patching**

**§ 3.14.1** The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

**§ 3.14.2** The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

### **§ 3.15 Cleaning Up**

**§ 3.15.1** The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

### § 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

### § 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

### § 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

§ 3.19 As applicable, the Contractor shall be responsible at the appropriate time during construction of the Project to have all permanent meters installed (electrical, water, gas, etc.) and all utilities connected prior to the time of Final Inspection. The Contractor shall pay all utility costs until the Project is accepted by the City of Mobile.

## ARTICLE 4 ARCHITECT

### § 4.1 General

§ 4.1.1 The Owner shall retain an Architect lawfully licensed to practice architecture or an entity lawfully practicing architecture in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

### § 4.2 Administration of the Contract

§ 4.2.1 The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or

for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents, unless otherwise modified in writing in accordance with other provisions of the Contract.

**§ 4.2.3** On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

#### **§ 4.2.4 Communications**

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

**§ 4.2.5** Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

**§ 4.2.6** The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

**§ 4.2.7** The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

**§ 4.2.8** The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

**§ 4.2.9** The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

**§ 4.2.10** If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

## **ARTICLE 5 SUBCONTRACTORS**

### **§ 5.1 Definitions**

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

### **§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work**

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor shall notify the Owner of any changes to the persons or entities proposed for each principal portion of the Work, as listed in the Contractor's Subcontracting plan submitted with Contractor's bid, prior to signing of the Contract. Within 14 days of receipt of the information, the Owner may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

### **§ 5.3 Subcontractual Relations**

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor,

prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

#### **§ 5.4 Contingent Assignment of Subcontracts**

**§ 5.4.1** Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

**§ 5.4.2** Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation may be equitably adjusted for increases in cost resulting from the suspension.

**§ 5.4.3** Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity.

### **ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS**

#### **§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts**

**§ 6.1.1** The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

**§ 6.1.2** When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

**§ 6.1.3** The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

**§ 6.1.4** Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

#### **§ 6.2 Mutual Responsibility**

**§ 6.2.1** The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

**§ 6.2.2** If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed

construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

### § 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

## ARTICLE 7 CHANGES IN THE WORK

### § 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents. Markups for overhead and profit for all changes in the Work shall not exceed a combined aggregate (15%) mark-up on Subcontractor's direct cost (actual cost of Labor & Materials) including lower tier subcontractor's markups and mark-up on General Contractor's direct cost(actual cost of Labor & Materials).

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

### § 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.
- .4 There shall be attached to each Change Order, a signed statement from the Architect containing the following:
  - A. A statement of what the Change Order covers and who instituted the Change Order and why it is necessary or desired.
  - B. A statement setting forth the reasons for using the Change Order method rather than taking new competitive bids.
  - C. A statement that all prices have been reviewed and found reasonable, fair, and equitable and recommending approval of the same.

### § 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, an amount not to exceed a combined aggregate (15%) mark-up on Subcontractor's direct cost (actual cost of Labor & Materials) including lower tier subcontractor's markups and mark-up on General Contractor's direct cost (actual cost of Labor & Materials). In such case, and also under Section 7.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented by the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

#### § 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

### ARTICLE 8 TIME

#### § 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

#### § 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

1. No Work shall commence and no materials shall be ordered until the Owner issues the written Notice to Proceed.
2. The Work shall be commenced within Fourteen (14) calendar days of the date of Contract award.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

#### § 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.



## ARTICLE 9 PAYMENTS AND COMPLETION

### § 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

### § 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

1. Unit Prices and Allowances, if stated in Contract Documents, shall be identified within the Schedule of Values.

### § 9.3 Applications for Payment

§ 9.3.1 The Contractor shall submit to the Architect an itemized Application for Payment on the first of each month for Work performed through the 25th of the preceding month, in accordance with the accepted schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage as provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work, that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

### § 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in

Init.

Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

**§ 9.4.2** The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

### **§ 9.5 Decisions to Withhold Certification**

**§ 9.5.1** The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- .3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a Separate Contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- .7 repeated failure to carry out the Work in accordance with the Contract Documents.

**§ 9.5.2** When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

**§ 9.5.3** When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

**§ 9.5.4** If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

### **§ 9.6 Progress Payments**

**§ 9.6.1** After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

**§ 9.6.2** The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the

Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

**§ 9.6.3** The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

**§ 9.6.4** The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

**§ 9.6.5** The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

**§ 9.6.6** A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

**§ 9.6.7** Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

**§ 9.6.8** Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

### **§ 9.7 Failure of Payment**

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time may be extended appropriately and the Contract Sum may be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

### **§ 9.8 Substantial Completion**

**§ 9.8.1** Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

**§ 9.8.2** When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

**§ 9.8.3** Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall,

before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

**§ 9.8.4** When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

**§ 9.8.5** The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

### **§ 9.9 Partial Occupancy or Use**

**§ 9.9.1** The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

**§ 9.9.2** Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

**§ 9.9.3** Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

### **§ 9.10 Final Completion and Final Payment**

**§ 9.10.1** Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

**§ 9.10.2** Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents;
- .3 terms of special warranties required by the Contract Documents; or
- .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

## ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

### § 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

### § 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall comply with all Federal, State, and Local law regarding safety including the requirements of the Occupational Safety and Health Act of 1970, Public Law #91-596, latest version. Contractor shall take all other reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.
- .4 The Contractor shall request utility locates by all known utility owners. The Contractor shall be responsible for damage done to buried cables and other utilities by Contractor's equipment and personnel if Contractor fails to request locates or fails to maintain utility locates.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage

or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

**§ 10.2.6** The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

**§ 10.2.7** The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

**§ 10.2.8 Injury or Damage to Person or Property**

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

**§ 10.3 Hazardous Materials and Substances**

**§ 10.3.1** The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

**§ 10.3.2** Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time may be extended appropriately and the Contract Sum may be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up, except to the extent that any such delay is attributable to the Contractor's objection to the persons or entities whom Owner shall have furnished to perform the task of removal or safe containment of such material or substance.

**§ 10.3.3** SECTION NOT USED BY CITY OF MOBILE.

**§ 10.3.4** The Owner shall not be responsible for materials or substances brought to the site by the Contractor regardless of whether such materials or substances were required by the Contract Documents.

**§ 10.3.5** The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

**§ 10.3.6** If, without negligence or wantonness on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner may reimburse the Contractor for all reasonable cost and expense thereby incurred.

## § 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency may be determined only as provided in Article 15 and Article 7.

## ARTICLE 11 INSURANCE AND BONDS

### § 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 **Notice of Cancellation or Expiration of Contractor's Required Insurance.** Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

### § 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 **Failure to Purchase Required Property Insurance.** If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 **Notice of Cancellation or Expiration of Owner's Required Property Insurance.** Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance

had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

**§ 11.3 Waivers of Subrogation** SECTION NOT USED BY CITY OF MOBILE

*(Paragraphs deleted)*

**§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance** SECTION NOT USED BY CITY OF MOBILE

**§11.5 Adjustment and Settlement of Insured Loss** SECTION NOT USED BY CITY OF MOBILE

*(Paragraphs deleted)*

**ARTICLE 12 UNCOVERING AND CORRECTION OF WORK**

**§ 12.1 Uncovering of Work**

**§ 12.1.1** If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

**§ 12.1.2** If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

**§ 12.2 Correction of Work**

**§ 12.2.1 Before Substantial Completion**

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

**§ 12.2.2 After Substantial Completion**

**§ 12.2.2.1** In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

**§ 12.2.2.2** The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

**§ 12.2.2.3** The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

**§ 12.2.3** The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.



§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

### § 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

## ARTICLE 13 MISCELLANEOUS PROVISIONS

### § 13.1 Governing Law

The Contract shall be governed by the laws of the State of Alabama.

### § 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.2.3 No assignment of the Contract shall be made without the written permission of Surety providing bonding and the City of Mobile.

### § 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

### § 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or

approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

### § 13.5 Interest SECTION NOT USED BY CITY OF MOBILE

## ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

### § 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

### § 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

### § 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time may be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- .1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

### § 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; and costs incurred by reason of the termination.

## ARTICLE 15 CLAIMS AND DISPUTES

### § 15.1 Claims

#### § 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

### § 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

### § 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant acting with due diligence, reasonably should have first recognized the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

### § 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

### § 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work giving rise to such claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

### § 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary. No claim for additional time shall be granted unless the Contractor demonstrates, through the Critical Path Method of scheduling, the Substantial Completion Date has been impacted.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time; could not have been reasonably anticipated and the Contractor had taken reasonable efforts to minimize the impact; the adverse weather conditions occurred on or impacted a scheduled work day during regularly scheduled work hours; and the Contractor demonstrates, through the Critical Path Method of scheduling, the Substantial Completion Date has been impacted.

### § 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

## § 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons **therefore**; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

## § 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall not be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

## § 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

## § 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose

presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.



**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 00 73 00 - SUPPLEMENTARY PROJECT CONDITIONS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

All Sections within DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS.

**1.2 SUMMARY**

The Supplementary Conditions of the Contract are meant to be viewed as a complement to the General Conditions of the Contract. Should any discrepancy or ambiguity be noted, the Supplementary Conditions of the Contract shall apply, and the General Conditions of the Contract shall defer to Supplementary Conditions of the Contract. The terms “Designer”, “Architect”, and “Engineer” shall be construed to mean Goodwyn Mills Cawood. The terms “Owner”, “Awarding Authority”, and “City of Mobile” shall be construed to mean The City of Mobile. The term “Program Manager (PM)”, “Construction Manager” and “Owner’s Representative” shall be construed to mean “Volkert, Inc.”. Where the Project Manual refers to Owner; it shall be recognized to include the Owner’s Representative (PM) as per the requirements and limitations of the contract between Owner and Program Manager.

- A. All documents to be submitted or otherwise provided by the Contractor shall be transmitted to the Architect and Program Manager via the project web site.
- B. The City of Mobile utilizes E-Builder as its project management system. E-builder is a secure data collections site: <https://www.e-builder.net>. Firms and/or individuals, including subconsultants, shall use E-Builder as an essential component of project management with the City of Mobile. Membership fees are \$2,150.00 per user to participate in the E-Builder project management system. The Contractor shall be required to have two user accounts and include this cost in the bid. The Contractor may request to add other users at the Contractor’s expense. The Contractor will be required to submit all Pay Applications, RFIs, Submittals, and other project documents required by the specifications through E-Builder Project Management Software.
- C. In the event the Contract Period of Performance extends into the Mobile Mardi Gras season, the Contractor shall account for potential disruptions to the work that may result from Mardi Gras. Any such disruptions shall be considered by the Contractor and included in the bid and shall not be a basis for a claim for additional compensation or time extension.
- D. The Contractor will not be permitted to work, have any road closures, nor traffic interferences in place on the following days:

- a. Veterans Day, November 11, 2024
  - b. Lundi Gras, March 3, 2025
  - c. Fat Tuesday, March 4, 2025
- E. Contractor shall have access to the site seven days a week, 24 hours per day. Normal work hours are considered to be 6:00 am until 6:00 pm Monday through Friday excluding holidays. Work outside of normal hours shall require approval of the Program Manager. Approval of the Program Manager does not relieve the bidder from complying with any and all City of Mobile ordinances regarding noise, light, or other nuisances.
- F. The Contractor may be allowed additional construction days due to inclement conditions ("rain days") only as such are appropriately documented and are in excess of the NOAA/National Weather Service average (previous 5 years) for the given month. A "rain day" is defined as more than (0.10") of rain falling within a given 24 hour period as measured at the project site. The Contractor shall request in writing any "rain days" they feel are legitimately due. Weather delay requests shall be submitted to the Program Manager in writing, on a monthly basis. The Contractor's claim shall account for and give credit to the Owner for days during the previous month that were less than the NOAA/National Weather Service average (previous 5 years) for the previous month.

The Claim shall include documentation of trades adversely impacted and the impacted activities of each trade. The documentation shall further substantiate that weather conditions were abnormal for the period of time; could not have been reasonably anticipated; the Contractor had taken reasonable efforts to minimize the impact; the adverse weather conditions occurred on or impacted a scheduled work day during regularly scheduled work hours; and the Contractor demonstrates, through the Critical Path Method of scheduling, the Substantial Completion Date has been impacted.

## **PART 2 - PRODUCTS (Not Applicable.)**

## **PART 3 - EXECUTION (Not Applicable.)**

- A. All temporary chain link construction fencing, and signage shall be installed prior to performing any site demolition other than that required to install the fencing.
- B. The Contractor's laydown area shall be as shown in the contract drawings. Contractor personnel shall not park in or otherwise utilize the laydown areas of other contractors working on the site.
- C. The Contractor's construction entrance shall be located on Claiborne Street.
- D. Construction traffic to include, but not limited to, heavy equipment delivery and pick up, haul trucks, and material delivery shall not be permitted on Lawrence Street.
- E. Due to the site's location in a historic district and close proximity of historic

structures and residential properties the use of explosives is prohibited.

- F. If the Contractor intends to utilize on site crushers for concrete and masonry debris processing prior to removal from the site, this equipment shall be located on the east side of the project site as far from the residential properties as is reasonably possible. The location shall be approved by the Program Manager. Crushing equipment shall comply with all City of Mobile Ordinances regarding noise and dust controls.
- G. There are two Mosaic Murals located in the current Arena lobby that are required to be removed and relocated to the exhibition hall of the Mobile Convention Center. The Contractor will be required to perform this work under the direction of ICC Commonwealth Corporation, a historic preservation company, who are currently developing the design and work plan for the removal and relocation of the murals. A bid allowance of \$1,000,000 has been included in the Contract documents for this work.
- H. The Contractor shall protect, disconnect, and remove the Carrier 500 Ton Chiller currently installed at the Arena for City of Mobile re-use. The Chiller shall be removed prior to demolition of the Arena and placed in the existing parking lot in a location so as not to interfere with the Contractor's work. The City of Mobile will load and transport the Chiller off site.

**END OF SECTION 00 73 00**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 01 10 00 - SUMMARY****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Project information.
  2. Work covered by Contract Documents.
  3. Access to site.
  4. Coordination with occupants.
  5. Work restrictions.
  6. Specification and drawing conventions.
- B. Related Requirements:
1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

**1.2 PROJECT INFORMATION**

- A. Project Identification: Insert Project identifier such as Mobile Arena.
1. Project Location: Insert Project location Mobile, Alabama
- B. Owner: City of Mobile.
1. Owner's Representative: Insert name of Owner's representative; Insert email address of Owner's representative.
- C. Architect: POPULOUS.
1. Architect's Representative: keith.parker@gmcnetwork.com.
- D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
1. **Associate Architect:** Insert firm name; Insert contact for project, Insert email address of contact for project.
  2. **Civil:** Insert firm name; Insert contact for project, Insert email address of contact for project.
  3. **Structural:** Insert firm name; Insert contact for project, Insert email address of contact for project.
  4. **Mechanical/Electrical/Plumbing:** Insert firm name; Insert contact for project, Insert email address of contact for project.
  5. **Food Service:** Insert firm name; Insert contact for project, Insert email address of contact for project.
  6. **Audio/Visual:** Insert firm name; Insert contact for project, Insert email address of contact for project.
- E. Project Web Site: A project Web site administered by Contractor will be used for purposes of managing communication and documents during the construction stage.
1. Architect will utilize Newforma Project Center Current Edition for purposes of managing communication and documents.
  2. See Section 01 31 00 "Project Management and Coordination." for requirements for administering and using the Project Web site.

**1.3 WORK COVERED BY CONTRACT DOCUMENTS**

- A. The Work of Project is defined by the Contract Documents and consists of the following:
  - 1. Insert a brief description of Project indicating the size, code classification for occupancy and construction type, and general description of major building assemblies.
- B. Type of Contract:
  - 1. Project will be constructed under a single prime contract.

**1.4 ACCESS TO SITE**

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

**1.5 COORDINATION WITH OCCUPANTS**

- A. Full Owner Occupancy: Owner will occupy site and existing building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
  - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
  - 2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

**1.6 WORK RESTRICTIONS**

- A. Work Restrictions, General: Comply with restrictions on construction operations.
  - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
  - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
  - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- C. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
  - 1. Notify Owner not less than two days in advance of proposed disruptive operations.
  - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- D. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.
- E. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.
- F. Employee Identification: Owner will provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
  - 1. Maintain list of approved screened personnel with Owner's representative.

**1.7 SPECIFICATION AND DRAWING CONVENTIONS**

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
  3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

**PART 2 - PRODUCTS (NOT USED)****PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 01 23 00 - ALTERNATES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for alternates.

**1.2 DEFINITIONS**

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
  2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

**1.3 PROCEDURES**

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other Work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Refer to Drawings for details of each alternate.

**PART 2 - PRODUCTS (NOT USED)****PART 3 - EXECUTION****3.1 SCHEDULE OF ALTERNATES**

- A. Alternate No. 1: Center Hung Scoreboard
1. Add Alternate Design: Base plan has wall mounted LED Scoreboards in endzones.
- B. Alternate No. 2: Day 2 Hockey – Ice Sheet/Slab
1. Deduct Alternate Design: Ice sheet would be implemented Day 1, other hockey program would have space allocated & shelled out.
- C. Alternate No. 3: Home Hockey Locker Room – Owner Fit-Out
1. Deduct Alternate Design: Home Hockey Locker Area to be 'white box' - shell space. Full fit-out of the area (5,570 SF) to be paid for by ownership of hockey team.

- D. Alternate No. 4: Behind Stage Main Concourse Amenities  
1. Deduct Alternate Design: 2,328 SF of Market + Restrooms would be eliminated behind stage-end of Main Concourse.
- E. Alternate No. 5: Delete Top Precast Tread & Seats of Lower Bowl  
1. Deduct Alternate Design: Reduction of seating bowl - allows concourse to shift inwards and reduce overall SF (3,550 SF). Removal of seating results in loss of 252 seats.
- F. Alternate No. 6: Deleting Exterior Balconies except for Northwest Balcony  
1. Deduct Alternate Design: Northwest balcony would remain in base arena - all other balconies would include structure for future fit-out but would not be finished Day 1.
- G. Alternate No. 7: Deleting All Exterior Balconies  
1. Deduct Alternate Design: Removal of all exterior balconies. Base arena to include structure for future balcony fit-out.
- H. Alternate No. 8: Reduce Height of Freight Elevator  
1. Deduct Alternate Design: Reduce height of freight elevator. (Would no longer reach height of catwalk - and would stop at Suite Level)
- I. Alternate No. 9: Main Concourse – Sideline Club – TI/Sponsorship  
1. Deduct Alternate Design: Sponsor to pay for fit-out of premium area - reducing initial Day 1 cost.
- J. Alternate No. 10: Event Level – Bunker Club – TI/Sponsorship  
1. Deduct Alternate Design: Sponsor to pay for fit-out of premium area - reducing initial Day 1 cost.
- K. Alternate No. 11: Suite Level – Club TI/Sponsorship  
1. Deduct Alternate Design: Sponsor to pay for fit-out of premium area - reducing initial Day 1 cost.
- L. Alternate No. 12: Event Level – Ballrooms – TI/Sponsorship  
1. Deduct Alternate Design: Sponsor to pay for fit-out of North Ballrooms & West Ballrooms - reducing initial Day 1 cost.
- M. Alternate No. 13: Team Store Fit out (By Team or Sponsorship)  
1. Deduct Alternate Design: Hockey Team or Retail Sponsor to pay for fit-out of Team Store.
- N. Alternate No. 14: Mural Reinstallation - Sponsorship  
1. Deduct Alternate Design: Reinstallation of mural cost separated and provided by sponsor in lieu of base arena cost.
- O. Alternate No. 15: Sponsorship/Service Provider for DAS/Wi-Fi  
1. Deduct Alternate Design: Owner to pay for DAS/Wi-Fi devices (the infrastructure for these are in base building) - reducing initial Day 1 cost.
- P. Alternate No. 16: ESPN Broadcast Capabilities  
1. Add Alternate Design: Additional infrastructure would need to be added to base arena to meet ESPN broadcast requirements.
- Q. Alternate No. 17: Color Tuning Sports Lighting  
1. Add Alternate Design: Additional infrastructure would provide arena additional sports lighting flexibility.

END OF SECTION

**SECTION 01 25 00 - SUBSTITUTION PROCEDURES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - 1. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
  - 2. Section 01 33 00 "Submittal Procedures" for approval process.
  - 3. Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

**1.2 DEFINITIONS**

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

**1.3 ACTION SUBMITTALS**

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use .pdf form provided in Project Manual, Substitution Request is identified with 01 25 00 prefix, and if approved the Substitution Request to be submitted for record under associated specification section which includes all required documentation in that section.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
    - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    - e. Samples, where applicable or requested.
    - f. Certificates and qualification data, where applicable or requested.
    - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.

- h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
  - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
  - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven (7) days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within fifteen (15) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Approved response to Substitution Request via submittal process and will be included in subsequent Change Order, Construction Change Directive or Architect's Supplemental Instructions.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

#### 1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

#### 1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

#### 1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than fifteen (15) days prior to time required for preparation and review of related submittals.
  - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - b. Substitution request is fully documented and properly submitted.
    - c. Requested substitution will not adversely affect Contractor's construction schedule.
    - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - e. Requested substitution is compatible with other portions of the Work.
    - f. Requested substitution has been coordinated with other portions of the Work.
    - g. Requested substitution provides specified warranty.



**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
  - 1. Section 01 25 00 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
  - 2. Section 01 31 00 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

**1.2 MINOR CHANGES IN THE WORK**

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instruction" or similar form.

**1.3 PROPOSAL REQUESTS**

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
  - 2. Within time specified in Proposal Request or twenty (20) days, when not otherwise specified but not less than fourteen (14) days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Contractor shall evaluate and present available float when requesting an extension of the Contract Time.
    - e. Quotation Form: Use CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail," or forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
  - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
  - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
  - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Contractor shall evaluate and present available float when requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

#### **1.4 ADMINISTRATIVE CHANGE ORDERS**

- A. Allowance Adjustment: See Section 01 21 00 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

#### **1.5 CHANGE ORDER PROCEDURES**

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701 or similar form.

#### **1.6 CONSTRUCTION CHANGE DIRECTIVE**

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: In the case when an agreed upon value is not reached prior to the work commencing, the Contractor must maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

END OF SECTION



**SECTION 01 29 00 - PAYMENT PROCEDURES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
  - 1. Section 01 22 00 "Unit Prices" for administrative requirements governing the use of unit prices.
  - 2. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
  - 3. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

**1.2 DEFINITIONS**

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

**1.3 SCHEDULE OF VALUES**

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule
  - 1. Coordinate line items in the schedule of values with items required administrative forms and schedules, including the following:
    - a. Application for Payment forms with continuation sheets.
    - b. Submittal schedule.
    - c. Items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven (7) days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
  - 1. Identification: Include the following Project identification on the schedule of values:
    - a. Project name and location.
    - b. Name of Architect.
    - c. Architect's Project number.
    - d. Contractor's name and address.
    - e. Date of submittal.
  - 2. Arrange schedule of values consistent with format of AIA Document G703.
  - 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
  - 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
  - 5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
  - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

#### **1.4 APPLICATIONS FOR PAYMENT**

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.
  1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
  4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- C. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
  1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
  2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  3. Provide summary documentation for stored materials indicating the following:
    - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- D. Transmittal: Submit in .pdf format, a digitally signed Application for Payment to Architect by a method ensuring receipt. Include waivers of lien and similar attachments if required.

- E. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  2. When an application shows completion of an item, submit conditional final or full waivers.
  3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
  5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- F. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of values.
  3. Contractor's construction schedule (preliminary if not final).
  4. Products list (preliminary if not final).
  5. Submittal schedule (preliminary if not final).
  6. List of Contractor's staff assignments.
  7. List of Contractor's principal consultants.
  8. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  9. Initial progress report.
  10. Report of preconstruction conference.
  11. Unless submitted before executing the Contract.
    - a. Certificates of insurance and insurance policies.
    - b. Performance and payment bonds.
    - c. Data needed to acquire Owner's insurance.
- G. Subsequent Application for Payment: If additional contracts are executed after the Initial Application for Payment, Contractor must submit all items listed in this section related to the new scope of work for the Subsequent Payment Application only. Administrative actions and submittals that must precede or coincide with Subsequent Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of values.
  3. Current Contractor's construction schedule.
  4. Current products list.
  5. Current progress report.
- H. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
    - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 01 77 00 "Closeout Procedures."
  2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Certification of completion of final punch list items.

3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706 "Contractor's Affidavit of Payment of Debts and Claims" or AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.
10. Proof that taxes, fees, and similar obligations are paid.
11. Waivers and releases.

**PART 2 - PRODUCTS (NOT USED)****PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. Coordination drawings.
  - 3. Request for Information (RFIs).
  - 4. Newforma Project Center or other web-based project management software package.
  - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific Contractor.
- C. Related Requirements:
  - 1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
  - 2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.

**1.2 DEFINITIONS**

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Construction Manager, or Contractor seeking information required by or clarifications of the Contract Documents.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A, or include the following information in tabular form:
  - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.
  - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within fifteen (15) days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list office addresses, including office and cellular telephone numbers, and e-mail addresses. Provide names, office addresses, and telephone numbers, and e-mail addresses of individuals assigned as alternates in the absence of individuals assigned to Project.
  - 1. Post copies of list in Project meeting room, in temporary field office, on Newforma Project Center Current Edition or other web-based project management software package, and in prominent location in each built facility. Keep list current at all times.
  - 2. When Construction Manager staff changes occur, notify Owner and Architect fifteen (15) days prior to staffs arrival or departure on site.
  - 3. Construction Manager to identify project staff for all Design Team correspondence.

#### 1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's construction schedule.
  - 2. Preparation of the schedule of values.
  - 3. Installation and removal of temporary facilities and controls.
  - 4. Delivery and processing of submittals.
  - 5. Progress meetings.
  - 6. Preinstallation conferences.
  - 7. Project closeout activities.
  - 8. Startup and adjustment of systems.
- C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work where applicable.

#### 1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one (1) entity.
  - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. The Architect's Revit Model and Construction Documents are not coordination drawings. Coordination drawings shall be generated based on the specific procured material and / or equipment. Include the following information, as applicable:
    - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    - b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    - d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    - e. Indicate required installation sequences.

- f. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows and as mutually agreed upon between Owner, Architect, and Construction Manager:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, (as needed to illustrate location of mechanical, electrical, plumbing and fire protection), and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices. Supplement plan drawings with section drawings where required to adequately represent the Work.
  2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, wall mounted mechanical, electrical, plumbing, and fire protection systems and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
  3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
  4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
  5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, box out for door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items. These items may be indicated on several submissions as it related to the performing subcontractor.
  6. Mechanical and Plumbing Work: Show the following:
    - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, in excess of two inches or bulk runs, including insulation, bracing, flanges, and support systems.
    - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    - c. Fire-rated enclosures around ductwork.
  7. Electrical Work: Show the following:
    - a. Runs of vertical and horizontal conduit two (2) inches in diameter and larger or conduit in bulk runs.
    - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    - c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
    - d. Location of major pull boxes and junction boxes, dimensioned from column center lines.
  8. Fire-Protection System: Show the following:
    - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
  9. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
  10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00 "Submittal Procedures."

- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: It is understood that trades will work in their native formats for 3D modeling production of the digital data files as long as the native 3D formats can accurately be reviewed in Navisworks Manage and in compliance with the 01370 contractor's 3D coordination specification. These native files will be made available to upon request as needed throughout the coordination process as well as the current 3D Coordination Navisworks Manage Model.
  2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format, or Portable Data File PDF format.
  3. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project. Portions of the Design Team CAD / Revit File may be used to develop or act as the construction BIM File as deemed necessary by the CM. The construction BIM File shall be generated by the Construction Manager. The CM may utilize components of the design models within the coordination process as deemed usable by the contractor. It is understood that these design models are not contract documents therefore they should only be referenced and compared to the Construction Documents. The Design Team is not responsible for the dependability of the Design Team CAD / Revit File as only portions may be utilized. The required trades 3D modeling their systems during the 3D coordination process shall be the mechanical, electrical, plumbing, fire protection, and structural steel trades. If other trades choose to model their systems per their standard practice, their models may also be included in the 3D coordination model as decided by the Contractor.
    - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
  4. Architect will furnish Contractor the comprehensive design models (design digital data files) for use in preparing coordination digital data files at major milestone design deliverable or design change.
    - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings. The Architect furnished digital data files are only to be used to prepare the coordination digital data files and not used as the coordination digital data files. Some components of the Design Team CAD / Revit file will be used in the construction BIM file for clash detection as deemed appropriate by the CM. These components will be portions of the Design Team CAD / Revit file that are not required to be recreated in 3d models for fabrication or required shop drawings. These components will be utilized for spatial requirements and verification of the building systems during the 3D coordination process.
    - b. Contractor shall execute a data licensing agreement in the form of Agreement included in this Project Manual.

## 1.6 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
  2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.



- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
  2. Name of Architect.
  3. Architect's Project number.
  4. Date.
  5. Name of Contractor.
  6. RFI number, numbered sequentially.
  7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
    - b. Collate all RFI documents into a single flattened .pdf document that includes cover sheet, related correspondence, photos, attachments, etc.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow ten working days for Architect's response for each RFI. RFIs received by Architect after 3:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within ten business days of receipt of the RFI response.
  4. If Architect's response requires additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit a new RFI in the form specified below:
    - a. Numbering of new RFI shall be the initial RFI number with a subsequent .1.
    - b. Include and identify updated information that identifies why the initial response was not valid.

- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
  - 1. Project name.
  - 2. Project number.
  - 3. Name and address of Contractor.
  - 4. Name and address of Architect.
  - 5. RFI number, including RFIs that were returned without action or withdrawn.
  - 6. RFI description.
  - 7. Date the RFI was submitted.
  - 8. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

### 1.7 PROJECT WEBSITE

- A. Provide, administer, and use a preferred web-based project management software package for purposes of hosting and managing project communication and documentation until Final Completion. Web-based project management software package shall include the following functions:
  - 1. Project directory.
  - 2. Project correspondence.
  - 3. Meeting minutes.
  - 4. Contract modifications forms and logs.
  - 5. RFI forms and logs.
  - 6. Task and issue management.
  - 7. Photo documentation.
  - 8. Schedule and calendar management.
  - 9. Submittals forms and logs.
  - 10. Payment application forms.
  - 11. Drawing and specification document hosting, viewing, and updating.
  - 12. Online document collaboration.
  - 13. Reminder and tracking functions.
  - 14. Archiving functions.
- B. Construction Manager will utilize a preferred web-based project management software package manage construction administration information but utilize Newforma Project Center to deliver construction administration information to the Design Team.
- C. Contractor, subcontractors, and other parties granted access by Contractor to Newforma Project Center.

### 1.8 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
  - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of fourteen days prior to meeting.
  - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three (3) days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than fifteen days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.
  2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Responsibilities and personnel assignments.
    - b. Tentative construction schedule.
    - c. Phasing.
    - d. Critical work sequencing and long lead items.
    - e. Designation of key personnel and their duties.
    - f. Lines of communications.
    - g. Use of web-based Project software.
    - h. Procedures for processing field decisions and Change Orders.
    - i. Procedures for RFIs.
    - j. Procedures for testing and inspecting.
    - k. Procedures for processing Applications for Payment.
    - l. Distribution of the Contract Documents.
    - m. Submittal procedures.
    - n. Sustainable design requirements.
    - o. Preparation of Record Documents.
    - p. Use of the premises and existing building.
    - q. Work restrictions.
    - r. Working hours.
    - s. Owner's occupancy requirements.
    - t. Responsibility for temporary facilities and controls.
    - u. Procedures for moisture and mold control.
    - v. Procedures for disruptions and shutdowns.
    - w. Construction waste management and recycling.
    - x. Parking availability.
    - y. Office, work, and storage areas.
    - z. Equipment deliveries and priorities.
    - aa. First aid.
    - bb. Security.
    - cc. Progress cleaning.
  4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates. Notification of meeting dates shall be minimum of fourteen days prior to meeting date.
  2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Review of mockups.

- i. Possible conflicts.
  - j. Compatibility requirements.
  - k. Time schedules.
  - l. Weather limitations.
  - m. Manufacturer's written instructions.
  - n. Warranty requirements.
  - o. Compatibility of materials.
  - p. Acceptability of substrates.
  - q. Temporary facilities and controls.
  - r. Space and access limitations.
  - s. Regulations of authorities having jurisdiction.
  - t. Testing and inspecting requirements.
  - u. Installation procedures.
  - v. Coordination with other work.
  - w. Required performance results.
  - x. Protection of adjacent work.
  - y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
  5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than ninety (90) days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of Record Documents.
    - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    - c. Procedures for completing and archiving web-based Project software site data files.
    - d. Submittal of written warranties.
    - e. Requirements for preparing operations and maintenance data.
    - f. Requirements for delivery of material samples, attic stock, and spare parts.
    - g. Requirements for demonstration and training.
    - h. Preparation of Contractor's punch list.
    - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    - j. Submittal procedures.
    - k. Coordination of separate contracts.
    - l. Owner's partial occupancy requirements.
    - m. Installation of Owner's furniture, fixtures, and equipment.
    - n. Responsibility for removing temporary facilities and controls.
  4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

- E. Progress Meetings: Conduct progress meetings at regular intervals.
1. Coordinate dates of meetings with preparation of payment requests.
  2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Resolution of BIM component conflicts.
      - 4) Status of submittals.
      - 5) Two week look ahead of upcoming priority submittals.
      - 6) Deliveries.
      - 7) Off-site fabrication.
      - 8) Access.
      - 9) Site use.
      - 10) Temporary facilities and controls.
      - 11) Progress cleaning.
      - 12) Quality and work standards.
      - 13) Status of correction of deficient items.
      - 14) Field observations.
      - 15) Status of RFIs.
      - 16) Status of Proposal Requests.
      - 17) Pending changes.
      - 18) Status of Change Orders.
      - 19) Pending claims and disputes.
      - 20) Documentation of information for payment requests.
  4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
    - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
  - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
  - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
  - c. Review present and future needs of each contractor present, including the following:
    - 1) Interface requirements.
    - 2) Sequence of operations.
    - 3) Resolution of BIM component conflicts.
    - 4) Status of submittals.
    - 5) Deliveries.
    - 6) Off-site fabrication.
    - 7) Access.
    - 8) Site use.
    - 9) Temporary facilities and controls.
    - 10) Work hours.
    - 11) Hazards and risks.
    - 12) Progress cleaning.
    - 13) Quality and work standards.
    - 14) Status of RFIs.
    - 15) Proposal Requests.
    - 16) Change Orders.
    - 17) Pending changes.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

## **PART 2 - PRODUCTS**

- A. All parties including Owner, Architect, Commissioning Agent shall utilize Newforma Project Center Current Edition (project management software) for the duration of the project. Contractor to provide training at no cost to participants.

## **PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Startup construction schedule.
  - 2. Contractor's Construction Schedule.
  - 3. Construction schedule updating reports.
  - 4. Daily construction reports.
  - 5. Material location reports.
  - 6. Site condition reports.
  - 7. Unusual event reports.
  - 8. Construction photographs.
- B. Related Requirements:
  - 1. Section 01 33 00 "Submittal Procedures" for submitting schedules and reports.
  - 2. Section 01 40 00 "Quality Requirements" for schedule of tests and inspections.

**1.2 DEFINITIONS**

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
  - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
  - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of labor and equipment necessary for completing an activity as scheduled.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Format for Submittals: Submit required submittals in the following format:
  - 1. Working electronic copy of schedule file.
  - 2. PDF electronic file.
- B. Startup construction schedule.
  - 1. Approval of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
  - 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports to contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
  - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
  - 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
  - 3. Total Float Report: List of activities sorted in ascending order of total float.
  - 4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.
- G. Daily Construction Reports: Submit at weekly intervals.
- H. Material Location Reports: Submit at monthly intervals.
- I. Site Condition Reports: Submit at time of discovery of differing conditions.
- J. Unusual Event Reports: Submit at time of unusual event.

**1.4 QUALITY ASSURANCE**

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
  - 1. Review software limitations and content and format for reports.
  - 2. Verify availability of qualified personnel needed to develop and update schedule.
  - 3. Discuss constraints, including phasing, work stages, area separations, interim milestones, and partial Owner occupancy.
  - 4. Review delivery dates for Owner-furnished products.
  - 5. Review schedule for work of Owner's separate contracts.
  - 6. Review submittal requirements and procedures.
  - 7. Review time required for review of submittals and resubmittals.
  - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
  - 9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
  - 10. Review and finalize list of construction activities to be included in schedule.



11. Review procedures for updating schedule.

## 1.5 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
  1. Secure time commitments for performing critical elements of the Work from entities involved.
  2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

## 1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting, using CPM scheduling.
  1. In-House Option: Owner may waive requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
  2. Meetings: Scheduling consultant to attend all meetings related to Project progress, alleged delays, and time impact.
- C. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.
  1. Contract completion date to not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- D. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
  1. Activity Duration: Define activities so no activity is longer than twenty business days, unless specifically allowed by Architect.
  2. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than sixty business days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
    - a. Structural steel components.
  3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
  4. Startup and Testing Time: Include no fewer than fifteen business days for startup and testing.
  5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
  6. Punch List and Final Completion: Include not more than thirty business days for completion of punch list items and Final Completion.
- E. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
  1. Phasing: Arrange list of activities on schedule by phase.
  2. Work under More Than One Contract: Include a separate activity for each contract.
  3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.

4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  6. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction.
    - b. Limitations of continued occupancies.
    - c. Uninterruptible services.
    - d. Partial occupancy before Substantial Completion.
    - e. Use-of-premises restrictions.
    - f. Provisions for future construction.
    - g. Seasonal variations.
    - h. Environmental control.
  7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
    - a. Subcontract awards.
    - b. Submittals.
    - c. Purchases.
    - d. Mockups.
    - e. Fabrication.
    - f. Sample testing.
    - g. Deliveries.
    - h. Installation.
    - i. Tests and inspections.
    - j. Adjusting.
    - k. Curing.
    - l. Building flush-out.
    - m. Startup and placement into final use and operation.
  8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
    - a. Structural completion.
    - b. Temporary enclosure and space conditioning.
    - c. Permanent space enclosure.
    - d. Completion of mechanical installation.
    - e. Completion of electrical installation.
    - f. Substantial Completion.
- F. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion and the following interim milestones:
1. Topping out.
  2. Temporary enclosure and space conditioning.
  3. HVAC start up.
  4. Permanent power start up.
  5. Testing and Balancing.
- G. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
1. See Section 01 29 00 "Payment Procedures" for cost reporting and payment procedures.

- H. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
  - 1. Unresolved issues.
  - 2. Unanswered Requests for Information.
  - 3. Rejected or unreturned submittals.
  - 4. Notations on returned submittals.
  - 5. Pending modifications affecting the Work and the Contract Time.
- I. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule before each regularly scheduled progress meeting.
  - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  - 3. As the Work progresses, indicate Final Completion percentage for each activity.
- J. Recovery Schedule: When periodic update indicates the Work is fourteen or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- K. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
  - 1. Post copies in Project meeting rooms and temporary field offices.
  - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

### 1.7 STARTUP CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within seven calendar days of date established for commencement of the Work.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first ninety business days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

### 1.8 CPM SCHEDULE REQUIREMENTS

- A. Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within fourteen business days of date established for commencement of the Work. Outline significant construction activities for the first ninety calendar days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

- C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than sixty business days after date established for commencement of the Work.
    - a. Failure to include any work item required for performance of this Contract must not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
  2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
  3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
  4. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
    - a. Preparation and processing of submittals.
    - b. Mobilization and demobilization.
    - c. Purchase of materials.
    - d. Delivery.
    - e. Fabrication.
    - f. Utility interruptions.
    - g. Installation.
    - h. Work by Owner that may affect or be affected by Contractor's activities.
    - i. Testing and inspection.
    - j. Punch list and Final Completion.
    - k. Activities occurring following Final Completion.
  2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates to be consistent with Contract milestone dates.
  3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
  4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
    - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
  5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents and demonstration and training (if applicable), in the amount of five percent of the Contract Sum.
    - a. Each activity cost to reflect an appropriate value subject to approval by Architect.
    - b. Total cost assigned to activities to equal the total Contract Sum.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
  2. Description of activity.
  3. Main events of activity.
  4. Immediate preceding and succeeding activities.
  5. Early and late start dates.
  6. Early and late finish dates.
  7. Activity duration in workdays.
  8. Total float or slack time.
  9. Average size of workforce.
  10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
  2. Changes in early and late start dates.
  3. Changes in early and late finish dates.
  4. Changes in activity durations in workdays.
  5. Changes in the critical path.
  6. Changes in total float or slack time.
  7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
  2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
  3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
  4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
    - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
    - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

## 1.9 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
  2. List of separate contractors at Project site.
  3. Approximate count of personnel at Project site.
  4. Equipment at Project site.
  5. Material deliveries.
  6. High and low temperatures and general weather conditions, including presence of rain or snow.
  7. Accidents.
  8. Meetings and significant decisions.
  9. Unusual events.
  10. Stoppages, delays, shortages, and losses.
  11. Meter readings and similar recordings.
  12. Emergency procedures.
  13. Orders and requests of authorities having jurisdiction.
  14. Change Orders received and implemented.

15. Construction Change Directives received and implemented.
  16. Services connected and disconnected.
  17. Equipment or system tests and startups.
  18. Partial completions and occupancies.
  19. Substantial Completions authorized.
- B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List to be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
  2. Material stored prior to previous report and since removed from storage and installed.
  3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
1. Submit unusual event or special reports directly to Owner within one business day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

#### **1.10 CONSTRUCTION PHOTOGRAPHS**

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
1. Date and Time: Include date and time in file name for each image.
  2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.
- D. Preconstruction Photographs: Before commencement of demolition, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
1. Flag construction limits before taking construction photographs.
  2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
  3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
  4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- E. Periodic Construction Photographs: Take 20 photographs, number and vantage point as directed by Architect, with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

- F. Final Completion Construction Photographs: Take 50 color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.
1. Do not include date stamp.
- G. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
1. Three days' notice will be given, where feasible.
  2. In emergency situations, take additional photographs within 24 hours of request.
  3. Circumstances that could require additional photographs include, but are not limited to, the following:
    - a. Special events planned at Project site.
    - b. Immediate follow-up when on-site events result in construction damage or losses.
    - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
    - d. Substantial Completion of a major phase or component of the Work.
    - e. Extra record photographs at time of final acceptance.
    - f. Owner's request for special publicity photographs.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 01 33 00 - SUBMITTAL PROCEDURES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
  - 1. Section 01 25 00 "Substitution Procedures" for submitting Substitution Request.
  - 2. Section 01 29 00 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
  - 3. Section 01 31 00 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
  - 4. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
  - 5. Section 01 40 00 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
  - 6. Section 01 77 00 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
  - 7. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
  - 8. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
  - 9. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

**1.2 DEFINITIONS**

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format with optical character recognition ("OCR").

**1.3 SUBMITTAL SCHEDULE**

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
  - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
  - a. Submit bi-monthly revised submittal schedule to reflect changes in current status and timing for submittals. Schedule should include forecasted submittals, approved submittals, revise / resubmit submittals, and rejected submittals.
4. Format: Arrange the following information in a tabular format:
  - a. Scheduled date for first submittal.
  - b. Specification Section number and title.
  - c. Submittal Category: Action; informational.
  - d. Name of subcontractor.
  - e. Description of the Work covered.
  - f. Scheduled date for Architect's final release or approval.
  - g. Scheduled dates for purchasing.
  - h. Scheduled date of fabrication.
  - i. Scheduled dates for installation.
  - j. Activity or event number.

#### 1.4 SUBMITTAL FORMATS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals only.
  1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.
    - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
    - b. Digital Drawing Software Program: The Contract Drawings are available in Revit 2023, Autocad 2017, Civil3D 2017, and Microsoft Excel. The Construction Manager is responsible for exporting all drawing formats from the Revit model.
    - c. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.
    - d. The following digital data files will be furnished for each appropriate discipline:
      - 1) Floor plans.
      - 2) Reflected ceiling plans.
- B. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
- C. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information. Form shall be appended to PDF submittal:
  1. Project name.
  2. Date.
  3. Name and address of Architect.
  4. Name of Contractor.
  5. Name of firm or entity that prepared submittal.
  6. Names of subcontractor, manufacturer, and supplier.
  7. Category and type of submittal.
  8. Submittal purpose and description.
  9. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
  10. Drawing number and detail references, as appropriate.
  11. Location(s) where product is to be installed, as appropriate.
  12. Related physical samples submitted directly.
  13. Indication of full or partial submittal.

14. Transmittal number, numbered consecutively.
  15. Submittal and transmittal distribution record.
  16. Other necessary identification.
  17. Remarks.
- D. Options: Identify options requiring selection by Architect.
- E. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record of relevant information, request for data on each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- F. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble submittals into an individual file per type required in each Specification Section.
  2. Name file with submittal number, including revision identifier. All submitted submittals with the incorrect numbering format will be rejected without review.
    - a. File name shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06 10 00-SD-001). Resubmittals shall include a numerical suffix after the original submittal number (e.g., 06 10 00-SD-001-01).
    - b. Submittals shall have a suffix code identifying the type of submittal.
      - 1) PD – Product Data
      - 2) SD – Shop Drawing
      - 3) SA – Sample
      - 4) WA – Warranty
      - 5) CA – Calculations
      - 6) TR – Test Report
      - 7) CE – Certification
      - 8) QA - Qualifications
      - 9) OM – Operation and Maintenance
      - 10) SR – Substitution Request
      - 11) PS – Product Schedules
      - 12) CD – Coordination Drawings
      - 13) CO – Close Out

## 1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Post electronic submittals as compressed and flattened PDF electronic files directly to Newforma Project Center Current Edition specifically established for Project.
    - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
  2. Action Submittals: Submit PDF electronic file.
  3. Informational Submittals: PDF electronic file.
  4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
    - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
    - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow fifteen days for initial review of each submittal. Allow additional time if coordination with subsequent submittals requiring review by the design team if quantity received is equal to or less than two hundred and fifty (250) sheets during five (5) consecutive working days. For each fifty (50) sheets in excess of two hundred and fifty (250) sheets received in five (5) consecutive working days, three additional days will be allowed for review. Architect will notify Contractor if review time will exceed the normally allowed 15 business days. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination. Submittals received by Architect after 3:00 p.m. (EST) will be considered as received the following working day.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow fifteen days for review of each resubmittal.
  4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow twenty-one days for initial review of each submittal. Architect will notify Contractor if review time will exceed the normally allowed fifteen business days.
  5. High-Volume Submittals: twenty-one business days will be required for the review of submittals totaling in excess of 150 sheets or pages received in seven consecutive days. Furthermore, additional time will be required for each subsequent submittal received within that timeframe. The Architect will advise the Contractor of additional time required.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal. All submitted resubmittals with the incorrect numbering format will be rejected without review.
1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

## 1.6 SUBMITTAL REQUIREMENTS

- A. Product Data (PD): Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams that show factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
  6. Submit Product Data in the following format:
    - a. PDF electronic file.
- B. Shop Drawings (SD): Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 36 by 48 inches.
  3. Submit Shop Drawings in the following format:
    - a. PDF electronic file.
  4. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.
    - a. Prepare Shop Drawings in the following format: Same digital data software program, version, and operating system as the original Drawings.
    - b. Refer to Section 01 31 00 "Project Management and Coordination" for requirements for coordination drawings.
- C. Samples (SA): Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
  2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of applicable Specification Section.
    - e. Specification paragraph number and generic name of each item.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
  4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
    - b. Maintain a common location in the Field Office for a neat and organized display of all approved samples.
  5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
  6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample. The three submitted samples do not count towards the contractor's samples on site.
      - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule (PS): As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within room or space.
  5. Submit product schedule in the following format:
    - a. PDF electronic file.
- E. Coordination Drawing Submittals (CD): Comply with requirements specified in Section 01 31 00 "Project Management and Coordination."
- F. Contractor's Construction Schedule (CC): Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation."
- G. Application for Payment and Schedule of Values (AP): Comply with requirements specified in Section 01 29 00 "Payment Procedures."
- H. Test and Inspection Reports and Schedule of Tests and Inspections Submittals (TR): Comply with requirements specified in Section 01 40 00 "Quality Requirements."
- I. Closeout Submittals and Maintenance Material Submittals (CO): Comply with requirements specified in Section 01 77 00 "Closeout Procedures."

- J. Maintenance Data (OM): Comply with requirements specified in Section 01 78 23 "Operation and Maintenance Data."
- K. Qualification Data (QA): Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- L. Design Data (DD): Prepare and submit written and graphic information, including, but not limited to performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- M. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
  2. Installer Certificates (CE): Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
  3. Manufacturer Certificates (CE): Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
  4. Material Certificates (CE): Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
  5. Product Certificates (CE): Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
  6. Welding Certificates (CE): Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- N. Test Reports (TR) and Research Reports (RR):
1. Compatibility Test Reports (TR): Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation needed for adhesion.
  2. Field Test Reports (TR): Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
  3. Material Test Reports (TR): Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
  4. Preconstruction Test Reports (TR): Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
  5. Product Test Reports (TR): Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
  6. Research Reports (RR): Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
    - a. Name of evaluation organization.
    - b. Date of evaluation.
    - c. Time period when report is in effect.

- d. Product and manufacturers' names.
- e. Description of product.
- f. Test procedures and results.
- g. Limitations of use.

### 1.7 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. BIM Incorporation: Incorporate delegated design drawing and data files into BIM established for Project.
  1. Prepare delegated design drawings in the following format: Same digital data software program, version, and operating system as original Drawings .

### 1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 77 00 "Closeout Procedures."
- C. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
  1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

### 1.9 ARCHITECT'S REVIEW

1. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required.
2. PDF Electronic Submittals: Architect will indicate, via markup on each submittal, the appropriate action as follows:
  - a. Approved: The Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents.
  - b. Approved as Noted: The Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal, and the requirements of the Contract Documents.
  - c. Approved as Noted / Resubmit: The Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal, and the requirements of the Contract Documents. Make corrections submittal according to the notations and resubmit for record.



- d. Revise / Resubmit: Do not proceed with Work covered by the submittal. Revise or prepare a new submittal according to the notations. Repeat if necessary to obtain different action mark.
  - e. Rejected: Do not proceed with Work covered by the submittal. The Work covered by the submittal does not conform to the Contract Documents. Prepare a new submittal. Repeat if necessary to obtain different action mark.
  - f. No Action Taken or Required: For Informational Submittals that are packaged with Action Submittals, and do not require action.
  - g. Not Required for Review: Portion of submittal was not required of the Contract Documents, and therefore was not reviewed by Architect.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents will be returned by Architect without action.

**PART 2 - PRODUCTS (NOT USED)****PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 01 35 16 - ALTERATION PROJECT PROCEDURES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes special procedures for alteration work.

**1.2 DEFINITIONS**

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.
- K. Retain: To keep an element or detail secure and intact.
- L. Strip: To remove existing finish down to base material unless otherwise indicated.

**1.3 COORDINATION**

- A. Alteration Work Sub-schedule: A construction schedule coordinating the sequencing and scheduling of alteration work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration work.
  - 1. Schedule construction operations in sequence required to obtain best Work results.
  - 2. Coordinate sequence of alteration work activities to accommodate the following:
    - a. Owner's continuing occupancy of portions of existing building.
    - b. Owner's partial occupancy of completed Work.
    - c. Other known work in progress.
    - d. Tests and inspections.
  - 3. Detail sequence of alteration work, with start and end dates.
  - 4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.

5. Equipment Data: List gross loaded weight, axle-load distribution, and wheel-base dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.
- B. Pedestrian and Vehicular Circulation: Coordinate alteration work with circulation patterns within Project building(s) and site. Some work is near circulation patterns and adjacent to restricted areas. Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of work. Access to restricted areas may not be obstructed. Plan and execute the Work accordingly.

#### 1.4 PROJECT MEETINGS FOR ALTERATION WORK

- A. Preliminary Conference for Alteration Work: Before starting alteration work Construction Manager will conduct conference at Project site.
  1. Attendees: In addition to representatives of Owner, Construction Manager, Architect, and Contractor, Owner's insurer, testing service representative, specialists, and chemical-cleaner manufacturer(s) shall be represented at the meeting.
  2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:
    - a. Alteration Work Subschedule: Discuss and finalize; verify availability of materials, specialists' personnel, equipment, and facilities needed to make progress and avoid delays.
    - b. Fire-prevention plan.
    - c. Governing regulations.
    - d. Areas where existing construction is to remain and the required protection.
    - e. Hauling routes.
    - f. Sequence of alteration work operations.
    - g. Storage, protection, and accounting for salvaged and specially fabricated items.
    - h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
    - i. Qualifications of personnel assigned to alteration work and assigned duties.
    - j. Requirements for extent and quality of work, tolerances, and required clearances.
    - k. Embedded work such as flashings and lintels, special details, collection of waste, protection of occupants and the public, and condition of other construction that affects the Work or will affect the work.
  3. Reporting: Construction Manager will record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.
- B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at weekly intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
  1. Attendees: In addition to representatives of Owner, Construction Manager, Architect, and Contractor, each specialist, supplier, installer, and other entity concerned with progress or involved in planning, coordination, or performance of alteration work activities shall be represented at these meetings. All participants at conference shall be familiar with Project and authorized to conclude matters relating to alteration work.
  2. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.
    - a. Alteration Work Subschedule: Review progress since last coordination meeting. Determine whether each schedule item is on time, ahead of schedule, or behind schedule. Determine how construction behind schedule will be expedited with retention of quality; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities are completed within the Contract Time.

- b. Schedule Updating: Revise Contractor's Alteration Work Subschedule after each coordination meeting where revisions to schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
- c. Review present and future needs of each entity present, including review items listed in the "Preliminary Conference for Alteration Work" Paragraph in this article and the following:
  - 1) Interface requirements of alteration work with other Project Work.
  - 2) Status of submittals for alteration work.
  - 3) Access to alteration work locations.
  - 4) Effectiveness of fire-prevention plan.
  - 5) Quality and work standards of alteration work.
  - 6) Change Orders for alteration work.
- 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Alteration Work Subschedule:
  - 1. Submit alteration work subschedule within thirty days of date established for commencement of alteration work.
- B. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration work operations.
- C. Alteration Work Program: Submit thirty days before work begins.
- D. Fire-Prevention Plan: Submit thirty days before work begins.

### 1.6 QUALITY ASSURANCE

- A. Specialist Qualifications: An experienced firm regularly engaged in specialty work similar in nature, materials, design, and extent to alteration work as specified in each Section and that has completed a minimum of five recent projects with a record of successful in-service performance that demonstrates the firm's qualifications to perform this work.
  - 1. Field Supervisor Qualifications: Full-time supervisors experienced in specialty work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on-site when specialty work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.
    - a. Construct new mockups of required work whenever a supervisor is replaced.
- B. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.
  - 1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
  - 2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
- C. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
- D. Safety and Health Standard: Comply with ANSI/ASSP A10.6.

**1.7 STORAGE AND HANDLING OF SALVAGED MATERIALS**

- A. Salvaged Materials:
  - 1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
  - 2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
  - 3. Store items in a secure area until delivery to Owner.
  - 4. Transport items to Owner's storage area designated by Owner.
  - 5. Protect items from damage during transport and storage.
- B. Salvaged Materials for Reinstallation:
  - 1. Repair and clean items for reuse as indicated.
  - 2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
  - 3. Protect items from damage during transport and storage.
  - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.
- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.
- D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
  - 1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
  - 2. Secure stored materials to protect from theft.
  - 3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F or more above the dew point.
- E. Storage Space:
  - 1. Owner will arrange for limited on-site location(s) for free storage of salvaged material. This storage space includes security and climate control for stored material.

**1.8 FIELD CONDITIONS**

- A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of preconstruction photographs.
- B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.
- C. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

**PART 2 - PRODUCTS - (NOT USED)****PART 3 - EXECUTION****3.1 PROTECTION**

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.
  - 1. Use only proven protection methods, appropriate to each area and surface being protected.
  - 2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
  - 3. Erect temporary barriers to form and maintain fire-egress routes.
  - 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
  - 5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
  - 6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
  - 7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
  - 8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.
- B. Temporary Protection of Materials to Remain:
  - 1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
  - 2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
  - 1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
  - 2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
  - 3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.
- E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.
  - 1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
  - 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- F. Existing Roofing: Prior to the start of work in an area, install roofing protection.

### 3.2 PROTECTION FROM FIRE

- A. General: Follow fire-prevention plan and the following:
1. Comply with NFPA 241 requirements unless otherwise indicated. Perform duties titled "Owner's Responsibility for Fire Protection."
  2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
    - a. If combustible material cannot be removed, provide fire blankets to cover such materials.
- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
1. Obtain Owner's approval for operations involving use of open-flame or welding or other high-heat equipment. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
  2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
  3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
  4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
  5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
  6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
    - a. Train each fire watch in the proper operation of fire-control equipment and alarms.
    - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
    - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
    - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work in each area to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
    - e. Maintain fire-watch personnel at each area of Project site until two hours after conclusion of daily work.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.
- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.



**3.3 PROTECTION DURING APPLICATION OF CHEMICALS**

- A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.
- B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.
- C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
- D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.
- E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

**3.4 GENERAL ALTERATION WORK**

- A. Have specialty work performed only by qualified specialists.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs.
- D. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- E. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
  - 1. Do not proceed with the work in question until directed by Architect.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 01 40 00 - QUALITY REQUIREMENTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
  - 4. Specific test and inspection requirements are not specified in this Section.

**1.2 DEFINITIONS**

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Full-size physical assemblies of portions of the Work constructed on-site to establish the standard by which the Work will be judged. Mockups are not Samples.
  - 1. Mockups are used for one or more of the following:
    - a. Verify selections made under Sample submittals.
    - b. Demonstrate aesthetic effects.
    - c. Demonstrate the qualities of products and workmanship execution.
    - d. Demonstrate successful installation of interfaces between components and systems.
    - e. Review coordination, testing, or operation; to show interface between dissimilar materials.
    - f. Demonstrate compliance with specified installation tolerances.
    - g. Perform preconstruction testing to determine system performance.
  - 2. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.
  - 3. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.

4. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
  5. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
  - F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
  - G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
  - H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
  - I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
  - J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

### **1.3 DELEGATED DESIGN SERVICES**

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

### **1.4 CONFLICTING REQUIREMENTS**

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

### 1.5 ACTION SUBMITTALS

- A. Exterior Mockup Shop Drawings:
  - 1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
  - 2. Indicate manufacturer and model number of individual components.
  - 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

### 1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
  - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
  - 2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  - 1. Specification Section number and title.
  - 2. Entity responsible for performing tests and inspections.
  - 3. Description of test and inspection.
  - 4. Identification of applicable standards.
  - 5. Identification of test and inspection methods.
  - 6. Number of tests and inspections required.
  - 7. Time schedule or time span for tests and inspections.
  - 8. Requirements for obtaining samples.
  - 9. Unique characteristics of each quality-control service.
  - 10. Integrate Test and Inspections into Project Construction Schedule.
- F. Reports: Prepare and submit certified written reports and documents as specified.
- G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

**1.7 CONTRACTOR'S QUALITY-CONTROL PLAN**

- A. Quality-Control Plan, General: Submit quality-control plan within ten days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
  - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
  - 1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
  - 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
  - 3. Owner-performed tests and inspections indicated in the Contract Documents.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

**1.8 REPORTS AND DOCUMENTS**

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, telephone number, and email address of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.
  - 6. Description of the Work and test and inspection method.
  - 7. Identification of product and Specification Section.
  - 8. Complete test or inspection data.
  - 9. Test and inspection results and an interpretation of test results.
  - 10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
  - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  - 12. Name and signature of laboratory inspector.
  - 13. Recommendations on retesting and reinspecting.

- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
  - 1. Name, address, telephone number, and email address of technical representative making report.
  - 2. Statement on condition of substrates and their acceptability for installation of product.
  - 3. Statement that products at Project site comply with requirements.
  - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  - 6. Statement of whether conditions, products, and installation will affect warranty.
  - 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
  - 1. Name, address, telephone number, and email address of factory-authorized service representative making report.
  - 2. Statement that equipment complies with requirements.
  - 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  - 4. Statement of whether conditions, products, and installation will affect warranty.
  - 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

## 1.9 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
  - 1. Requirements of authorities having jurisdiction supersede requirements for specialists.

- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E 329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
  2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor's Responsibilities:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
    - d. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
    - e. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
  2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups of size indicated.
  2. Build mockups in location indicated or, if not indicated, as directed by Architect.
  3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
  5. Demonstrate the proposed range of aesthetic effects and workmanship.
  6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
    - a. Allow seven business days for initial review and each re-review of each mockup.
  7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
  8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  10. Demolish and remove mockups when directed unless otherwise indicated.



- L. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

#### 1.10 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
  - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
  - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
  - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  - 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform quality-control services.
    - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  - 3. Notify testing agencies at least twenty-four hours in advance of time when Work that requires testing or inspection will be performed.
  - 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  - 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  - 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
  - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  - 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  - 3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
  - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  - 6. Do not perform duties of Contractor.

- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
  - 1. Access to the Work.
  - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
  - 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  - 4. Facilities for storage and field curing of test samples.
  - 5. Delivery of samples to testing agencies.
  - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  - 7. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
  - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
  - 1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
  - 2. Distribution: Distribute schedule to Owner, Architect testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

#### **1.11 SPECIAL TESTS AND INSPECTIONS**

- A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner as follows:
  - 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
  - 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  - 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
  - 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  - 5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
  - 6. Retesting and reinspecting corrected Work.

**PART 2 - PRODUCTS (NOT USED)****PART 3 - EXECUTION****3.1 TEST AND INSPECTION LOG**

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
  - 1. Date test or inspection was conducted.
  - 2. Description of the Work tested or inspected.
  - 3. Date test or inspection results were transmitted to Architect.
  - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and Owner's Representative reference during normal working hours.
  - 1. Submit log at Project closeout as part of Project Record Documents.

**3.2 REPAIR AND PROTECTION**

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
  - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 01 42 00 - REFERENCES****PART 1 - GENERAL****1.1 DEFINITIONS**

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms, including "requested," "authorized," "selected," "required," and "permitted," have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms, including "shown," "noted," "scheduled," and "specified," have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

**1.2 INDUSTRY STANDARDS**

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
  - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

**1.3 ABBREVIATIONS AND ACRONYMS**

- A. Industry Organizations, List: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; [www.aabc.com](http://www.aabc.com).
2. AAMA - American Architectural Manufacturers Association; (see FGIA).
3. AAPFCO - Association of American Plant Food Control Officials; [www.aapfco.org](http://www.aapfco.org).
4. AASHTO - American Association of State Highway and Transportation Officials; [www.transportation.org](http://www.transportation.org).
5. AATCC - American Association of Textile Chemists and Colorists; [www.aatcc.org](http://www.aatcc.org).
6. ABMA - American Bearing Manufacturers Association; [www.americanbearings.org](http://www.americanbearings.org).
7. ABMA - American Boiler Manufacturers Association; [www.abma.com](http://www.abma.com).
8. ACI - American Concrete Institute; [www.concrete.org](http://www.concrete.org).
9. ACP - American Clean Power; (Formerly: American Wind Energy Association); [www.cleanpower.org](http://www.cleanpower.org).
10. ACPA - American Concrete Pipe Association; [www.concretepipe.org](http://www.concretepipe.org).
11. AEIC - Association of Edison Illuminating Companies, Inc. (The); [www.aeic.org](http://www.aeic.org).
12. AF&PA - American Forest & Paper Association; [www.afandpa.org](http://www.afandpa.org).
13. AGA - American Gas Association; [www.aga.org](http://www.aga.org).
14. AHAM - Association of Home Appliance Manufacturers; [www.aham.org](http://www.aham.org).
15. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); [www.ahrinet.org](http://www.ahrinet.org).
16. AI - Asphalt Institute; [www.asphaltinstitute.org](http://www.asphaltinstitute.org).
17. AIA - American Institute of Architects (The); [www.aia.org](http://www.aia.org).
18. AISC - American Institute of Steel Construction; [www.aisc.org](http://www.aisc.org).
19. AISI - American Iron and Steel Institute; [www.steel.org](http://www.steel.org).
20. AITC - American Institute of Timber Construction; (see PLIB).
21. AMCA - Air Movement and Control Association International, Inc.; [www.amca.org](http://www.amca.org).
22. AMPP - Association for Materials Protection and Performance; [www.ampp.org](http://www.ampp.org).
23. ANSI - American National Standards Institute; [www.ansi.org](http://www.ansi.org).
24. AOSA/SCST - Association of Official Seed Analysts (The)/Society of Commercial Seed Technologists (The); [www.analyzeseeds.com](http://www.analyzeseeds.com).
25. APA - APA - The Engineered Wood Association; [www.apawood.org](http://www.apawood.org).
26. APA - Architectural Precast Association; [www.archprecast.org](http://www.archprecast.org).
27. API - American Petroleum Institute; [www.api.org](http://www.api.org).
28. ARMA - Asphalt Roofing Manufacturers Association; [www.asphaltroofing.org](http://www.asphaltroofing.org).
29. ASA - Acoustical Society of America; [www.acousticalsociety.org](http://www.acousticalsociety.org).
30. ASCE - American Society of Civil Engineers; [www.asce.org](http://www.asce.org).
31. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (see ASCE).
32. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; [www.ashrae.org](http://www.ashrae.org).
33. ASME - ASME International; American Society of Mechanical Engineers (The); [www.asme.org](http://www.asme.org).
34. ASSE - ASSE International; (American Society of Sanitary Engineering); [www.asse-plumbing.org](http://www.asse-plumbing.org).
35. ASSP - American Society of Safety Professionals; [www.assp.org](http://www.assp.org).
36. ASTM - ASTM International; [www.astm.org](http://www.astm.org).
37. ATIS - Alliance for Telecommunications Industry Solutions; [www.atis.org](http://www.atis.org).
38. AVIXA - Audiovisual and Integrated Experience Association; [www.avixa.org](http://www.avixa.org).
39. AWI - Architectural Woodwork Institute; [www.awinet.org](http://www.awinet.org).
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; [www.awmac.com](http://www.awmac.com).
41. AWPA - American Wood Protection Association; [www.awpa.com](http://www.awpa.com).
42. AWS - American Welding Society; [www.aws.org](http://www.aws.org).
43. AWWA - American Water Works Association; [www.awwa.org](http://www.awwa.org).
44. BHMA - Builders Hardware Manufacturers Association; [www.buildershardware.com](http://www.buildershardware.com).
45. BIA - Brick Industry Association (The); [www.gobrick.com](http://www.gobrick.com).
46. BICSI - BICSI, Inc.; [www.bicsi.org](http://www.bicsi.org).
47. BIFMA - Business and Institutional Furniture Manufacturer's Association; [www.bifma.org](http://www.bifma.org).
48. BISSC - Baking Industry Sanitation Standards Committee; [www.bissc.org](http://www.bissc.org).

49. BWF - Badminton World Federation; [www.bwfbadminton.com](http://www.bwfbadminton.com).
50. CARB - California Air Resources Board; [www.arb.ca.gov](http://www.arb.ca.gov).
51. CDA - Copper Development Association Inc.; [www.copper.org](http://www.copper.org).
52. CE - Conformite Europeenne (European Commission); [www.ec.europa.eu/growth/single-market/ce-marking](http://www.ec.europa.eu/growth/single-market/ce-marking).
53. CEA - Canadian Electricity Association; [www.electricity.ca](http://www.electricity.ca).
54. CFFA - Chemical Fabrics and Film Association, Inc.; [www.chemicalfabricsandfilm.com](http://www.chemicalfabricsandfilm.com).
55. CFSEI - Cold-Formed Steel Engineers Institute; [www.cfsei.org](http://www.cfsei.org).
56. CGA - Compressed Gas Association; [www.cganet.com](http://www.cganet.com).
57. CIMA - Cellulose Insulation Manufacturers Association; [www.cellulose.org](http://www.cellulose.org).
58. CISCA - Ceilings & Interior Systems Construction Association; [www.cisca.org](http://www.cisca.org).
59. CISPI - Cast Iron Soil Pipe Institute; [www.cispi.org](http://www.cispi.org).
60. CLFMI - Chain Link Fence Manufacturers Institute; [www.chainlinkinfo.org](http://www.chainlinkinfo.org).
61. CPA - Composite Panel Association; [www.compositepanel.org](http://www.compositepanel.org).
62. CRI - Carpet and Rug Institute (The); [www.carpet-rug.org](http://www.carpet-rug.org).
63. CRRC - Cool Roof Rating Council; [www.coolroofs.org](http://www.coolroofs.org).
64. CRSI - Concrete Reinforcing Steel Institute; [www.crsi.org](http://www.crsi.org).
65. CSA - CSA Group; [www.csagroup.org](http://www.csagroup.org).
66. CSI - Cast Stone Institute; [www.caststone.org](http://www.caststone.org).
67. CSI - Construction Specifications Institute (The); [www.csiresources.org](http://www.csiresources.org).
68. CSSB - Cedar Shake & Shingle Bureau; [www.cedarbureau.org](http://www.cedarbureau.org).
69. CTA - Consumer Technology Association; [www.cta.tech](http://www.cta.tech).
70. CTI - Cooling Technology Institute; [www.coolingtechnology.org](http://www.coolingtechnology.org).
71. DASMA - Door and Access Systems Manufacturers Association; [www.dasma.com](http://www.dasma.com).
72. DHA - Decorative Hardwoods Association; [www.decorativehardwoods.org](http://www.decorativehardwoods.org).
73. DHI - Door and Hardware Institute; [www.dhi.org](http://www.dhi.org).
74. ECIA - Electronic Components Industry Association; [www.ecianow.org](http://www.ecianow.org).
75. EIMA - EIFS Industry Members Association; [www.eima.com](http://www.eima.com).
76. EJMA - Expansion Joint Manufacturers Association, Inc.; [www.ejma.org](http://www.ejma.org).
77. EOS/ESD - EOS/ESD Association, Inc.; Electrostatic Discharge Association; [www.esda.org](http://www.esda.org).
78. ESTA - Entertainment Services and Technology Association; [www.esta.org](http://www.esta.org).
79. EVO - Efficiency Valuation Organization; [www.evo-world.org](http://www.evo-world.org).
80. FCI - Fluid Controls Institute; [www.fluidcontrolsinstitute.org](http://www.fluidcontrolsinstitute.org).
81. FGIA - Fenestration and Glazing Industry Alliance; <https://fgiaonline.org>.
82. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); [www.fiba.com](http://www.fiba.com).
83. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); [www.fivb.org](http://www.fivb.org).
84. FM Approvals - FM Approvals LLC; [www.fmapprovals.com](http://www.fmapprovals.com).
85. FM Global - FM Global; [www.fmglobal.com](http://www.fmglobal.com).
86. FRSA - Florida Roofing and Sheet Metal Contractors Association, Inc.; [www.floridarroof.com](http://www.floridarroof.com).
87. FSA - Fluid Sealing Association; [www.fluidsealing.com](http://www.fluidsealing.com).
88. FSC - Forest Stewardship Council U.S.; [www.fscus.org](http://www.fscus.org).
89. GA - Gypsum Association; [www.gypsum.org](http://www.gypsum.org).
90. GS - Green Seal; [www.greenseal.org](http://www.greenseal.org).
91. HI - Hydraulic Institute; [www.pumps.org](http://www.pumps.org).
92. HMMA - Hollow Metal Manufacturers Association; (see NAAMM).
93. IAPSC - International Association of Professional Security Consultants; [www.iapsc.org](http://www.iapsc.org).
94. IAS - International Accreditation Service; [www.iasonline.org](http://www.iasonline.org).
95. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
96. ICEA - Insulated Cable Engineers Association, Inc.; [www.icea.net](http://www.icea.net).
97. ICPA - International Cast Polymer Association (The); [www.theicpa.com](http://www.theicpa.com).
98. ICRI - International Concrete Repair Institute, Inc.; [www.icri.org](http://www.icri.org).
99. IEC - International Electrotechnical Commission; [www.iec.ch](http://www.iec.ch).

100. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); [www.ieee.org](http://www.ieee.org).
101. IES - Illuminating Engineering Society; [www.ies.org](http://www.ies.org).
102. IEST - Institute of Environmental Sciences and Technology; [www.iest.org](http://www.iest.org).
103. IGMA - Insulating Glass Manufacturers Alliance; (see FGIA).
104. IGSHPA - International Ground Source Heat Pump Association; [www.igshpa.org](http://www.igshpa.org).
105. ILI - Indiana Limestone Institute of America, Inc.; [www.iliai.com](http://www.iliai.com).
106. Intertek - Intertek Group; [www.intertek.com](http://www.intertek.com).
107. ISA - International Society of Automation (The); [www.isa.org](http://www.isa.org).
108. ISFA - International Surface Fabricators Association; [www.isfanow.org](http://www.isfanow.org).
109. ISO - International Organization for Standardization; [www.iso.org](http://www.iso.org).
110. ITU - International Telecommunication Union; [www.itu.int](http://www.itu.int).
111. KCMA - Kitchen Cabinet Manufacturers Association; [www.kcma.org](http://www.kcma.org).
112. LPI - Lightning Protection Institute; [www.lightning.org](http://www.lightning.org).
113. MBMA - Metal Building Manufacturers Association; [www.mbma.com](http://www.mbma.com).
114. MCA - Metal Construction Association; [www.metalconstruction.org](http://www.metalconstruction.org).
115. MFMA - Maple Flooring Manufacturers Association, Inc.; [www.maplefloor.org](http://www.maplefloor.org).
116. MFMA - Metal Framing Manufacturers Association, Inc.; [www.metalframingmfg.org](http://www.metalframingmfg.org).
117. MHI - Material Handling Industry; [www.mhi.org](http://www.mhi.org).
118. MMPA - Moulding & Millwork Producers Association; [www.wmmpa.com](http://www.wmmpa.com).
119. MPI - Master Painters Institute; [www.paintinfo.com](http://www.paintinfo.com).
120. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.; [www.msshq.org](http://www.msshq.org).
121. NAAMM - National Association of Architectural Metal Manufacturers; [www.naamm.org](http://www.naamm.org).
122. NACE - NACE International; (National Association of Corrosion Engineers International); (see AMPP).
123. NADCA - National Air Duct Cleaners Association; [www.nadca.com](http://www.nadca.com).
124. NAIMA - North American Insulation Manufacturers Association; [www.insulationinstitute.org](http://www.insulationinstitute.org).
125. NALP - National Association of Landscape Professionals; [www.landscapeprofessionals.org](http://www.landscapeprofessionals.org).
126. NBGQA - National Building Granite Quarries Association, Inc.; [www.nbgqa.com](http://www.nbgqa.com).
127. NBI - New Buildings Institute; [www.newbuildings.org](http://www.newbuildings.org).
128. NCAA - National Collegiate Athletic Association (The); [www.ncaa.org](http://www.ncaa.org).
129. NCMA - National Concrete Masonry Association; [www.ncma.org](http://www.ncma.org).
130. NEBB - National Environmental Balancing Bureau; [www.nebb.org](http://www.nebb.org).
131. NECA - National Electrical Contractors Association; [www.necanet.org](http://www.necanet.org).
132. NeLMA - Northeastern Lumber Manufacturers Association; [www.nelma.org](http://www.nelma.org).
133. NEMA - National Electrical Manufacturers Association; [www.nema.org](http://www.nema.org).
134. NETA - InterNational Electrical Testing Association; [www.netaworld.org](http://www.netaworld.org).
135. NFHS - National Federation of State High School Associations; [www.nfhs.org](http://www.nfhs.org).
136. NFPA - National Fire Protection Association; [www.nfpa.org](http://www.nfpa.org).
137. NFPA - NFPA International; (see NFPA).
138. NFRC - National Fenestration Rating Council; [www.nfrc.org](http://www.nfrc.org).
139. NGA - National Glass Association; [www.glass.org](http://www.glass.org).
140. NHLA - National Hardwood Lumber Association; [www.nhla.com](http://www.nhla.com).
141. NLGA - National Lumber Grades Authority; [www.nlga.org](http://www.nlga.org).
142. NOFMA - National Oak Flooring Manufacturers Association; (see NWFA).
143. NOMMA - National Ornamental & Miscellaneous Metals Association; [www.nomma.org](http://www.nomma.org).
144. NRCA - National Roofing Contractors Association; [www.nrca.net](http://www.nrca.net).
145. NRMCA - National Ready Mixed Concrete Association; [www.nrmca.org](http://www.nrmca.org).
146. NSF - NSF International; [www.nsf.org](http://www.nsf.org).
147. NSI - Natural Stone Institute; [www.naturalstoneinstitute.org](http://www.naturalstoneinstitute.org).
148. NSPE - National Society of Professional Engineers; [www.nspe.org](http://www.nspe.org).
149. NSSGA - National Stone, Sand & Gravel Association; [www.nssga.org](http://www.nssga.org).
150. NTMA - National Terrazzo & Mosaic Association, Inc. (The); [www.ntma.com](http://www.ntma.com).
151. NWFA - National Wood Flooring Association; [www.nwfa.org](http://www.nwfa.org).



152. NWRA - National Waste & Recycling Association; [www.wasterecycling.org](http://www.wasterecycling.org).
153. PCI - Precast/Prestressed Concrete Institute; [www.pci.org](http://www.pci.org).
154. PDI - Plumbing & Drainage Institute; [www.pdionline.org](http://www.pdionline.org).
155. PLASA - PLASA; [www.plasa.org](http://www.plasa.org).
156. PLIB - Pacific Lumber Inspection Bureau; [www.plib.org](http://www.plib.org).
157. PVCPA - Uni-Bell PVC Pipe Association; [www.uni-bell.org](http://www.uni-bell.org).
158. RCSC - Research Council on Structural Connections; [www.boltcouncil.org](http://www.boltcouncil.org).
159. RFCI - Resilient Floor Covering Institute; [www.rfci.com](http://www.rfci.com).
160. RIS - Redwood Inspection Service; (see WWPA).
161. SAE - SAE International; [www.sae.org](http://www.sae.org).
162. SCTE - Society of Cable Telecommunications Engineers; [www.scte.org](http://www.scte.org).
163. SDI - Steel Deck Institute; [www.sdi.org](http://www.sdi.org).
164. SDI - Steel Door Institute; [www.steeldoor.org](http://www.steeldoor.org).
165. SEFA - Scientific Equipment and Furniture Association (The); [www.sefalabs.com](http://www.sefalabs.com).
166. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (see ASCE).
167. SIA - Security Industry Association; [www.securityindustry.org](http://www.securityindustry.org).
168. SJI - Steel Joist Institute; [www.steeljoist.org](http://www.steeljoist.org).
169. SMA - Screen Manufacturers Association; [www.smainfo.org](http://www.smainfo.org).
170. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; [www.smacna.org](http://www.smacna.org).
171. SMPTE - Society of Motion Picture and Television Engineers; [www.smpite.org](http://www.smpite.org).
172. SPFA - Spray Polyurethane Foam Alliance; [www.sprayfoam.org](http://www.sprayfoam.org).
173. SPIB - Southern Pine Inspection Bureau; [www.spib.org](http://www.spib.org).
174. SPRI - Single Ply Roofing Industry; [www.spri.org](http://www.spri.org).
175. SRCC - Solar Rating & Certification Corporation; [www.solar-rating.org](http://www.solar-rating.org).
176. SSINA - Specialty Steel Industry of North America; [www.ssina.com](http://www.ssina.com).
177. SSPC - SSPC: The Society for Protective Coatings; (see AMPP).
178. STI/SPFA - Steel Tank Institute/Steel Plate Fabricators Association; [www.steeltank.com](http://www.steeltank.com).
179. SWI - Steel Window Institute; [www.steelwindows.com](http://www.steelwindows.com).
180. SWPA - Submersible Wastewater Pump Association; [www.swpa.org](http://www.swpa.org).
181. TCA - Tilt-Up Concrete Association; [www.tilt-up.org](http://www.tilt-up.org).
182. TCNA - Tile Council of North America, Inc.; [www.tcnatile.com](http://www.tcnatile.com).
183. TEMA - Tubular Exchanger Manufacturers Association, Inc.; [www.kbcdco.tema.org](http://www.kbcdco.tema.org).
184. TIA - Telecommunications Industry Association (The); [www.tiaonline.org](http://www.tiaonline.org).
185. TMS - The Masonry Society; [www.masonrysociety.org](http://www.masonrysociety.org).
186. TPI - Truss Plate Institute; [www.tpinst.org](http://www.tpinst.org).
187. TPI - Turfgrass Producers International; [www.turfgrassod.org](http://www.turfgrassod.org).
188. TRI - Tile Roofing Industry Alliance; [www.tilerooting.org](http://www.tilerooting.org).
189. UL - Underwriters Laboratories Inc.; [www.ul.org](http://www.ul.org).
190. UL LLC - UL LLC; [www.ul.com](http://www.ul.com).
191. USAV - USA Volleyball; [www.usavolleyball.org](http://www.usavolleyball.org).
192. USGBC - U.S. Green Building Council; [www.usgbc.org](http://www.usgbc.org).
193. USITT - United States Institute for Theatre Technology, Inc.; [www.usitt.org](http://www.usitt.org).
194. WA - Wallcoverings Association; [www.wallcoverings.org](http://www.wallcoverings.org).
195. WCLIB - West Coast Lumber Inspection Bureau; (see PLIB).
196. WCMA - Window Covering Manufacturers Association; [www.wcmanet.org](http://www.wcmanet.org).
197. WDMA - Window & Door Manufacturers Association; [www.wdma.com](http://www.wdma.com).
198. WI - Woodwork Institute; [www.woodworkinstitute.com](http://www.woodworkinstitute.com).
199. WSRCA - Western States Roofing Contractors Association; [www.wsrca.com](http://www.wsrca.com).
200. WWPA - Western Wood Products Association; [www.wwpa.org](http://www.wwpa.org).

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
1. DIN - Deutsches Institut fur Normung e.V.; [www.din.de](http://www.din.de).
  2. IAPMO - International Association of Plumbing and Mechanical Officials; [www.iapmo.org](http://www.iapmo.org).
  3. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
  4. ICC-ES - ICC Evaluation Service, LLC; [www.icc-es.org](http://www.icc-es.org).
- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
1. CPSC - U.S. Consumer Product Safety Commission; [www.cpsc.gov](http://www.cpsc.gov).
  2. DOC - U.S. Department of Commerce; [www.commerce.gov](http://www.commerce.gov).
  3. DOD - U.S. Department of Defense; [www.defense.gov](http://www.defense.gov).
  4. DOE - U.S. Department of Energy; [www.energy.gov](http://www.energy.gov).
  5. DOJ - U.S. Department of Justice; [www.ojp.usdoj.gov](http://www.ojp.usdoj.gov)
  6. DOS - U.S. Department of State; [www.state.gov](http://www.state.gov).
  7. EPA - United States Environmental Protection Agency; [www.epa.gov](http://www.epa.gov).
  8. FAA - Federal Aviation Administration; [www.faa.gov](http://www.faa.gov).
  9. GPO - U.S. Government Publishing Office; [www.gpo.gov](http://www.gpo.gov).
  10. GSA - U.S. General Services Administration; [www.gsa.gov](http://www.gsa.gov).
  11. HUD - U.S. Department of Housing and Urban Development; [www.hud.gov](http://www.hud.gov).
  12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; [www.lbl.gov/](http://www.lbl.gov/).
  13. NIST - National Institute of Standards and Technology; [www.nist.gov](http://www.nist.gov).
  14. OSHA - Occupational Safety & Health Administration; [www.osha.gov](http://www.osha.gov).
  15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; [www.trb.org](http://www.trb.org).
  16. USACE - U.S. Army Corps of Engineers; [www.usace.army.mil](http://www.usace.army.mil).
  17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; [www.ars.usda.gov](http://www.ars.usda.gov).
  18. USDA - U.S. Department of Agriculture; Rural Utilities Service; [www.usda.gov](http://www.usda.gov).
  19. USP - U.S. Pharmacopeial Convention; [www.usp.org](http://www.usp.org).
  20. USPS - United States Postal Service; [www.usps.com](http://www.usps.com).
- D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from U.S. Government Publishing Office; [www.govinfo.gov](http://www.govinfo.gov).
  2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; [www.dsp.dla.mil/Specs-Standards/](http://www.dsp.dla.mil/Specs-Standards/).
  3. DSCC - Defense Supply Center Columbus; (see FS).
  4. FED-STD - Federal Standard; (see FS).
  5. FS - Federal Specification; Available from DLA Document Services; [www.dsp.dla.mil/Specs-Standards/](http://www.dsp.dla.mil/Specs-Standards/).
    - a. Available from Defense Standardization Program; [www.dsp.dla.mil](http://www.dsp.dla.mil).
    - b. Available from U.S. General Services Administration; [www.gsa.gov](http://www.gsa.gov).
    - c. Available from National Institute of Building Sciences/Whole Building Design Guide; [www.wbdg.org](http://www.wbdg.org).
  6. MILSPEC - Military Specification and Standards; (see DOD).
  7. USAB - United States Access Board; [www.access-board.gov](http://www.access-board.gov).
  8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).

- E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. BEARHFTI; California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; (see BHGS).
  2. BHGS; State of California Bureau of Household Goods and Services; (Formerly: California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation); [www.bhgs.dca.ca.gov](http://www.bhgs.dca.ca.gov).
  3. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; [www.oal.ca.gov/publications/ccr/](http://www.oal.ca.gov/publications/ccr/).
  4. CDPH; California Department of Public Health; Indoor Air Quality Program; [www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx](http://www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx).
  5. CPUC; California Public Utilities Commission; [www.cpuc.ca.gov](http://www.cpuc.ca.gov).
  6. SCAQMD; South Coast Air Quality Management District; [www.aqmd.gov](http://www.aqmd.gov).
  7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; <https://tfsweb.tamu.edu/>.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 01 43 39 - MOCKUPS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Integrated exterior mockups.
  - 2. Interior mockups
- B. Related Requirements:
  - 1. Section 01 40 00 "Quality Requirements" for quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.
  - 2. Division 02 through 33 Sections for specific material mockups unique to individual work results.

**1.2 ALLOWANCES**

- A. See Section 01 21 00 "Allowances" for description of allowances affecting items specified in this Section.

**1.3 DEFINITIONS**

- A. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
  - 1. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as erected separately from the building but on the Project site consisting of multiple products, assemblies, and subassemblies.

**1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Meet with Owner, Architect, testing and inspecting agency representative, and installers of major systems whose Work is included in integrated exterior and interior mockups.
  - 2. Review locations and extent of mockups.
  - 3. Review testing procedures to be performed on mockups.
  - 4. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and testing and maintain schedule for the Work.

**1.5 ACTION SUBMITTALS**

- A. Shop Drawings: For integrated exterior and interior mockups.
  - 1. Include plans, elevations, sections, and indicating materials and size of mockup construction.
  - 2. Indicate manufacturer and model number of individual components, subassemblies, and assemblies.
  - 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
  - 4. Include site location drawing indicating orientation of mockup.

- B. Delegated Design Submittal: For temporary structural supports for mockups not attached to building structure, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Preconstruction Test Reports: For integrated exterior mockups.

## 1.7 QUALITY ASSURANCE

- A. Coordinate with trades affected in completion of required mockups at location designated by Owner.
- B. Complete each item or system of the mockup by the tradesmen who will provide the actual work.
- C. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
  - 1. Contractors responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying work.
    - c. Provide sizes and configurations of test assemblies, mockups to adequately demonstrate capability of products to comply with performance requirements.
    - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
    - e. When testing is complete, remove test specimens, assemblies and mockups; do not reuse products on Project.
    - f. When testing is complete, remove test specimens, assemblies, mockups; do not reuse products on Project.
- D. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.
  - 1. Build mockups of size indicated, or if not indicated, as directed by Architect.
  - 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
  - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
  - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
  - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 6. Demolish and remove mockups when directed unless otherwise indicated.
- E. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
  - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
  - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
  - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
  - 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
    - a. Allow seven days for initial review and each re-review of each mockup.

6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
- F. Notifications:
1. Notify Architect seven days in advance of the dates and times when mockups will be constructed.
  2. Notify Architect fourteen days in advance of the dates and times when mockups will be tested.
  3. Allow seven days for initial review and each re-review of each mockup.
- G. Approval: Obtain Architect's approval of mockups before starting fabrication or construction of corresponding Work.
1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- H. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

## 1.8 COORDINATION

- A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.
- B. Coordinate with trades affected in completion of required mockups at location designated by Owner.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design support structure for free-standing mockups.
- B. Structural Performance:
  1. Wind Loads: As indicated on Drawings.
- C. Mockup Testing Performance Requirements: Perform tests using design pressures and performance criteria indicated for assemblies and products that are specified in other Sections and incorporated into integrated exterior mockups.

### 2.2 INTEGRATED EXTERIOR MOCKUPS

- A. Construct integrated exterior mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.
- B. Design and construct foundation and superstructure to support free-standing integrated exterior mockups.
- C. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.

- D. Use specified products that have been approved by Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.
- E. The Work of integrated exterior mockups includes, but is not limited to, the following:
  - 1. Ornamental metal screen assembly.
  - 2. Metal panel wall assembly.
  - 3. Precast concrete wall panel w/ thin brick veneer (Gates Precast or sim).
  - 4. Curtain wall assembly at Grand Hall.
- F. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work, or to pass performance testing requirements. Obtain Architect's approval for modifications.
- G. Retain approved mockups constructed in place. Incorporate fully into the Work.

### 2.3 INTERIOR MOCKUPS

- A. Build interior mockups according to mockup Shop Drawings or as indicated on Drawings.
- B. Provide interior mockups of the following:
  - 1. Polished concrete floors.
  - 2. Ceiling Canopy at Main Concourse Bar.
  - 3. Interior Wall Treatment at North Ballroom.

## PART 3 - EXECUTION

### 3.1 TESTING OF INTEGRATED EXTERIOR MOCKUPS

- A. Integrated Exterior Mockup Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
  - 1. Testing and inspecting agency will interpret tests and state in each report whether tested Work complies with or deviates from requirements.
- B. Integrated Exterior Mockup Testing Services: Perform the following tests in the following order:
  - 1. Water-Spray Test: Before installation of interior finishes has begun, test areas designated by Architect in accordance with AAMA 501.2 for evidence of water penetration.
    - a. Perform a minimum of two tests in areas as directed by Architect.
  - 2. Air Leakage: Test in accordance with ASTM E783 at 1.5 times the rate specified in "Mockup Testing Performance Requirements" Paragraph in "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. Perform a minimum of two test in areas as directed by Architect.
    - a. Perform a minimum of two tests in areas as directed by Architect.
  - 3. Water Penetration: Test in accordance with ASTM E1105 at a minimum [**uniform**] [**and**] [**cyclic**] static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Mockup Testing Performance Requirements" Paragraph in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and verify no evidence of water penetration.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections, and also to observe testing for the following systems and assemblies.
  - 1. Curtain wall specified in Section 08 44 13 "Glazed Aluminum Curtain Walls."



- D. Integrated exterior mockup will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 01 45 29 – STRUCTURAL TESTING AND INSPECTIONS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division **01** Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes requirements for quality assurance and quality control to be completed by the Testing Laboratory, Contractor, and/or the Geotechnical Engineer for the following structural items:
1. Concrete Forming and Accessories.
  2. Concrete Reinforcing.
  3. Cast-in-Place Concrete.
  4. Precast Pretensioned Concrete Seating Units.
  5. Precast Architectural Concrete.
  6. Masonry.
  7. Structural Steel.
  8. Steel Decking.
  9. Earthwork.
- B. Related Requirements:
1. Specification **014000** "Quality Requirements" for other independent testing agency procedures and administrative requirements.

**1.3 PRICE AND PAYMENT PROCEDURES**

- A. Unit Prices:
1. Cost Proposal: The Testing Laboratory's proposal to the Owner shall contain unit price stipulations for specified tests and inspections and on an hourly basis for personnel. A total estimated price shall also be submitted.
- B. Measurement and Payment
1. Payment of the Testing Laboratory: The Owner will pay for the initial Laboratory services for inspection and testing of materials for compliance with the requirements of the Contract Documents.
  2. Payment for Substitution Testing: The Contractor shall arrange for and pay for any additional samples and tests above those required by the Contract Documents as requested by the Contractor for his convenience in performing the work.
  3. Payment for Retesting: When initial tests indicate work does not comply with the requirements of the Contract Documents, the Contractor shall be liable to the Owner for the cost for any additional inspections, sampling, testing, and retesting done by the Testing Laboratory.
  4. Payment by Contractor: The Contractor shall furnish and pay for the following items if required:
    - a. Soil survey of the location of borrow soil materials, samples of existing soil materials, and delivery to the Contractor's Testing Laboratory.
    - b. Samples of concrete aggregates and delivery to the Contractor's Testing Laboratory.
    - c. Concrete mix designs as prepared by his concrete supplier.
    - d. Site-situated storage boxes for concrete cylinders
    - e. Concrete coring, tests of below strength concrete, and load tests, if ordered by the Owner, Architect, or Engineer.
    - f. Certification of reinforcing steel and prestressing steel mill order.
    - g. Certification of structural steel mill order.

- h. Certification of portland cement, lime, fly ash.
  - i. Certification of welders and preparation of Welding Procedure Specifications.
  - j. Tests, samples, and mock-ups of substitute material where the substitution is requested by the Contractor and the tests are necessary in the opinion of the Owner, Architect or Engineer to establish equality with specified items.
  - k. The making and testing of concrete cylinders for the purpose of evaluating strength at time of form stripping or for post-tensioning or the time spent evaluating the in situ strength of concrete using the Maturity Method.
  - l. Any other tests when such costs are required by the Contract Documents to be paid by the Contractor.
5. Payment for Tests of Suspected Deficient Work: If, in the opinion of the Building Official, Owner, Architect, or Engineer, any of the work of the Contractor is not satisfactory, the Contractor shall furnish and pay for all tests that the Owner, Architect, or Engineer deem advisable to determine its proper construction. The Owner shall pay all costs if the tests prove the questioned work to be satisfactory.

#### 1.4 OWNER RESPONSIBILITIES

- A. The Owner shall engage a Geotechnical Engineer to provide inspection services for the foundations as outlined below in [Article 3.9](#).
- B. The Owner shall provide a copy of the project plans and specifications to the Testing Laboratory prior to the start of construction and prior to any preinstallation meetings.

#### 1.5 CONTRACTOR RESPONSIBILITIES

- A. The Contractor shall not engage the same Testing Laboratory for construction services as the Owner has for Structural Testing Laboratory Services as defined herein.,
- B. Furnishing Samples and Certificates: The Contractor shall provide to the laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.
- C. Furnishing Casual Labor, Equipment and Facilities: The Contractor shall furnish casual labor, equipment, and facilities as required for sampling and testing by the laboratory and otherwise facilitate the required inspections and tests.

#### 1.6 TESTING LABORATORY RESPONSIBILITIES

- A. The Testing Laboratory shall sample and test materials as they are being installed for compliance with specified acceptance criteria. The Testing Laboratory will report and interpret the test results. The Laboratory shall monitor and report on the installation of construction work and shall perform tests on the completed construction as required to indicate Contractor's compliance with the various material specifications governing this work.
- B. The Testing Laboratory shall serve as a Special Inspector to provide Special Inspection services for the items listed below. The scope of such services for each item shall be as defined in the **Building Code** or as defined in the local building code of the jurisdiction wherein the project is located. These inspections are mandatory for conformance to the legal requirements of the building code and shall be in addition to the inspections and tests otherwise defined in this specification.
  - 1. Special Inspector Responsibilities:
    - a. The special inspector shall observe the work assigned to ascertain that, to the best of his/her knowledge, it is in conformance with the approved design drawings and specifications.
    - b. The special inspector shall furnish inspection reports to the Building Official, the Architect/Engineer, and the Owner. All discrepancies shall be brought to the immediate attention of the Architect/Engineer, Contractor, and Owner. A report that

- the corrected work has been inspected shall be sent to the Building Official, the Architect/Engineer, and the Owner.
- c. The special inspector shall create and maintain a log of all discrepancies throughout the duration of the Project. This log shall include, but is not limited to, discrepancy date, description of discrepancy, drawing and/or detail reference, description of as-built condition, description of any remedial work performed, and status of discrepancy. This log shall be submitted to the Architect/Engineer on a periodic basis for review and comment. Upon completion of the Project, this log shall be submitted in its entirety as an attachment to the final signed report described below.
  - d. The special inspector shall submit a final signed report stating whether the work requiring special inspection was, to the best of the inspector's knowledge, in conformance to the approved plans and specifications and the applicable workmanship provisions of the building code.
- C. The Testing Laboratory shall provide inspections on the following items:
- 1. Reinforcing steel placement.
  - 2. Concrete work.
  - 3. Welding of reinforcing steel.
  - 4. Bolts to be installed in concrete.
  - 5. Bolts, anchors, and reinforcing bars installed in hardened concrete (post-installed anchors).
  - 6. Precast concrete erection.
  - 7. Inspection of structural steel, bolting, and welding material.
  - 8. Welding of structural steel.
  - 9. High-strength bolting.
  - 10. Compacted earth fill.
  - 11. Pile foundations.
  - 12. Pier foundations.
  - 13. Masonry work.
- D. Inspections Required by Government Agencies: The Testing Laboratory shall perform inspections and submit reports and certifications as required by government agencies having jurisdiction over the aspects of the project covered by this specification.
- E. Notification of Deficiencies in the Work: The Testing Laboratory shall notify the Architect, Engineer, and Contractor within 24 hours of discovery of observed irregularities and deficiencies of the Work and other conditions not in compliance with the requirements of the Contract Documents. Notification shall be by telephone or e-mail and then in writing (PDF format).
- F. Accounting: The Testing Laboratory shall be responsible for separating and billing costs attributed to the Owner and costs attributed to the Contractor.
- G. Monitoring Product and Material Certifications: The Testing Laboratory shall be responsible for monitoring the submittals of product and material certifications from manufacturers and suppliers as specified in the Specifications and shall report to the Owner, Architect, and Engineer when those submittals are not made in a timely manner.
- H. Limitations of Authority: The Testing Laboratory is not authorized to revoke, alter, relax, enlarge upon, or release any requirements of the Specifications or to approve or accept any portion of the work or to perform any duties of the General Contractor and his Subcontractors.

## 1.7 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
- 1. The Testing Laboratory shall cooperate with the Architect, Engineer, and Contractor and provide qualified personnel promptly on notice.
  - 2. The Contractor shall cooperate with Testing Laboratory personnel and provide access to the work and to manufacturers' operations.

3. Notification of Source Change: The Contractor shall be responsible for notifying the Owner, Architect, Engineer, and Testing Laboratory when the source of any material is changed after the original tests or inspections have been made.
- B. Preinstallation Meetings: The Testing Laboratory shall attend preinstallation meetings with the Architect, Engineer, Contractor, and material suppliers as required to coordinate materials inspection and testing requirements with the planned construction schedule and shall participate in such meetings throughout the course of the project.
- C. Scheduling:
  1. Advance Notice: The Contractor shall be responsible for notifying the Testing Laboratory sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests. Failure to sufficiently notify may result in additional costs incurred by the Testing Laboratory that may be back-charged to the Contractor by the Owner.

## 1.8 SUBMITTALS

- A. Quality Control Reports:
  1. Information on Reports: The Testing Laboratory shall submit copies of reports (PDF format) of inspections and tests promptly. The reports shall contain at least the following information:
    - a. Project name.
    - b. Date report issued.
    - c. Testing Laboratory name and address.
    - d. Name and signature of inspector/technician.
    - e. Date of inspection and/or sampling.
    - f. Date of test.
    - g. Identification of product and Specification section.
    - h. Location in the project.
    - i. Identification of inspection or test.
    - j. Record of weather conditions and temperature (if applicable).
    - k. Results of test regarding compliance with Contract Documents.
  2. Copies: The Laboratory shall send signed electronic copies (PDF format) of test and inspection reports to the following parties:
    - a. Owner or his/her representative.
    - b. General Contractor.
    - c. Architect.
    - d. Engineer of Record.
- B. Discrepancy Log: The Testing Laboratory shall create and maintain a log of all discrepancies throughout the duration of the project.
  1. Information on Log: This log shall include, but is not limited to:
    - a. Discrepancy date.
    - b. Description of discrepancy.
    - c. Drawing and/or detail reference.
    - d. Description of as-built condition.
    - e. Description of any remedial work performed.
    - f. Status of discrepancy.
  2. Submission Schedule: This log shall be submitted to the Architect/Engineer on a periodic basis for review and comment. Upon completion of the Project, this log shall be submitted in its entirety as an attachment to the final signed report described below under Certifications.
- C. Certification: Upon completion of the job, the Laboratory shall furnish to the Owner, Architect, and Engineer of Record, a statement signed by a licensed professional engineer that, to the best of their knowledge, required tests and inspections were made in accordance with the requirements of the Contract Documents.

**1.9 QUALITY ASSURANCE**

- A. Qualifications of Special Inspector: The special inspector shall be a qualified person who shall demonstrate competence, to the satisfaction of the Building Official, for inspection of the particular type of construction or operation being inspected. The Special Inspector shall meet the legal qualifications of the building code having jurisdiction.
- B. Qualifications of Testing Laboratory:
1. The Testing Laboratory shall meet the basic requirements of ASTM E 329 and shall submit to the Owner, Architect, and Engineer evidence of current accreditation from the American Association for Laboratory Accreditation, the AASHTO Accreditation Program or the "NIST" National Voluntary Laboratory Accreditation Program.
  2. The Testing Laboratory shall be an Approved Agency by the Building Official to perform Special Inspections and other tests and inspections as outlined in the applicable building code.
  3. Tests and inspections shall be conducted in accordance with specified requirements, and if not specified, in accordance with the applicable standards of the American Society for Testing and Materials or other recognized and accepted authorities in the field.
  4. Qualifications of Welding Inspectors
    - a. Inspectors performing visual weld inspection shall meet the requirements of AWS D1.1 Section 6.1.4. Inspectors shall have current certification as an AWS Certified Welding Inspector (CWI). Assistant inspectors, if any, shall be supervised by an Inspector and shall be qualified by training and experience to perform the specific functions to which they are assigned.
    - b. Inspectors performing nondestructive examinations of welds other than visual inspection (MT, PT, UT, and RT) shall meet the requirements of AWS D1.1, Section 6.14.6.
  5. Qualifications for Post-Tensioning Inspector - The technician for the Testing Laboratory performing the field inspections required for post-tensioned concrete shall possess a currently valid Level 2 Post-Tensioning Inspector Certification issued by the Post-Tensioning Institute. A copy of such certification for each such technician shall be submitted for Engineer review and approval.
- C. The Contractor shall not engage the same testing laboratory for construction services as the Owner has for quality assurance testing, unless agreed to by the Owner.

**PART 2 - PRODUCTS (Not Used)****PART 3 - EXECUTION****3.1 SCOPE OF WORK**

- A. The work to be performed by the Testing Laboratory shall be as specified in this Section of the Specification and as determined in meetings with the Owner, Architect, and Engineer.

**3.2 CONCRETE FORMING AND ACCESSORIES**

- A. Field Inspection:
1. Shallow Foundation Elements:
    - a. Verify element width, length, depth, and elevation.
    - b. Verify that forms are plumb and straight, braced against movement, and lubricated for removal.
  2. Slabs-on-Grade:
    - a. Verify formwork at turndowns and slab edges is plumb and straight, braced against movement and lubricated for removal.

3. In-Situ Concrete Strength Verification Prior to Form Stripping: The Testing Laboratory shall verify that the concrete has reached the required minimum strength before form removal by evaluating the specified tests. Refer to Paragraph 3.4B.2.a for additional information regarding the tests.

### 3.3 CONCRETE REINFORCING

- A. Quality Assurance:
  1. Review the Welding Procedure Specification (WPS) submitted by the contractor for any reinforcing steel other than ASTM A 706 that is proposed to be welded for consistency with acceptable welding practices and AWS.
  2. Review welder qualifications by certification or verify by retesting. Obtain welder certificates.
- B. Field Testing: The following tests shall be completed by the Testing Laboratory:
- C. Field Inspection: The scope of the work to be performed by the inspector on the jobsite shall be as follows:
  1. Reinforcing Steel: The Testing Laboratory or designated Special Inspector shall inspect 100% of reinforcement before each concrete pour to verify the information noted below. Inspection reports shall be prepared and distributed in accordance with the local building code and as specified in this specification.
    - a. Primary and secondary longitudinal reinforcement has correct size and number in proper layers.
    - b. Longitudinal reinforcement has correct length and lap.
    - c. Ties and stirrups are of correct size, spacing, and number and have the proper termination hook geometry.
    - d. Unscheduled face reinforcement in beams are provided and are of correct size, number and spacing and have the proper end terminations.
    - e. Proper hooks are provided at bar ends as detailed.
    - f. Reinforcement is properly supported and braced to formwork to prevent movement during concrete placement.
    - g. Reinforcement has proper cover.
    - h. Sufficient spacing between reinforcement for concrete placement.
    - i. Dowel reinforcement is of proper size, at proper spacing, and has proper lap length and embedment length.
    - j. Welded wire reinforcement is composed of flat sheets, has proper wire gage and spacing, is properly supported, and is properly lapped.
    - k. Proper construction/control/expansion joint spacing and reinforcement.
    - l. Reinforcement around embedded items is placed according to details.
    - m. Welded reinforcement has been done according to AWS requirements.
    - n. Mechanical Tension Splices: The Testing Laboratory shall provide 100% visual inspection of mechanical tension splices on the project and consult with the manufacturer regarding recommendations for installation. Inspection shall verify compliance with specifications and conformance with the manufacturer's recommendations for installation after consulting with the manufacturer, who is to be present for the first installation of the splice on the project.

### 3.4 CAST-IN-PLACE CONCRETE

- A. Quality Assurance:
  1. Concrete Mix Designs: The Testing Laboratory shall review the submitted mix designs for conformance to the specifications and for suitability for use in the project.
  2. Preinstallation Meetings: The Testing Laboratory shall attend the preinstallation meetings as noted in Specification **033000** "Cast-in-Place Concrete."
- B. Field Testing: The following tests shall be completed by the Testing Laboratory:



1. During Concrete Placement:
  - a. Record the amount of water added and note if it exceeds the amount allowed to be added shown in the approved mix design.
  - b. Mold concrete test cylinders as specified below in Paragraph 3.a.
  - c. Perform tests to determine slump, concrete temperature, unit weight, and air entrainment as specified below.
  - d. Record information for concrete test reports as specified below.
  - e. Pick up and transport to Laboratory cylinders cast the previous day.
2. After Concrete Placement:
  - a. In-situ Concrete Strength Verification for Form Stripping: The Testing Laboratory shall perform the tests necessary to determine the concrete strength prior to form stripping:
    - 1) If concrete strength for form stripping is to be determined using field-cured cylinders, the cylinder shall be broken at the time of form removal as directed by the Contractor.
    - 2) If concrete strength for form stripping is to be determined using the Maturity Method, the Testing Laboratory shall verify that the requirements of ASTM C 1074 are being followed and that the proper criteria for determining concrete strength by this method has been established and is being followed.
  - b. Investigation of Low Strength Concrete Test Results:
    - 1) Cost of Investigations for Low Strength Concrete: The Contractor shall reimburse the Owner for the costs of investigations of low strength concrete, as defined in Part I above.
    - 2) Scope of Investigations: See Specification Section **033000** "Cast-In-Place Concrete" for the investigations that may be required by the Engineer. The Testing Laboratory will conduct these investigations if required.
  - c. Post-Installed Anchors in Concrete:
    - 1) Verify maximum anchor tightening torque for all applicable post-installed anchors.
    - 2) Verify that all drilled holes for adhesive anchors are within 6 degrees of perpendicular to the surface of the concrete member.
    - 3) Provide pull tests on individual anchors as specified in the ICC Evaluation Services Report, on the drawings, or as directed by the Engineer-of-Record.
  - d. Floor Flatness and Levelness Measuring: Perform tests as defined below.
  - e. Testing of Concrete Floor Slabs for Acceptability to Receive an Adhesive-Applied, Low-Permeable Floor Covering: Perform tests as defined below.
  - f. Testing of Non-Shrink Grout for Base Plates, Bearing Plates, and Precast Wall Panels:
    - 1) Compressive Strength Tests: Compressive strength of grout shall be determined by testing grout cubes according to the requirements of ASTM C 109 - Modified. Test one set of three cubes at one day, and one set of three cubes at 28 days.
    - 2) Frequency of Testing: One set of cubes (6 cubes) shall be made for every ten base plates and bearing plates or fraction thereof but not less than one set for each day's operation. One set of cubes shall be made for each day's operation of grouting wall panels.
3. Standards for Concrete Tests:
  - a. Concrete Test Cylinders: Mold and test concrete cylinders as described below:
    - 1) Cylinder Molding and Testing: Cylinders for strength tests shall be molded and Laboratory cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39. Cylinders may be either 6" in diameter by 12" or 4" in diameter by 8", however, the diameter of the cylinder shall be at least three times the nominal maximum size of the coarse aggregate in the mix tested. All of the cylinders for each class of concrete shall be of the same dimension for all sets of that class.
    - 2) Field Samples: Field samples for strength tests shall be taken in accordance with ASTM C 172 **at the point of placement**.
    - 3) Quantity of Cylinders: Each set of test cylinders shall consist of a minimum of four standard test cylinders. If concrete strength for form stripping is to be

determined using field-cured cylinders, one additional cylinder per set will be required for formed slab and pan-formed beam floors for the purpose of evaluating the concrete strength at the time of form stripping. This cylinder shall be stored on the floor where form removal is to occur under the same exposure conditions as the floor concrete. The cylinder shall be cured under field conditions in accordance with ASTM C 31. Field-cured test cylinders shall be molded at the same time and from the same samples as laboratory-cured test specimens. The Contractor shall reimburse the Owner for the cost of making and testing these cylinders.

- 4) Frequency of Testing: A set of test cylinders shall be made according to the following minimum frequency guidelines:
  - a) One set for each class of concrete taken not less than once a day.
  - b) Piers, Piles: One set for each 50 cubic yards or fraction thereof.
  - c) Spread Footings: One set for each 50 cubic yards or fraction thereof.
  - d) Pier Caps: One set for each 50 cubic yards or fraction thereof.
  - e) Floors: One set for each 150 cubic yards or fraction thereof but not less than one set for each 5,000 square foot of floor area.
  - f) All Other Concrete: A minimum of one set for each 150 cubic yards or fraction thereof but not less than one set for each 5,000 square foot of area for walls.
  - g) No more than one set of cylinders at a time shall be made from any single truck.
  - h) If the total volume of concrete is such that the frequency of testing as specified above would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.
  - i) The above frequencies assume that one batch plant will be used for each pour. If more than one batch plant is used, the frequencies cited above shall apply for each plant used.
- 5) The cylinders shall be numbered, dated, and the point of concrete placement in the building recorded.
- 6) For concrete specified on the drawings to reach the required strength at 28 days, break one cylinder of the set at seven days, two 6" by 12" cylinders or three 4" by 8" cylinders at 28 days, and keep one in reserve for testing at the Engineer's direction.
- 7) For concrete specified on the drawings to reach the required strength at 56 days, break one cylinder of the set at seven days, one cylinder at 28 days, two 6" by 12" cylinders or three 4" by 8" cylinders at 56 days, and one kept in reserve for testing at the Engineer's direction.
- 8) For concrete specified on the drawings to reach the required strength at 90 days, break one cylinder of the set at seven days, one cylinder at 28 days, one cylinder at 56 days, two 6" by 12" cylinders or three 4" by 8" cylinders at 90 days, and one kept in reserve for testing at the Engineer's direction.
- 9) Cylinder Storage Box: The Contractor shall be responsible for providing a protected concrete cylinder wooden storage box at a point on the job site mutually agreeable with the Testing Laboratory for the purpose of storing concrete cylinders until they are transported to the Laboratory. The box shall be constructed and equipped to maintain the environment specified for initial curing in ASTM C 31.
- 10) Transporting Cylinders: The Testing Laboratory shall be responsible for transporting the cylinders to the Laboratory in a protected environment such that no damage or ill effect will occur to the concrete cylinders including loss of moisture, freezing temperatures or jarring.

- 11) Information on Concrete Test Reports: The Testing Laboratory shall make and distribute concrete test reports after each job cylinder is broken. Such reports shall contain the following information:
- a) Truck number and ticket number.
  - b) Concrete Batch Plant.
  - c) Mix design number.
  - d) Accurate location of pour in the structure.
  - e) Strength requirement.
  - f) Date cylinders made and broken.
  - g) Technician making cylinders.
  - h) Concrete temperature at placing.
  - i) Air temperature at point of placement in the structure.
  - j) Amount of water added to the truck at the batch plant and at the site and whether or not it exceeds the amount allowed by the mix design.
  - k) Slump.
  - l) Unit weight.
  - m) Air content.
  - n) Cylinder compressive strengths with type of failure if concrete does not meet Specification requirements. Seven day breaks are to be flagged if they are less than 60% of the required 28 day strength. 28 day breaks are to be brought to the attention of the Architect and Engineer in writing if either cylinder fails to meet specification requirements.
- b. Slump Tests: Slump Tests (ASTM C 143) shall be completed at the beginning of concrete placement for each batch plant and for each set of test cylinders made. The slump test shall be made from concrete taken from the end of the concrete truck chute. The concrete shall be considered acceptable if the slump is within the slump tolerance noted on the mix design submittal form for that class of concrete.
- c. Air Entrainment: Air entrainment tests (ASTM C 231 or C 173, C 173 only for lightweight concrete) shall be made at the same time slump tests are made as cited above. Samples for air entrainment tests shall be taken **at the point of placement**.
- d. Concrete Temperature: Concrete temperature at placement shall be measured (ASTM C 1064) at the same time slump tests are made as cited above.
- e. Unit Weight Test: ASTM C 138.
- f. Floor Flatness and Levelness Measuring:
- 1) The Testing Laboratory shall measure the floor for flatness and levelness according to ASTM E 1155.
  - 2) Measurement of the finished concrete surface profile for any test section shall be made when requested by the Representative at his option. Notwithstanding, measurements shall be made within 24 hours after completion of finishing operations. For structural elevated floors measurement shall also be made prior to removal of forms and shores. The Contractor shall be notified immediately after the measurements of any section are complete and a written report of the floor measurement results shall be submitted within 72 hours after finishing operations are complete.
  - 3) The concrete surface profile shall be measured using equipment manufactured for the purpose such as a Dipstick Floor Profiler as manufactured by the Edward W. Face Company in Norfolk, Virginia, F-Meters manufactured by Allen Face & Company in Norfolk, Virginia, optical, or laser means or other method specified in ASTM E 1155.
  - 4) Each floor test section and the overall floor area shall conform to the two-tiered measurement standard as specified herein.
    - a) Minimum Local Value (MLV). The minimum local  $F_F/F_L$  values represent the absolute minimum surface profile that will be acceptable in any one floor test section.

- b) Specified Overall Value (SOV). The specified overall  $F_F/F_L$  values represent the minimum values acceptable for all combined floor test sections representing the overall floor.
- 5) For purposes of this specification a floor test section is defined as the smaller of the following areas:
  - a) The area bounded by column and/or wall lines.
  - b) The area bounded by construction and/or control joint lines.
  - c) Any combination of column lines and/or control joint lines.
  - d) Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines as defined by ASTM E 1155.
  - e) The precise layout of each test section shall be determined by the Testing Laboratory and shall be submitted for Architect/Engineer review and approval.
- g. Testing of Concrete Floor Slabs for Acceptability to Receive an Adhesive-Applied, Low-Permeable Floor Covering:
  - 1) The following tests shall be performed by the Testing Laboratory as a part of quality assurance testing to insure that the proper moisture condition and alkalinity of the substrate has been achieved prior to installing adhesive-applied, low-permeability floor coverings such as vinyl composition tile (VCT), linoleum, sheet vinyl, vinyl-backed carpet, rubber, athletic flooring, synthetic turf, wood, acrylic terrazzo, thin-set tile, epoxy overlays and adhesives, waterproofing, et.al.
  - 2) Moisture Vapor Emission Rate: Perform testing according to ASTM F 1869 to determine if the moisture emission rate from the floor is below the flooring manufacturer's maximum recommended value but not greater than five pounds per 1,000 square feet per 24 hours.
  - 3) Relative Humidity Determination Test: As an alternate to the Moisture Vapor Emission Rate Test, and if agreed to by the Contractor, Architect and Owner, perform testing according to ASTM F 2170 to determine if the relative humidity of the concrete slab is below the flooring manufacturer's maximum recommended value but not greater than 75%.
  - 4) Alkalinity Testing: Perform testing in accordance with ASTM F 710, Paragraph 5.3, to determine if the pH level of the concrete slab surface is below the flooring manufacturer's maximum recommended value but not greater than 10. Perform one test per 1,000 square feet with a minimum of three tests within the total area being tested.
- 4. Evaluation and Acceptance of Concrete:
  - a. Strength Test: A strength test shall be defined as the average strength of two six inch cylinder breaks or three four inch cylinder breaks from each set of cylinders tested at the time indicated above.
  - b. Quality Control Charts and Logs: The Testing Laboratory shall keep the following quality control logs and charts for each class of concrete containing more than 2,000 cubic yards. The records shall be kept for each batch plant and submitted on a weekly basis with cylinder test reports:
    - 1) Number of strength tests made to date.
    - 2) Strength test results containing the average of all strength tests to date, the high test result, the low test result, the standard deviation, and the coefficient of variation.
    - 3) Number of tests under specified strength.
    - 4) A histogram plotting the number of strength test cylinders versus compressive strength.
    - 5) Quality control chart plotting compressive strength test results for each test.
    - 6) Quality control chart plotting moving average for strength where each point plotted is the average strength of three previous test results.

- 7) Quality control chart plotting moving average for range where each point plotted is the average of 10 previous ranges.
  - c. Acceptance Criteria: The strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:
    - 1) The average of all sets of three consecutive strength tests equal or exceed the required  $f'c$ .
    - 2) No individual strength test falls below the required  $f'c$  by more than the greater of 10% of  $f'c$  or 500 PSI.
  - d. If either of the above Acceptance Criteria requirements is not met, the Testing Laboratory shall immediately notify the Engineer by telephone. Steps shall immediately be taken to increase the average of subsequent strength tests.
- C. Field Inspection: The scope of the work to be performed by the inspector on the jobsite shall be as follows:
1. Before Concrete Placement:
    - a. Inspect concrete formwork per Article 3.2.
    - b. Inspect concrete reinforcing per Article 3.3.
    - c. Inspect bolts and rods to be embedded in concrete for proper grade, size, length, and embedment.
    - d. For slabs-on-grade, verify that the moisture retarder is provided, is lapped properly, and is not torn or punctured.
    - e. Verify that there is no standing water in pour area and that all debris has been removed from the area and from the formwork.
    - f. Verify that openings and sleeves in slabs or walls are correct size and location. Verify that the openings are shown on the structural drawings and notify the Engineer immediately of any openings in the field that are not shown on the drawings.
    - g. Verify that horizontal and vertical sleeves through girders, beams, or joists have been approved by the Engineer and that approved reinforcement is provided.
    - h. Verify the tops of previously poured columns and/or walls are 1/2 inch below the deck soffit.
  2. During Concrete Placement: Provide continuous monitoring to:
    - a. Upon arrival of concrete, inspect the concrete to verify that the proper concrete mix number, type of concrete, concrete strength is being placed at the proper location. Verify that the mix meets the project specifications and is not over 90 minutes old at the time of placement. Report concrete not meeting the specified requirements and immediately notify the Contractor, Batch Plant Inspector, Architect, Engineer, and Owner.
    - b. Inspect plastic concrete upon arrival at the jobsite to verify proper batching. Observe mix consistency and adding of water as required to achieve target slumps in mix designs. The responsibility for adding water to trucks at the job site shall rest only with the Contractor's designated representative. The Contractor is responsible that all concrete placed in the field is in conformance to the Contract Documents.
    - c. Verify that the Contractor is following appropriate Hot Weather or Cold Weather concreting practices consistent with any extreme environmental conditions at the point of placement in the structure.
    - d. Verify that concrete deposited is uniform and that vertical drop does not exceed six feet and is not permitted to drop freely over reinforcement causing segregation.
    - e. Verify that the formwork has remained stable during the concreting operation.
    - f. Verify that there are no cold joints.
    - g. Verify that the concrete is properly vibrated.
    - h. Inspect bolts embedded in concrete during concrete placement for verification that they have been properly installed to the specified embedment.
    - i. Verify that the finishing of the concrete surface is done according to specifications.

The Testing Laboratory shall report any irregularities that occur in the concrete at the job site or test results to the Contractor, Architect, Owner, and Engineer.

3. After Concrete Placement:
  - a. Verify that the curing process is according to Specifications and that any curing compound used is applied in accordance with the manufacturer's recommendations.
  - b. Verify that sawcut control joints in slab-on-grades are cut within 12 hours of placement.
  - c. Post-Installed Anchors in Concrete: Provide inspection of post-installed anchor installations at the frequency noted in the specifications and in accordance with the published, currently valid, Evaluation Service Report (ESR) for each anchor product. Post-installed anchors include anchors and reinforcing steel. Inspection of post-installed anchors shall include but not be limited to the following:
    - 1) Periodic Inspection: Verify initial installation of post-installed anchors in concrete for each individual installer with each individual anchor product in accordance with the requirements stated below for each type of anchor. Periodically inspect anchor installation after the initial verification.
    - 2) Continuous Inspection: Verify each installation of post-installed anchors in concrete in accordance with the requirements stated below for each type of anchor.
    - 3) All Post-Installed Anchors: Verify that the anchor is installed in accordance with manufacturer's printed installation instructions as well as the following design requirements.
      - a) Concrete type, concrete strength and concrete thickness are in accordance with design drawings.
      - b) Anchor manufacturer and product, including material, is in accordance with design drawings or approved substitution.
      - c) Anchor diameter, length and installed embedment depth.
      - d) Drill bit type and diameter.
      - e) Anchor edge distance and spacing.
      - f) Hole diameter and depth.
      - g) Hole cleaning procedure and cleanliness.
      - h) Anchor maximum tightening torque.
    - 4) Adhesive Anchors: In addition to the requirements for All Post-Installed Anchors, verify adhesive identification and expiration date.
      - a) The installation of all adhesive anchors shall be continuously inspected when anchors are subject to sustained tension loads, such as anchors for shelf angles, or when anchors are installed in an upwardly inclined condition.
- D. Causes for Rejection of Concrete: The Contractor shall reject concrete delivered to the site for any of the following reasons:
  1. Wrong class of concrete (incorrect mix design number).
  2. Environmental Conditions: Environmental condition limits shall be as follows unless appropriate provisions in concreting practices have been made for cold or hot weather:
    - a. Cold Weather: Air temperature must be 40°F and rising or the average daily temperature cannot have been lower than 40°F for 3 consecutive days unless the temperature rose above 50°F for at least one-half of any of those 24 hour periods.
    - b. Hot Weather: Environmental conditions must be such that cause an evaporation rate from the concrete surface of 0.2 lb./sq. ft./hr. or less as determined by Figure 2.1.5 in ACI 305R-91.

Concrete may be placed at other environmental condition ranges only with approval of the job inspector for the Testing Laboratory or other duly appointed representative.
  3. Concrete with temperatures exceeding 95°F shall not be placed in the structure.
  4. Air contents outside the limits specified in the mix designs.
  5. Slumps outside the limits specified.
  6. Excessive Age: Concrete shall be discharged within 90 minutes of plant departure or before it begins to set if sooner than 90 minutes unless approved by the Laboratory job inspector or other duly appointed representative.

- E. Concrete Batch Trip Tickets: Concrete batch trip tickets shall be collected and retained by the Contractor. Compressive strength, slump, air, and temperature tests shall be identified by reference to a particular trip ticket. Tickets shall contain the information specified in ASTM C 94. Each ticket shall also show the amount of water that may be added in the field for the entire batch that will not exceed the specified water cement ratio for the design mix. The Contractor and Testing Laboratory shall immediately notify the Architect/Engineer and each other of tickets not meeting the criteria specified.

### 3.5 PRECAST STRUCTURAL CONCRETE AND PRETENSIONED CONCRETE SEATING UNITS

- A. Scope of Work: The Testing Laboratory shall furnish the necessary technicians and equipment to perform the following tests and inspections. Schedule the time for visits to the precast plant in consultation with the Supplier, Architect, Engineer, and Owner. Submit a proposed unit price for each visit and base the total proposed price on providing **[three] <Enter number of precast plant site visits>** visits. Inspections shall be performed by a qualified technician with a minimum of two years of experience in precast concrete testing and inspection.
- B. Quality Assurance:
1. Verify that the fabricator's fabrication and quality control procedures provide a sound basis for inspection control of workmanship and of the ability to conform to construction documents and industry standards. Review the procedures for completeness and adequacy relative to code requirements for the fabricator's finished product.
- C. Source Inspection:
1. Preliminary plant inspection prior to the start of fabrication including the following:
    - a. Inspection of the batching facilities including aggregate stock piles, material handling facilities, concrete batching and mixing facilities, and in plant concrete handling, placing, and consolidating procedures and equipment.
    - b. Inspection of the in-plant testing and curing facilities.
    - c. Inspection of the casting beds shall be made to check for cleanliness, alignment, and surface condition of the bed.
    - d. Inspection of the stressing blocks and stressing procedures including verification of the calibration of the stressing jacks to be used in the work.
    - e. A review of the concrete mix designs proposed for use in the work.
- D. Field Testing: Refer to Article 3.4 for testing requirements of cast-in-place concrete elements associated with precast structural concrete, such as topping slabs.
- E. Field Inspection: Inspection of bearing conditions, members and connections shall include the following:
1. Inspect anchor rod layout, embedment, and bolt tightening to base plates.
  2. Check base plates for proper grouting.
  3. Check connection of bearing walls to foundation for proper bolting and grouting.
  4. For welded connections, check for proper location of embedded plates or angles. 100% of welded connections shall be visually inspected for completeness including weld types, locations, sizes, and lengths.
  5. For precast plank floor members, check the following:
    - a. Proper length and width of bearing at each support end.
    - b. Proper width, length, thickness, and type of bearing pads.
    - c. Proper connection of tees or planks to each other and to support members at each end.
    - d. Proper vertical alignment of tees or planks with respect to each other and to supports.
    - e. Excessive camber or deflection after pouring of topping slabs.
    - f. Any damage of tees or planks sustained during erection or shipping.
    - g. Any flexural cracking sustained in bottom webs after erection and pouring of topping slabs.
  6. For precast beams, both interior and spandrel, check the following:

- a. Proper length and width of bearing at each support end.
  - b. Proper width, length, thickness, and type of bearing pads.
  - c. Proper connection of beams to columns at each end and to intersecting floor members.
7. Verify proper finish (painted or galvanized) of 100 % of steel connection plates and angles including touch-up of welds.
- F. Reporting:
1. The Testing Laboratory shall write an inspection report promptly after each plant and site visit for distribution to the parties specified.
  2. Any irregularities in the work shall be immediately reported by telephone to the Engineer and Architect.

### 3.6 PRECAST ARCHITECTURAL CONCRETE

- A. Field Inspection: The Testing Laboratory shall:
- a. Verify proper bolting and/or welding of panel connection to the structure.
  - b. Verify proper panel position with specified panel joint thickness.
  - c. Verify proper sealant materials and methods at joints.
  - d. Report any cracked panels or panels with improper finish to the Architect and Engineer.

### 3.7 STRUCTURAL STEEL

- A. Scope of Work:
1. Contract Obligations:
    - a. Owner Responsibility: The Owner shall pay for initial shop and field inspections and tests as required during the fabrication and erection of the structural steel.
    - b. Testing Laboratory Responsibility: The inspection by the Testing Laboratory of the Fabricator's work shall be in sequence, timely, and performed in such a manner so that corrections can be made without delaying the progress of the work. Inspections shall be performed by qualified technicians with a minimum of two years of experience in structural steel testing and inspection. Refer to Paragraph 1.9B.4 for special requirements for welding inspectors. The Testing Laboratory shall provide test reports of inspections. All test reports shall indicate types and locations of defects found during inspection, the measures required and performed to correct such defects, statements of final approval of welding and bolting of shop and field connections, and other fabrication and erection data pertinent to the safe and proper welding and bolting of shop and field connections. Weld inspection reports shall be signed by an inspector with current certification as an AWS Certified Welding Inspector (CWI). In addition to the parties listed in this Specification the Fabricator and Erector shall receive copies of the test reports.
    - c. Rejection of Material or Workmanship: The Owner, Architect, Engineer, and Testing Laboratory reserve the right to reject any material or workmanship not in conformance with the Contract Documents at any time during the progress of the work. However, this provision does not allow waiving the obligation for timely, in sequence inspections.
- B. Quality Assurance:
1. Verify the fabrication shop's certification from AISC.
  2. Verify that the fabricator's fabrication and quality control procedures provide a sound basis for inspection control of workmanship and of the ability to conform to construction documents and industry standards. Review the procedures for completeness and adequacy relative to code requirements for the fabricator's finished product.
  3. Review field welder qualifications by certification or verify by retesting. Obtain welder certificates.



- C. Source Testing: The Testing Laboratory shall provide the following tests at the designated fabrication shops:
1. Test welds completed in the shop according to Paragraph H "Weld Testing" below.
  2. Test bolted connections completed in the shop according to Paragraph I "High-Strength Bolt Testing."
- D. Source Inspection: The Testing Laboratory shall provide the following inspections at the designated fabrication shops:
1. Shop Inspection Waiver: The requirement to perform fabricating shop inspections may be waived if the Fabricator produces evidence from the Building Official of being a registered, approved fabricating shop and if allowed by the Engineer. If these are waived, then the inspection, testing, and reporting requirements of the Owner's Testing Laboratory shall be transferred to the Fabricator.
  2. An initial shop inspection prior to the start of any fabricating work shall be made to accomplish the following:
    - a. Perform tasks outlined in Paragraphs G.1, G.2 and G.3 of welding inspection duties described below in Paragraph G "Weld Inspection and Process Monitoring" when shop welding is to be performed.
    - b. Perform tasks outlined in paragraph J.1 of bolt inspection duties described below in Paragraph I "High-Strength Bolt Inspection and Process Monitoring" when shop bolting involves joints that are designated on the plans as Pretensioned or Slip-Critical.
  3. Process Monitoring:
    - a. Provide continuous or periodic monitoring of welding as described below in Paragraph G "Weld Inspection and Process Monitoring."
    - b. Provide continuous or periodic monitoring of bolting as described below in Paragraph I "High-Strength Bolt Inspection and Process Monitoring" of high-strength bolt installation in pre-tensioned or slip-critical joints using turn-of-the-nut without matchmarking or calibrated wrench method of bolt installation.
    - c. Provide periodic verification of specified camber of steel beams.
- E. Field Testing: The Testing Laboratory shall provide the following tests in the field:
1. Test welds completed in the field according to Paragraph H "Weld Testing:" below.
  2. Test bolted connections completed in the field according to Paragraph I "High-Strength Bolt Testing."
  3. Perform bend tests on completed shear connectors attached to beams as required according to procedures outlined in AWS D1.1. In addition, perform field bend tests on an additional 2% of completed shear connectors on each beam but not less than one connector per beam.
  4. Testing of Non-Shrink Grout for Base Plates, Bearing Plates, and Precast Wall Panels:
    - a. Compressive Strength Tests: Compressive strength of grout shall be determined by testing grout cubes according to the requirements of ASTM C 109 - Modified. Test one set of three cubes at one day, and one set of three cubes at 28 days.
    - b. Frequency of Testing: One set of cubes (6 cubes) shall be made for every ten base plates and bearing plates or fraction thereof but not less than one set for each day's operation. One set of cubes shall be made for each day's operation of grouting wall panels.
- F. Field Inspection: The Testing Laboratory shall provide the following inspections in the field:
1. Inspect galvanized HSS and other cold-worked structural steel members for cracking or other damage resulting from galvanizing process. Endeavor to complete inspections prior to erection of these members. Immediately notify Contractor and Architect/Engineer of any irregularities discovered.
  2. Provide continuous or periodic monitoring of field welding as described below in Paragraph G "Weld Inspection and Process Monitoring."
  3. Provide continuous or periodic monitoring of field bolting as described below in Paragraph I "High-Strength Bolt Inspection and Process Monitoring" of high-strength bolt installation

- in pre-tensioned or slip-critical joints using turn-of-the-nut without matchmarking or calibrated wrench method of bolt installation.
4. Inspect welded or bolted connections that were completed, but not inspected, in the shop. Perform inspections according to Paragraph G “Weld Inspection and Process Monitoring” and/or Paragraph I “High-Strength Bolt Inspection and Process Monitoring” as appropriate.
  5. Obtain the planned erection procedure, and review with the Erector’s supervisory personnel.
  6. Check the installation of base plates for proper leveling, grout type, and grout application.
  7. Check structural steel as received in the field for possible shipping damage, workmanship, and identification marking to conform to AISC 360 for structural steel and specified ASTM standards for other steel.
  8. Verify that surveys are occurring as specified to check plumbness and frame alignment as erection progresses. Review the submitted survey report.
  9. Periodically inspect the steel frame for such items as bracing and stiffening details, member locations, and joint details at each connection for compliance with approved construction documents.
  10. Inspect 100% of the column compression and base joints for verification that gaps in contact bearing do not exceed 1/16 inch. Gaps greater than 1/16 inch but less than 1/4 inch shall be reported to the Owner and Engineer for assessment. All gaps greater than 1/4 inch shall be shimmed according to Specification **051200** “Structural Steel Framing.”
  11. Endeavor to guard the Owner against the Contractor cutting, grinding, reaming, or making any other field modification to structural steel without the prior approval of the Engineer. Report any noted unauthorized modifications to the Owner and Engineer.
- G. Weld Inspection and Process Monitoring: The Testing Laboratory shall make the following inspections of the welds and welding processes. Welds performed in the fabricating shop may be inspected in the field unless continuous monitoring of the welding process is herein specified or if access in the field due to other work or shop finishes makes field inspection impractical:
1. Approve Welding Procedure Specifications submitted by the Contractor. Approve any changes submitted by the Contractor to any WPS that has already been approved. Obtain the Welding Procedure Qualification Record (WPQR) for each successful WPS qualification.
  2. Periodically verify welding electrodes to be used and other welding consumables as the job progresses.
  3. Periodically observe joint preparation, assembly practice, welding techniques including preheating and sequence, and the performance of welders with sufficient frequency to assure compliance with code and contract document requirements. Check preheating to assure conformance with AWS D1.1, Section 5.6. Verify procedure for control of distortion and shrinkage stresses.
  4. Continuously observe joint preparation and fit up, backing strips, and runout plates for welded moment connections and column splices.
  5. Periodically provide visual inspection of the root pass of partial and complete joint penetration welds.
  6. Visually inspect 100 % of welds for proper size, length, location, and weld quality in accordance with AWS D1.1 requirements. Unless specifically noted otherwise, all welding shall be considered statically loaded nontubular connections.
  7. Visually inspect 100% of completed shear connectors on each beam.
  8. Visually inspect 100% of the welds of anchors to embedded plates that are to be cast into concrete elements.
  9. In addition to the inspections above, perform the following:
    - a. Continuously monitor and observe joint preparation, assembly practice, welding techniques including preheating and sequence, and the performance of welders for 100% of complete and partial joint penetration welds, plug and slot welds, multiple-pass fillet welds, and single-pass fillet welds greater than 5/16 inch. Check preheating to assure conformance with AWS D1.1, Section 5.6. Verify procedure for control of distortion and shrinkage stresses.

- b. Periodically monitor welding of single-pass fillet welds that are less than or equal to 5/16 inch.
  - c. Periodically monitor the welding of headed studs to floor beams.
  - d. Periodically monitor the welding of anchors to embedded plates that are to be cast into concrete elements.
- H. Weld Testing:
- 1. Perform nondestructive examination services using a qualified technician with the necessary equipment to perform the following:
    - a. Nondestructive examination conducted in accordance with the specific requirements for the item being examined including radiographic (RT), ultrasonic (UT), magnetic particle (MT), or dye-penetrant inspection (PT). Nondestructive inspection procedures shall conform to AWS D1.1.
    - b. Interpret, record, and report results of the nondestructive tests.
    - c. Mark for repair, any area not meeting Specification requirements. Correction of rejected welds shall be made in accordance with AWS D1.1.
    - d. Re-examine repair areas and interpret, record, and report the results of examinations of repair welds.
    - e. Verify that quality of welds meet the requirements of AWS D1.1.
  - 2. Fillet Welds: Provide the following:
    - a. MT test a minimum of 10% of the length of each fillet weld exceeding 5/16".
    - b. Periodic MT testing of representative fillet welds 5/16" and less but need not exceed 10% of all such welds, except as required for high rejection rates as indicated in the following paragraph.
    - c. Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.
  - 3. Partial Joint Penetration (PJP) Welds, including Flare-Bevel Groove Welds: Provide the following:
    - a. MT test a minimum of 25% of the length of each PJP weld exceeding 5/16" effective throat.
    - b. Periodic MT testing of representative PJP welds 5/16" and less but need not exceed 10% of all such welds, except as required for high rejection rates as indicated in the following paragraph.
    - c. Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.
  - 4. Complete Joint Penetration (CJP) Welds: Provide the following:
    - a. All CJP welds exceeding 5/16" thickness shall be 100% UT tested per AWS D1.1 Clause 6 Part F. The Testing Laboratory shall review the CJP joints to determine where geometry or accessibility precludes the use of standard scanning patterns per AWS D1.1 Clause 6 Part F. At these locations the testing laboratory shall develop and submit for approval a written testing procedure in accordance with AWS D1.1 Annex S.
    - b. Periodic MT testing of representative CJP welds 5/16" and less not to exceed 10% of all such welds, except as required for high rejection rates as indicated in the following paragraph.
    - c. Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.
  - 5. Acceptance Criteria:
    - a. Visual, MT, PT shall be per AWS D1.1 Table 6.1.
    - b. UT testing shall be per AWS D1.1 6.13.1 and Table 6.2.
  - 6. Base metal thicker than 1.5 inches, where subjected to through-thickness weld shrinkage strains, shall be UT tested for discontinuities behind and adjacent to such welds. UT testing shall occur no sooner than 24 hours after the weld has cooled to ambient temperatures. Any material discontinuities shall be recorded on the basis of ASTM A 435 or ASTM A 898 (Level 1 criteria) and reported for Engineer disposition.
  - 7. Welds of Anchors to Embedded Plates:

- a. Headed Studs: Perform field bend tests according to AWS D1.1 on 2% of the studs welded to plates, but not less than one stud per plate.
  - b. Deformed Bar Anchors: Perform MT testing on 10% of deformed bar anchors larger than 5/8" diameter.
8. The costs of repairing defective welds and the costs of retesting by the Testing Laboratory providing services for the Owner shall be borne by the Contractor. If removal of a backing strip is required by the Testing Laboratory to investigate a suspected weld defect, such cost shall be borne by the Contractor.
- I. High-Strength Bolt Inspection and Process Monitoring: The Testing Laboratory shall perform the following inspections for connections joined with high-strength bolts. Bolting performed in the shop may be inspected in the field unless continuous monitoring of the bolting operation is specified herein:
1. Observe preinstallation verification testing of the pretensioning method to be used in accordance with the requirements of the "Specification for Structural Joints Using High-Strength Bolts".
  2. Check daily the calibration of impact wrenches used in field bolted connections.
  3. Inspect bolt installation for 100% of high strength bolted connections according to inspection procedures outlined in the "Specification for Structural Joints Using High-Strength Bolts".
  4. Monitoring of Bolting Installation:
    - a. Continuous Monitoring: The Testing Laboratory shall be continuously present and monitor the bolting installation for compliance with the selected procedure for installation as specified in the "Specification for Structural Joints Using High-Strength Bolts" for joints using high-strength bolts that are designated on the plans as Pretensioned (PT) or Slip-Critical (SC) type joints and that are being installed using the calibrated wrench method or the turn-of-nut without matchmarking method of installation.
    - b. Periodic Monitoring: All <other> joint types and bolt installation methods shall be monitored on a periodic basis.
- J. High-Strength Bolt Testing: The Testing Laboratory shall perform the following tests for connections joined with high-strength bolts:
1. Perform Arbitration Testing according to procedures outlined in the "Specification for Structural Joints using High-Strength Bolts" when a disagreement exists between the Testing Laboratory and the Fabricator as to the minimum tension of installed bolts that have been inspected according to paragraph below.

### 3.8 STEEL DECKING

- A. Field Inspection:
1. Check steel deck as received in the field for possible shipping damage, workmanship, and identification marking to conform to specified ASTM standards for steel deck.
  2. Periodically monitor the method of attaching the steel floor and roof decking to the structural frame.
  3. Visually inspect 100% of the welding or other attachment method of steel deck to the structure and at sidelaps.

### 3.9 EARTHWORK

- A. Quality Assurance:
- B. Field Testing:
1. Compacted Fill:
    - a. Verification of Fill Material: Perform classification and testing to verify that the fill material to be used complies with the project specifications.
    - b. Field Density Testing: Perform field density testing as described below:

- 1) Field density tests shall be run according to ASTM D 2937 or ASTM D 6938 as applicable.
  - 2) Acceptance Criteria: The results of field density tests by the Laboratory will be considered satisfactory if the average of any three consecutive tests has a value not less than the required density with no single test falling more than 2 percent below the required density and the moisture content conforms to the requirements of the specification.
  - 3) Test Frequency for Paved Areas and Building Slab Subgrade:
    - a) Make at least one field density test of the natural subgrade for every 2500 square feet of paved area or building slab but in no case less than three tests.
    - b) In each compacted fill layer or lift, make one field density test for every 2500 square feet of building slab or paved area but in no case less than three tests.
  - 4) Test Frequency for Foundation Wall Backfill: At each compacted backfill layer, make at least one field density test for each 200 lineal feet of wall with a minimum of 4 tests for the basement walls around the perimeter of each building and a minimum of one test for every other type of foundation wall on the site. Tests shall be performed in random lifts along each wall.
- c. Report Copies: Moisture-density curves and results of field density tests shall be submitted to the parties specified earlier in this section.
  - d. Additional Testing: If reports by the Laboratory indicate field densities lower than specified, additional tests will be run by the Laboratory with at least the frequencies scheduled above on recompacted fill and/or natural subgrade. The Testing Laboratory shall notify the Contractor on a timely basis for any required retesting so as not to delay the work. The costs of such tests shall be liable to the Owner for repayment by the Contractor.
2. Drilled Piers and Underreamed Footings:
    - a. Concrete Cylinders: Make and test concrete cylinders as specified for Cast-in-Place Concrete.
  3. Spread (Excavated) Footings
    - a. Concrete Cylinders: Make and test concrete cylinders as specified for Cast-in-Place Concrete.
- C. Field Inspection by the Testing Laboratory:
1. The Testing Laboratory shall provide inspection of materials used in foundation elements as described below.
  2. Compacted Fill:
    - a. Subgrade below Compacted Fill: Observe and verify that the subgrade below compacted fill has been properly prepared before compact fill construction begins.
    - b. During placement and compaction of fill, determine that the material being used and the maximum lift thickness comply with the specifications.
  3. Drilled Piers:
    - a. Reinforcing Steel: Inspect reinforcing steel for proper number and size of bars and confirm dowel or anchor rod placement into top of pier.
  4. Spread (Excavated) Footings:
    - a. Reinforcing Steel: Inspect reinforcing steel size, number of bars, and placement and confirm dowel or anchor rod placement into footing.
- D. Foundation Inspection by the Geotechnical Engineer: The Geotechnical Engineer of Record shall provide inspection service for the following items before and during foundation installation as appropriate for the foundation type. The Geotechnical Engineer shall submit written field inspection reports promptly after inspection to the parties listed above and report his findings after each inspection by telephone or e-mail to the Engineer.
1. Spread (Excavated) Footing:
    - a. Subgrade: Verify that foundation bearing conditions are consistent with soil report tests and that the footing is being installed in the proper soil strata at the proper

elevation. Make recommendations regarding adjustment to subgrade or bearing elevation if subgrade is not adequate to support footing.

2. Drilled Piers:
  - a. Bearing Elevation: Observe that piers are founded in proper bearing strata as defined in the Geotechnical Report and that bottom of hole is clean and properly formed. Recommend appropriate action if specified bearing elevation does not provide proper strength.
  - b. Bell and Shaft Sizes: Verify that the shaft and bell diameters are within specified tolerances.
  - c. Shaft Stability: Observe the shaft sides as drilling proceeds and recommend appropriate action if sloughing becomes excessive.
  - d. Concrete Quantities: Record quantity of concrete placed in each pier and compare against theoretical quantity required. Report discrepancies to Engineer.
  - e. Placement Method: Observe that piers are placed by approved methods as defined in the Geotechnical Report and in the Specifications. Confirm that casings are being used as recommended in the Geotechnical Report. Confirm that concrete is not being contaminated by soil encroachment into pier.
  - f. Report: For each drilled shaft installed, prepare and submit a report indicating the following information:
    - 1) Name of the Project.
    - 2) Name of the drilling contractor
    - 3) Name of the field superintendent.
    - 4) Pier number and location.
    - 5) Pier shaft diameter.
    - 6) Pier underream diameter (if applicable).
    - 7) Bottom elevation.
    - 8) Top elevation.
    - 9) Pier length.
    - 10) Theoretical volume of concrete in pier.
    - 11) Estimate of actual volume of concrete placed.
    - 12) Reinforcing steel size and depth actually placed.
    - 13) Drilling start and finish time.
    - 14) Concreting start and finish time.
    - 15) Variation from specified tolerances including surveyed location and plumbness.
    - 16) Construction method (dry method, casing method, or slurry displacement method).
    - 17) Groundwater conditions (rate of water infiltration and depth of water in hole prior to concreting for dry piers; water elevation in hole for wet piers).
    - 18) Elevation of top and bottom of any casing left in place.
    - 19) Description of temporary or permanent casing (including purpose, diameter, wall thickness and length).
    - 20) Description and elevation of any obstructions encountered and whether removal was obtained
    - 21) Description of pier bottom including amount and extent of loose material.
    - 22) Method of concrete placement.
    - 23) Any difficulties encountered in drilling or concreting operations.
    - 24) Any deviations from specifications.

The report shall be signed by a licensed engineer in the state where the project is located.

- E. Pile Load Test: The Geotechnical Engineer shall supervise a pile load test(s) as specified on the drawings according to **ASTM D 1143**. He/she shall submit a written report of his findings to the parties listed above and report, by telephone or e-mail to the Engineer, the results of the pile load tests. Refer to the Pile Specifications for additional requirements of the test.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
  - 1. Section 01 10 00 "Summary" for work restrictions and limitations on utility interruptions.

**1.2 USE CHARGES**

- A. Installation, removal, and use charges for temporary facilities to be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to Architect, Owner's Representative, occupants of Project, testing agencies, and authorities having jurisdiction.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
  - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
  - 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
  - 3. Indicate methods to be used to avoid trapping water in finished work.
- E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
  - 1. Locations of dust-control partitions at each phase of work.
  - 2. HVAC system isolation schematic drawing.
  - 3. Location of proposed air-filtration system discharge.
  - 4. Waste-handling procedures.
  - 5. Other dust-control measures.

- F. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by Owner. Include the following:
1. Methods used to meet the goals and requirements of Owner.
  2. Concrete cutting method(s) to be used.
  3. Location of construction devices on the site.
  4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
  5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with Owner.
  6. Indicate locations of sensitive equipment areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

#### 1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

#### 1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

### PART 2 - PRODUCTS

#### 2.1 TEMPORARY FACILITIES

- A. Field Offices:
1. Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
1. Two Hoteling Offices offices, approximately 10' x 12'.
    - a. Four tables and two castered task chairs.
    - b. Four hardline internet connections with a minimum speed of 100 Mbps.
    - c. Two dedicated Design Team parking spots adjacent to Field Office.
    - d. Four task lights.
    - e. Four walls shall have tack boards.
    - f. Two 3' x 6' white boards.
  2. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.
  3. Conference room of sufficient size to accommodate meetings of 120 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.

4. Drinking water and private toilet.
  5. Coffee machine and supplies
  6. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
  7. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
  8. Separate men's and women's restroom facilities.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
1. Store combustible materials apart from building.

## 2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- C. Air-Filtration Units: Primary and secondary pre-filter media-equipped units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously. Refer to approved Construction Indoor Air Quality Plan.
- D. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Owner approved Project identification signs.
  2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
    - a. Provide temporary, directional signs for construction personnel and visitors.
  3. Maintain and touch up signs, so they are legible at all times.

## PART 3 - EXECUTION

### 3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

### 3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
1. Locate facilities to limit site disturbance as specified in Section 01 10 00 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

**3.3 TEMPORARY UTILITY INSTALLATION**

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
  - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
  - 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- G. Electric Power Service:
  - 1. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
    - a. Install electric power service exposed and out of the way unless otherwise indicated.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
  - 2. Install lighting for Project identification sign.
  - 3. At each telephone, post a list of important telephone numbers.
    - a. Police and fire departments.
    - b. Ambulance service.
    - c. Contractor's home office.
    - d. Contractor's emergency after-hours telephone number.
    - e. Architect's office.
    - f. Engineers' offices.
    - g. Owner's office.
    - h. Principal subcontractors' field and home offices.
  - 4. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

**3.4 SUPPORT FACILITIES INSTALLATION**

- A. Comply with the following:
1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E 136. Comply with NFPA 241.
  2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
  2. Prepare subgrade and install subbase and base for temporary roads and paved areas in accordance with Section 31 20 00 "Earth Moving."
  3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
  4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course in accordance with Section 32 12 16 "Asphalt Paving."
- D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.
- E. Parking: Provide temporary parking areas for construction personnel.
- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
  2. Remove snow and ice as required to minimize accumulations.
- G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Owner approved Project identification signs.
  2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
    - a. Provide temporary, directional signs for construction personnel and visitors.
  3. Maintain and touch up signs, so they are legible at all times.
- H. Waste Disposal Facilities:
1. Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."
  2. Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 "Execution."

- I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
  - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- J. Temporary Elevator Use: Temporary use of elevators is permitted. See Section 14 21 00 "Electric Traction Elevators."
- K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- L. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

### 3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
  - 1. Comply with work restrictions specified in Section 01 10 00 "Summary."
- C. Temporary Erosion and Sedimentation Control:
  - 1. Comply with requirements specified in Section 31 10 25 "Erosion Control."
- D. Temporary Erosion and Sedimentation Control: Refer to Bid Package #01 – Mass Grading. Insert local regulations for environmental protection.
- E. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- F. Tree and Plant Protection:
  - 1. Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- G. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
- H. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
  - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
  - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner and one set to Owner's Representative.
- I. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- J. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

- K. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program, and approved plan from Authority Having Jurisdiction and Fire Marshal.
  - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
  - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.
- M. Temporary Heat/Cooling: Use of newly installed HVAC systems will be permitted for temporary heating and cooling provided equipment shall be maintained per manufacturer's recommendations. At Substantial Completion, restore equipment to condition existing before initial use, including replacing filters, worn parts or sensors and items of limited life. Equipment warranties will be unaffected by early use and maintained as specified in Contract Documents.

### 3.6 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
  - 1. Protect porous materials from water damage.
  - 2. Protect stored and installed material from flowing or standing water.
  - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
  - 4. Remove standing water from decks.
  - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
  - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  - 2. Keep interior spaces reasonably clean and protected from water damage.
  - 3. Periodically collect and remove waste containing cellulose or other organic matter.
  - 4. Discard or replace water-damaged material.
  - 5. Do not install material that is wet.
  - 6. Discard and replace stored or installed material that begins to grow mold.
  - 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
  - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
  - 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.

3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
  - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
  - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
  - c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

### **3.7 OPERATION, TERMINATION, AND REMOVAL**

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when the need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
  3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION



**SECTION 01 60 00 - PRODUCT REQUIREMENTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. The Work of This Section Includes: Administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Section 01 25 00 "Substitution Procedures" for requests for substitutions.
  - 2. Section 01 33 00 "Submittal Procedures."
  - 3. Section 01 42 00 "References" for applicable industry standards for products specified.

**1.2 DEFINITIONS**

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products unless otherwise indicated.
  - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.
  - 1. Evaluating Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

### 1.3 ACTION SUBMITTALS

- A. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
  - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
  - 2. Data indicating compliance with the requirements specified in "Comparable Products" Article.
  - 3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 10 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
    - a. Form of Approval: As specified in Section 01 33 00 "Submittal Procedures."
    - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 33 00 "Submittal Procedures."
- C. Substitution: Refer to Section 01 25 00 "Substitution Procedures" for definition and limitations on substitutions.

### 1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
  - 1. Resolution of Compatibility Disputes between Multiple Contractors:
    - a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
    - b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Architect will determine which products will be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
  - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is inconspicuous.
  - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
    - a. Name of product and manufacturer.
    - b. Model and serial number.
    - c. Capacity.
    - d. Speed.
    - e. Ratings.
  - 3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

### 1.5 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

**1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  - 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
  - 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
  - 2. Store products to allow for inspection and measurement of quantity or counting of units.
  - 3. Store materials in a manner that will not endanger Project structure.
  - 4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
  - 5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
  - 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
  - 7. Protect stored products from damage and liquids from freezing.
  - 8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

**1.7 PRODUCT WARRANTIES**

- A. Warranties specified in other Sections are to be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of Owner or endorsed by manufacturer to Owner.
  - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
  - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  - 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
  - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00 "Closeout Procedures."

**PART 2 - PRODUCTS****2.1 PRODUCT SELECTION PROCEDURES**

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.
  5. Descriptive, performance, and reference standard requirements in Specifications establish salient characteristics of products.
  6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
    - a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by Architect, whose determination is final.
- B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
  2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
  3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
    - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
  4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
    - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
    - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
  6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
    - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
    - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
  7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
    - a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 25 00 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.
1. Select products for which sustainable design documentation submittals are available from manufacturer.

## 2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those of the named in the Specification. Significant product qualities include attributes such as type, function, performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.

3. Evidence that proposed product provides specified warranty.
  4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
  5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and title. If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for a comparable product. Architect will notify Contractor of approval or rejection of proposed comparable product within ten days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
  2. Architect's Approval of Submittal: See Section 01 33 00 "Submittal Procedures."
  3. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 "Submittal Procedures." Show compliance with requirements.
- D. Submittal Requirements, Two-Step Process: Approval by Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- E. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

**PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**SECTION 01 73 00 - EXECUTION****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering.
  - 3. Installation.
  - 4. Cutting and patching.
  - 5. Coordination of Owner's portion of the Work.
  - 6. Progress cleaning.
  - 7. Starting and adjusting.
  - 8. Protection of installed construction.
  - 9. Correction of the Work.
- B. Related Requirements:
  - 1. Section 01 10 00 "Summary" for limits on use of Project site.
  - 2. Section 01 33 00 "Submittal Procedures" for submitting surveys.
  - 3. Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
  - 4. Section 07 84 13 "Penetration Firestopping" for patching penetrations in fire-rated construction.

**1.2 DEFINITIONS**

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

**1.3 PREINSTALLATION MEETINGS**

- A. Cutting and Patching Conference: Conduct conference at Project site.
  - 1. Prior to submitting cutting and patching plan commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
    - a. Contractor's superintendent.
    - b. Trade supervisor responsible for cutting operations.
    - c. Trade supervisor(s) responsible for patching of each type of substrate.
    - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
  - 2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

- B. Layout Conference: Conduct conference at Project site.
  - 1. Prior to establishing layout of new and existing perimeter and structural column grid(s), review building location requirements. Review benchmark, control point, and layout and dimension requirements. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:
    - a. Contractor's superintendent.
    - b. Professional surveyor responsible for performing Project surveying and layout.
    - c. Professional surveyor responsible for performing site survey serving as basis for Project design.
  - 2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
  - 3. Review requirements for including layouts on Shop Drawings and other submittals.
  - 4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Owner to provide benchmarks and control points. Once benchmarks and control points have been established, general contractor shall be responsible for protecting and maintaining survey information.
- C. Certified Surveys: Submit two copies signed by land surveyor.
- D. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.
- E. Cutting and Patching Plan: Submit plan describing procedures at least ten days prior to the time cutting and patching will be performed. Include the following information:
  - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
  - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
  - 3. Products: List products to be used for patching and firms or entities that will perform patching work.
  - 4. Dates: Indicate when cutting and patching will be performed.
  - 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
    - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
- F. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.



**1.6 QUALITY ASSURANCE**

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated. Owner to provide benchmarks and control points. Once benchmarks and control points have been established, general contractor shall be responsible for protecting and maintaining survey information.
- B. Professional Engineer Qualifications: Refer to Section 01 40 00 "Quality Requirements."
- C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
  - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
    - a. Concrete
      - 1) Drilled Piers
      - 2) Footings
      - 3) Columns
      - 4) Beams
      - 5) Walls
      - 6) Joist
      - 7) Elevated Slabs
    - b. Precast Concrete
      - 1) Stadia
      - 2) Walls
      - 3) Horizontal slabs
    - c. Structural Masonry Walls
    - d. Structural Steel Framing
      - 1) Including metal floor and roof deck
      - 2) Bracing and bracing connection gussets
      - 3) Exterior wall supports
      - 4) Kickers and bar joist bridging
    - e. Cold-formed roof framing
    - f. Exterior cold-formed wall and soffit framing
  - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
    - a. Primary operational systems and equipment.
    - b. Fire separation assemblies.
    - c. Air or smoke barriers.
    - d. Fire-suppression systems.
    - e. Plumbing piping systems.
    - f. Mechanical systems piping and ducts.
    - g. Control systems.
    - h. Communication systems.
    - i. Fire-detection and -alarm systems.
    - j. Conveying systems.
    - k. Electrical wiring systems.
    - l. Operating systems of special construction.
    - m. Security Systems.
    - n. Structured Cabling.
    - o. Videoboard Display Systems.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
    - a. Water, moisture, or vapor barriers.
    - b. Membranes and flashings.
    - c. Exterior curtain-wall construction.
    - d. Sprayed fire-resistive material.
    - e. Equipment supports.
    - f. Piping, ductwork, vessels, and equipment.
    - g. Noise- and vibration-control elements and systems.
  4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- D. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- E. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
  1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
  2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
  - 1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
  - 2. List of detrimental conditions, including substrates.
  - 3. List of unacceptable installation tolerances.
  - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor submit a request for information to Architect in accordance with requirements in Section 01 31 00 "Project Management and Coordination."

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.
- B. Engage a licensed land surveyor experienced in laying out the Work, using the following accepted surveying practices:
  - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  - 2. Establish limits on use of Project site.
  - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  - 4. Inform installers of lines and levels to which they must comply.
  - 5. Check the location, level and plumb, of every major element as the Work progresses.
  - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.

7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

### 3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
  1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
  2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
  1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage an experienced licensed land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by an experienced licensed land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
  1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
  2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

### 3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  1. Make vertical work plumb, and make horizontal work level.

2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
  4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
  - C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
  - D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
  - E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
  - F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
  - G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
  - H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
    1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
    2. Allow for building movement, including thermal expansion and contraction.
    3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
  - I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

### **3.6 CUTTING AND PATCHING**

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Temporary Support: Provide temporary support of Work to be cut.
- C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- D. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  6. Proceed with patching after construction operations requiring cutting are complete.
- E. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
  4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- F. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### 3.7 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
  2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

**3.8 PROGRESS CLEANING**

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
  - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00 "Temporary Facilities and Controls.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

**3.9 STARTING AND ADJUSTING**

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 91 13 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

### **3.10 PROTECTION OF INSTALLED CONSTRUCTION**

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

### **3.11 CORRECTION OF THE WORK**

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION



**SECTION 01 77 00 - CLOSEOUT PROCEDURES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final Completion procedures.
  - 3. List of incomplete items.
  - 4. Submittal of Project warranties.
  - 5. Final cleaning.
  - 6. Repair of the Work.
- B. Related Requirements:
  - 1. Section 01 73 00 "Execution" for progress cleaning of Project site.
  - 2. Section 01 78 23 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
  - 3. Section 01 78 39 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 4. Section 01 79 00 "Demonstration and Training" for requirements to train Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

**1.2 DEFINITIONS**

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

**1.4 CLOSEOUT SUBMITTALS**

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest-control inspection.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

**1.6 SUBSTANTIAL COMPLETION PROCEDURES**

- A. Contractor's List of Incomplete Items: Prepare and submit with Substation Completion, a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
  3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
    - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.
  5. Submit testing, adjusting, and balancing records.
  6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00 "Demonstration and Training."
  6. Advise Owner of changeover in utility services.
  7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  9. Complete final cleaning requirements.
  10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
  11. Obtain Code Official approval of thermal envelope air leakage test required by the International Energy Conservation Code (IECC).
    - a. "Whole Building" test per C402.5 – Air Leakage – thermal envelope (Mandatory).
    - b. Conditioned space includes enclosed loading dock.
    - c. Installation verified by Owner's testing agency.

- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 14 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for Final Completion.

## 1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 01 29 00 "Payment Procedures."
  2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list will state that each item has been completed or otherwise resolved for acceptance.
  3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

## 1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order,, listed by room or space number.
  2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Project number.
    - c. Date.
    - d. Name of Architect.
    - e. Name of Contractor.
    - f. Page number.
  4. Submit list of incomplete items in the following format:
    - a. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).
    - b. MS Excel electronic file. Attached will return annotated file.
    - c. PDF electronic file. Architect will return annotated file.

## 1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
  - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2 -by-11-inch paper.
  - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number or Installer.
  - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES" Project name, and name of Contractor.
  - 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
  - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

## PART 3 - EXECUTION

### 3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.

- d. Remove tools, construction equipment, machinery, and surplus material from Project site.
  - e. Remove snow and ice to provide safe access to building.
  - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
  - g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
  - h. Sweep concrete floors broom clean in unoccupied spaces.
  - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
  - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - k. Remove labels that are not permanent.
  - l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
    - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
  - p. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
  - q. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 01 50 00 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 01 50 00 "Temporary Facilities and Controls."

### 3.2 CORRECTION OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
  - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
  - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
  - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION

**SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory.
  - 2. Emergency manuals.
  - 3. Operation manuals for systems, subsystems, and equipment.
  - 4. Product maintenance manuals.
  - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
  - 1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

**1.2 DEFINITIONS**

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

**1.3 CLOSEOUT SUBMITTALS**

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
  - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
    - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
    - b. Enable inserted reviewer comments on draft submittals.
  - 2. One paper copy. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return the copy.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least fifteen days before commencing demonstration and training. Architect will return copy with comments.
  - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within fifteen days of receipt of Architect's comments and prior to commencing demonstration and training.

**PART 2 - PRODUCTS****2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY**

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
  - 1. List of documents.
  - 2. List of systems.
  - 3. List of equipment.
  - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

**2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS**

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page.
  - 2. Table of contents.
  - 3. Manual contents.
- B. Title Page: Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name and contact information for Contractor.
  - 6. Name and contact information for Architect.
  - 7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  - 8. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
  - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.



1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

### 2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
  1. Type of emergency.
  2. Emergency instructions.
  3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
  1. Fire.
  2. Flood.
  3. Gas leak.
  4. Water leak.
  5. Power failure.
  6. Water outage.
  7. System, subsystem, or equipment failure.
  8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
  1. Instructions on stopping.
  2. Shutdown instructions for each type of emergency.
  3. Operating instructions for conditions outside normal operating limits.
  4. Required sequences for electric or electronic systems.
  5. Special operating instructions and procedures.

### 2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  2. Performance and design criteria if Contractor has delegated design responsibility.
  3. Operating standards.
  4. Operating procedures.
  5. Operating logs.
  6. Wiring diagrams.
  7. Control diagrams.
  8. Piped system diagrams.
  9. Precautions against improper use.
  10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.
  4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.
  7. Performance curves.
  8. Engineering data and tests.
  9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.
  5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Seasonal and weekend operating instructions.
  8. Required sequences for electric or electronic systems.
  9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

## 2.5 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
  2. Manufacturer's name.
  3. Color, pattern, and texture.
  4. Material and chemical composition.
  5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
  2. Types of cleaning agents to be used and methods of cleaning.
  3. List of cleaning agents and methods of cleaning detrimental to product.
  4. Schedule for routine cleaning and maintenance.
  5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

## 2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  - 1. Standard maintenance instructions and bulletins.
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - 3. Identification and nomenclature of parts and components.
  - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions.
  - 2. Troubleshooting guide.
  - 3. Precautions against improper maintenance.
  - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - 5. Aligning, adjusting, and checking instructions.
  - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
  - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

## PART 3 - EXECUTION

### 3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
  - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
  - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
  - 1. Do not use original project record documents as part of operation and maintenance manuals.
  - 2. Comply with requirements of newly prepared record Drawings in Section 01 78 39 "Project Record Documents."
- G. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION

**SECTION 01 78 39 - PROJECT RECORD DOCUMENTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.
- B. Related Requirements:
  - 1. Section 01 73 00 "Execution" for final property survey.
  - 2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
  - 3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

**1.2 CLOSEOUT SUBMITTALS**

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit of PDF electronic files of marked-up record prints.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
  - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

**1.3 RECORD DRAWINGS**

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
  - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding photographic documentation.
  - 2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.

- c. Depths of foundations.
  - d. Locations and depths of underground utilities.
  - e. Revisions to routing of piping and conduits.
  - f. Revisions to electrical circuitry.
  - g. Actual equipment locations.
  - h. Duct size and routing.
  - i. Locations of concealed internal utilities.
  - j. Changes made by Change Order or Construction Change Directive.
  - k. Changes made following Architect's written orders.
  - l. Details not on the original Contract Drawings.
  - m. Field records for variable and concealed conditions.
  - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
  2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  3. Refer instances of uncertainty to Architect for resolution.
  4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
    - a. See Section 01 33 00 "Submittal Procedures" for requirements related to use of Architect's digital data files.
    - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Format: Annotated PDF electronic file with comment function enabled.
  3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  4. Identification: As follows:
    - a. Project name.
    - b. Project number.
    - c. Date.
    - d. Designation "PROJECT RECORD DRAWINGS."
    - e. Name of Architect.
    - f. Name of Contractor.

#### 1.4 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
  5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.
- B. Format: Submit record specifications as annotated PDF electronic file.

### **1.5 RECORD PRODUCT DATA**

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
- B. Format: Submit Record Product Data as annotated PDF electronic file.
1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

### **1.6 MISCELLANEOUS RECORD SUBMITTALS**

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

### **1.7 MAINTENANCE OF RECORD DOCUMENTS**

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 01 79 00 - DEMONSTRATION AND TRAINING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.
  - 3. Demonstration and training video recordings.

**1.2 INFORMATIONAL SUBMITTALS**

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
  - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For instructor and videographer.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

**1.3 CLOSEOUT SUBMITTALS**

- A. Demonstration and Training Video Recordings: Submit one copy within seven days of end of each training module.
  - 1. Identification: On each copy, provide an applied label with the following information:
    - a. Name of Project.
    - b. Project number.
    - c. Name and address of videographer.
    - d. Name of Architect.
    - e. Name of Construction Manager.
    - f. Name of Contractor.
    - g. Date of video recording.
  - 2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
  - 3. At completion of training, submit complete training manual(s) for Owner's use in PDF electronic file format.

**1.4 QUALITY ASSURANCE**

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.

- B. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- C. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
  - 1. Inspect and discuss locations and other facilities required for instruction.
  - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
  - 3. Review required content of instruction.
  - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

## 1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

## PART 2 - PRODUCTS

### 2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.
  - 2. Documentation: Review the following items in detail:
    - a. Emergency manuals.
    - b. Operations manuals.
    - c. Maintenance manuals.
    - d. Project record documents.
    - e. Identification systems.
    - f. Warranties and bonds.
    - g. Maintenance service agreements and similar continuing commitments.
  - 3. Emergencies: Include the following, as applicable:
    - a. Instructions on meaning of warnings, trouble indications, and error messages.
    - b. Instructions on stopping.

- c. Shutdown instructions for each type of emergency.
- d. Operating instructions for conditions outside of normal operating limits.
- e. Sequences for electric or electronic systems.
- f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
  - a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
  - a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

#### **3.2 INSTRUCTION**

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  1. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, a written, or a demonstration performance-based test.
- E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

### 3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
  1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video: Provide minimum 640 x 480 video resolution converted to .mp4 format file type, on electronic media.
  1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
  2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
  3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
  4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
    - a. Name of Contractor/Installer.
    - b. Business address.
    - c. Business phone number.
    - d. Point of contact.
    - e. E-mail address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
  1. Film training session(s) in segments not to exceed 15 minutes.
    - a. Produce segments to present a single significant piece of equipment per segment.
    - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
    - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
  1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 03 10 00 – CONCRETE FORMING AND ACCESSORIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

**1.2 SUMMARY**

- A. Section includes formwork, shoring, reshoring, backshoring, falsework, bracing, and other temporary supports required to form and support all cast-in-place concrete shown on the drawings.
- B. Related Requirements:
  - 1. Specification **014000** “**Quality Requirements**” for requirements of material testing and inspection.
  - 2. Specification **014529** “**Structural Testing and Inspections**” for inspection requirements associated with forming and accessories.
  - 3. Specification **032000** “**Concrete Reinforcing**” for reinforcement associated with cast-in-place concrete.
  - 4. Specification **033000** “**Cast-in-Place Concrete**” for cast-in-place concrete and related products.

**1.3 REFERENCES**

- A. Definitions:
  - 1. Formwork: The total system of support for freshly placed concrete, including the mold or sheathing that contacts the concrete and all supporting members, hardware, and necessary bracing.
  - 2. Professional Engineer: A professional engineer who is licensed to practice engineering in the state where the project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with concrete formwork that are similar to that indicated for this Project in material.
  - 3. Shores: Vertical or inclined support members designed to carry the weight of formwork, concrete, and construction loads above.
- B. Reference Standards:
  - 1. Comply with the provision of the following codes, specifications, and standards except where more stringent requirements are shown or specified:
    - a. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
    - b. ACI 301 - Specifications for Structural Concrete.
    - c. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
    - d. ACI 347R - Guide to Formwork for Concrete; 2014.
    - e. ASME A17.1 - Safety Code for Elevators and Escalators; 2013.
    - f. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
    - g. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
    - h. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

- i. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.
- j. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2015a.
- k. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- l. PS 1 - Structural Plywood; 2009.
- m. CRSI, "Manual of Standard Practice."

#### 1.4 RESPONSIBILITY

- A. The design, construction, and safety of all formwork shall be the responsibility of the Contractor. All forms, shores, reshores, backshores, falsework, bracing, and other temporary supports shall be engineered to support all loads imposed including the wet weight of concrete, construction equipment, live loads, lateral loads due to wind and wet concrete imbalance. The Contractor shall also be responsible for determining when temporary supports, shores, reshores, backshores, and other bracing may be safely removed.

#### 1.5 SUBMITTALS

- A. Shop Drawings:
  1. Formwork Drawings: Formwork drawings, prepared under the supervision and sealed by the formwork design engineer, shall be submitted for Owner's record and shall be reviewed by the Engineer for conformance to structural layout only. Such shop drawings shall indicate all dimensions and types of materials, sizes, lengths, connection details, design allowance for construction loads, anchors, form ties, shores, braces, construction joints, reveals, camber, openings, formwork coatings, and all other pertinent information.
- B. Temporary Structure Design Submittals: Submit the following items for the Owner's records:
  1. Design Calculations: Submit, for record purposes, calculations of all concrete formwork sealed by the formwork design engineer.

#### 1.6 QUALITY ASSURANCE

- A. Qualifications:
  1. Licensed Professionals: The formwork design engineer retained by the Contractor shall be a professional engineer registered in the state where the project is located and shall be experienced in the design of concrete formwork.

### PART 2 - PRODUCTS

#### 2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Unless otherwise specified, formwork for exposed concrete surfaces as defined by the Surface Finish Class noted on the drawings, shall consist of plywood, metal, metal framed plywood, or other acceptable surface. Formwork shall provide a continuous straight and smooth surface conforming to the joint system as specified on the Architect's drawings. Form material shall have sufficient thickness to withstand pressure of concrete without bow or deflection. Plywood shall be exterior grade plywood panels, suitable for concrete forms, complying with U.S. Product Standard PS-1, each piece bearing a legible inspection trademark, and as follows:
  1. **[Phenolic Surface Film Overlay over Hardwood Face, Class 1 or better.]**
  2. **[High Density Overlay (100/30 min. rating) on Hardwood Face, Class 1 or better.]**
  3. **[High Density Overlay (100/30 min. rating) on Softwood Face, Class 1 or better.]**



4. **[Medium Density Overlay on Hardwood Face, Class 1 or better, mill-release agent treated and edge sealed.]**
  5. **[Medium Density Overlay on Softwood Face, Class 1 or better, mill-release agent treated and edge sealed.]**
  6. **[Structural 1, B-B, or better, mill oiled and edged sealed.]**
  7. **["B-B (Concrete Form) Plywood", Class 1, or better, mill-oiled and edge sealed.]**
- B. Non-specific formed concrete: Unless otherwise specified, the default finish for formed surfaces shall be rough-form finish constructed with plywood, lumber, metal, or other acceptable material. Lumber shall be dressed on at least two edges and one side for tight fit. The minimum grade shall be B-C, exterior grade.
- C. Textured-form finished concrete: For exposed surfaces as noted on the drawings provide units of form face design, size, arrangement and configuration that matches Architect's control sample. Provide solid backing and form supports to ensure stability of textured form liners. See Architect's drawings, specifications and control sample for special form textured finish concrete.

## 2.2 FORMWORK COATINGS

- A. Formwork coatings shall be of a commercial formulation that will not bond with, stain, nor adversely affect concrete surfaces or impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede curing with water or curing compounds. Provide a product that has a maximum VOC (Volatile Organic Compounds) of 50 g/l but not greater than that permitted by the local government agency having jurisdiction in the area where the project is located.
- B. Products: Subject to compliance with requirements, provide one of the following:
1. Dayton Superior; Clean Strip J1EF.
  2. Dayton Superior; Farm Fresh XL.
  3. W.R. Meadows; Duogard II.

## 2.3 NAILS AND FASTENERS

- A. Use only galvanized nails and fasteners for securing formwork in structures exposed to weather or unconditioned spaces such as garages, canopies, and porte-cocheres.

## 2.4 FORM TIES

- A. Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to minimize spalling of concrete on removal.
1. Exposed Surfaces: For surfaces designated with Surface Finish Class SF-2.x or SF-3.x, furnish units that will leave no portion of the tie closer than 3/4 inch to the plane of the concrete surface and that will leave holes not larger than one inch in diameter in concrete surface when the ends or end-fasteners have been removed.
  2. Dampproofed Surfaces: Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.
  3. Exposed to Weather or Unconditioned Space: Provide removable, glass-fiber-reinforced plastic, stainless steel, or galvanized form ties that will leave no corrodible metal closer than 1 1/2 inches in surfaces that will be exposed to weather or in an unconditioned space in the final structure. The ties shall leave holes no larger than one inch in diameter in concrete surfaces when the ends or end-fasteners are removed.

**2.5 CHAMFER STRIPS**

- A. Provide wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

**PART 3 - EXECUTION****3.1 FABRICATION AND CONSTRUCTION**

- A. Design, erect, support, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic construction loads that might be applied until the concrete structure can support such loads.
  - 1. The formwork design engineer shall design the concrete formwork, formwork removal, shoring, reshoring, and backshoring.
- B. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of concrete mortar.
- C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
- D. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- E. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and patch forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- F. Chamfer exposed corners and edges as indicated, using specified chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.

**3.2 CLEANING AND TIGHTENING**

- A. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and all other debris just prior to concrete placement. Retighten forms and bracing prior to concrete placement as required to prevent concrete mortar leaks and maintain proper alignment.

**3.3 CLEANING AND RE-USE OF FORMS**

- A. Forms reused in the work shall be repaired and cleaned. Split, frayed, delaminated, or otherwise damaged facing material will not be acceptable for exposed surfaces. Forms intended for successive concrete placement shall have surfaces cleaned, fins and laitance removed, and joints tightened to avoid surface offsets. New form coating compound shall be applied to reused forms. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating compound manufacturer's directions.

Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

### 3.4 TOLERANCES

- A. Unless specified otherwise, all tolerances for concrete formwork shall conform to ACI Standard 117, "Standard Tolerances for Concrete Construction and Materials". Before concrete placement the Contractor shall check lines and levels of erected formwork and make any corrections and adjustments as required to ensure proper size and location of concrete members and stability of forming systems. During concrete placement the Contractor shall check formwork and supports to ensure that forms have not displaced and that completed work will be within specified tolerances.

### 3.5 REMOVAL OF FORMS AND SUPPORTS

- A. Determination by Contractor's Registered Engineer: The Contractor's registered professional engineer shall determine and submit for Owner's record the time and sequence of formwork and shore removal subject to the criteria as specified below. The submittal shall clearly distinguish between reshoring and backshoring procedures.
- B. Determining in situ Strength of Concrete: The General Contractor shall be responsible for making and curing concrete cylinders, cured under field conditions, for the purpose of determining concrete strength at time of form and shore removal. Such cylinders shall be made by the Contractor and tested by his testing laboratory. Alternatively, the in situ strength of concrete may be determined by the Maturity Method following the requirements of ASTM C 1074. An acceptable system for this method is the "intelliRock" system manufactured and supplied by EngiUS Constructive Intelligence of Stillwater, OK.
- C. Records of Weather Conditions: The Contractor shall be responsible for keeping records of weather conditions to be used in the decision on when to remove forms.
- D. Formwork Not Supporting Concrete: Formwork not supporting concrete, such as sides of beams, walls, columns and similar parts of the structure, may be removed after cumulatively (not necessarily consecutively) curing at not less than 50°F for 12 hours after placing concrete, provided the concrete is sufficiently hard so as not to be damaged by form removal operations and provided curing and protection operations are maintained. If ambient air temperatures remain below 50°F, if retarding agents are used, or if Type II and Type V Portland cement is used, then this specified minimum period shall be increased as required to safely remove the forms without damage to the concrete. Where such forms also support formwork for slab or beam soffits, the removal times of the latter shall govern.
- E. Formwork Supporting Weight of Concrete: Formwork supporting weight of concrete such as beam soffits, joists, slabs and other structural elements shall not be removed until concrete has attained at least the following percentages of the design compressive strength:
  - 1. Joists, Beam Bottoms: 70%, but not less than 2,800 psi.
  - 2. Slabs: 70%, but not less than 2,800 psi.

### 3.6 FIELD QUALITY CONTROL

- A. Field Inspection: Refer to Specification 014529 "Structural Testing and Inspections" for inspection requirements associated with forming and accessories.

END OF SECTION

**SECTION 03 20 00 – CONCRETE REINFORCING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

**1.2 SUMMARY**

- A. Section includes labor, materials, hardware, equipment, transportation and services required to fabricate and place all reinforcement for cast-in-place concrete including bars, welded wire reinforcement, ties and supports shown on the drawings and as specified. Prestressing reinforcement is specified in Post-Tensioned Concrete and/or Precast Concrete sections of the specifications.
- B. Related Requirements:
1. Specification 014000 "Quality Requirements" for requirements of material testing and inspection.
  2. Specification 014529 "Structural Testing and Inspections" for testing and inspection requirements associated with concrete reinforcing.
  3. Specification 031000 "Concrete Forming and Accessories" for forming associated with cast-in-place concrete.
  4. Specification **033000** "Cast-in-Place Concrete" for cast-in-place concrete and related products.

**1.3 REFERENCES**

- A. Reference Standards:
1. Comply with all provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified:
    - a. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
    - b. ACI 301, "Specifications for Structural Concrete for Buildings."
    - c. ANSI/AWS D1.4, "Structural Welding Code – Reinforcing Steel."
    - d. CRSI, "Manual of Standard Practice."

**1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
1. Quality Control: The Contractor is responsible for quality control, including workmanship and materials furnished by subcontractors and suppliers.
  2. Document Conflict and Precedence: In case of conflict among documents, including architectural and structural drawings and specifications, notify the Architect/Engineer prior to submitting proposal. In case of conflict between and/or among the structural drawings and specifications, the strictest interpretation shall govern, unless specified otherwise in writing by the Architect/Engineer.
- B. Preinstallation Meetings: The Reinforcing-Placing subcontractor shall attend the Pre-Concrete Conference conducted by the Concrete Contractor as described in Specification **033000** "Cast-in-Place Concrete."

**1.5 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items including mechanical splices, hooked anchorage systems, large-headed stud punching shear reinforcement, dowel bar replacement systems, and dowel bar sleeves. For fiber reinforcement, submit manufacturer's product data, including application rate and mixing instructions.
- B. Shop Drawings:
  - 1. Submit shop drawings for all reinforcing steel and related accessories for the Engineer's approval. Shop drawings shall show arrangement and layout, bending and assembly diagrams, bar schedules, stirrup spacing, splicing and laps of bars and shall be prepared in accordance with CRSI Standards.
- C. Certificates:
  - 1. Submit, for record, mill certificates and/or test results signed by Producer, for all reinforcement.
- D. Test and Evaluation Reports:
  - 1. Submit International Code Council (ICC) Evaluation Service Reports indicating approval from ICC Evaluation Service, Inc. for mechanical splices, hooked anchorage systems, large-headed stud punching shear reinforcement and dowel bar replacement systems.
  - 2. Submit test results for deformed bar material not identifiable as outlined in Part 2 below.
- E. Qualification Statements: Submit welding certificates.
- F. Environmental Product Declarations:
  - 1. To encourage the use of building products that are working to minimize their environmental and health impacts, consideration will be given to products with publicly available Environmental Product Declarations (EPDs). For all reinforcement proposed to be used on the project submit one of the following that applies to the product:
    - a. Product-specific Type III EPD with internal or external review that conform to ISO 14025, and EN 15804 or ISO 21930 and has at least a cradle to gate scope and that is valid at time of submission.
    - b. Industry Wide Type III EPD. A letter from the rebar fabricator, on fabricator's letterhead, stating that they and the mill(s) that will provide the rebar, participated in the CRSI Industry-Wide Environmental Product Declaration for Steel Reinforcement Bar issued September 20, 2022.
    - c. A letter from the fabricator, on fabricator's letterhead, stating that either they and/or the mills they propose to use to furnish the reinforcement do not have a product specific EPD nor was a participant in an industry wide EPD.
  - 2. Submit required EPDs at time of bid. If the availability of EPDs varies based on proposed reinforcement product, please indicate which products have EPDs.

**1.6 QUALITY ASSURANCE**

- A. Testing Laboratory Requirements: The Owner's Testing Laboratory shall:
  - 1. Review the Welding Procedure Specification (WPS) submitted by the Contractor for any reinforcing steel other than ASTM A 706 that is proposed to be welded for consistency with acceptable welding practices and AWS.
  - 2. Review the welder qualifications by certification or verify by retesting and shall obtain the welder certificates.
- B. Welder Qualifications: Qualify procedures and personnel according to ANSI/AWS D1.4.

**PART 2 - PRODUCTS****2.1 MATERIALS****A. Steel Reinforcement:**

1. Reinforcing materials shall be delivered from the mill in bundles that are identified as to heat number and manufacturer and accompanied with mill and analysis test reports and an affidavit from the supplier stating that the material conforms to the requirements of the governing ASTM specification listed herein.
2. Reinforcing Bars: Reinforcing bars shall conform to ASTM A 615, Grade 60 as noted on the drawings.
3. Weldable Reinforcing Bars: All reinforcing bars noted on the drawings as being required to be welded shall conform to ASTM A 706, Grade 60.
4. Deformed Bar Anchors: 3/8" to 5/8" diameter AWS Type C studs manufactured in conformance with ASTM A 1064 with a minimum yield strength of 70,000 psi and a tensile strength of 80,000 PSI. 3/4" or larger diameter, ASTM A 706 bars of equal size with welds to steel substrate that develop the full strength of the anchor. ASTM A 615 reinforcing bars may not be substituted for deformed bar anchors. Reinforcement shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Service Report submitted for Engineer review. The following are acceptable products, provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
  - a. Nelson Stud Welding, Inc.; Nelson D2L Deformed Bar Anchor Studs (ESR-2907).
  - b. Tru-Weld Division, TFP Corporation; Deformed Bar Anchors (ESR-2823).
5. Plain Steel Welded Wire Reinforcement: ASTM A 1064 with a yield strength of 65,000 PSI. Provide in flat sheets only.
6. Deformed-Steel Welded Wire Reinforcement: ASTM A 1064 with a yield strength of 70,000 PSI. Provide in flat sheets only.
7. Galvanized Plain-Steel Welded Wire Reinforcement: ASTM A 1064, fabricated from galvanized steel wire into flat sheets.
8. Wire: Smooth wire for spiral reinforcement shall conform to ASTM A 82 with a minimum yield strength of 70,000 PSI.

**B. Fiber Reinforcement:**

1. Synthetic Micro Fiber Reinforcement: Collated, fibrillated, or monofilament polypropylene, cellulose, or multi-filament nylon fibers conforming to ASTM C 1116, Type III or Type IV. Reinforcement shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Service Report submitted for Engineer review. The following are acceptable products, provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
  - a. The Euclid Chemical Company; Fiberstrand Series.
  - b. Forta Corporation; Econo-Mono or Econo-Net (ESR-2720).
  - c. Propex Concrete Systems Corp.; Fibermesh 300 (ESR-1165).
  - d. W.R. Grace & Company; Grace Microfibers (ESR-1506).
  - e. Nycon, Inc.; Nycon RC.
  - f. Buckeye Technologies; UltraFiber 500 (ESR-1032).
  - g. BASF Construction Chemicals; MasterFiber M or F series.
  - h. Maccaferri; Fibromac.
2. Synthetic Macro Fiber Reinforcement: Monofilament polypropylene/polyethylene fibers conforming to ASTM C 1116, Type III having an aspect ratio between 50 and 90 and a minimum tensile strength of 90 KSI. The fiber lengths shall be between 1.5 and 2 inches long. Reinforcement shall be approved by the ICC-Evaluation Service, Inc. and shall have the Evaluation Service Report submitted for Engineer review. The following are acceptable products, provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
  - a. The Euclid Chemical Company; Tuf-Strand SF.
  - b. Forta Corp.; Forta-Ferro.

- c. W.R. Grace; Strux 90/40.
- d. Propex Concrete Systems, Corp.; Fibermesh 650.
- e. Bekaert Corp.; Synmix.
- f. BASF Construction Chemicals; MasterFiber MAC.

## 2.2 SPLICES

- A. Dowel Bar Replacement: All grade 60 reinforcing steel dowel bars shown on the drawings crossing concrete construction joint surfaces with inserts cast flush against the form and having reinforcing bars connected to the insert in a subsequent concrete pour shall conform to the following:
  - 1. Splice connection to the insert shall develop the 1.25 times the specified yield strength and the full tensile strength of the spliced bar.
  - 2. Splices shall be approved by the ICC Evaluation Service, Inc. as expressed in an ICC Evaluation Service Report which shall be submitted for review.
  - 3. The following are acceptable products (for use only with grade 60 bars), provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
    - a. Dextra Manufacturing Co., Ltd.; Bartec Mechanical Splice System for Steel Reinforcing Bars in Concrete (ESR-1705).
    - b. nVent Electric, plc.; Lenton Form Saver SA (IAPMO-UES 0129).
- B. Hooked Anchorage Replacement: Reinforcing bar terminations shall be manufactured out of ASTM A 576, ASTM A 615, or A 706 material and shall develop the full tensile strength of the bar when installed at the manufacturer's recommended depth.
  - 1. The anchorage shall be approved by the ICC Evaluation Service Inc. as expressed in an ICC Evaluation Service Report which shall be submitted for review.
  - 2. The following are acceptable products (for use only with grade 60 bars), provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
    - a. Dextra Manufacturing Co., Ltd; Bartec Mechanical Anchorages for Steel Reinforcing Bars in Concrete (ESR-2166).
    - b. Headed Reinforcement Corporation; HRC 555 Headed Reinforcing Bars (ESR-2935).
    - c. Headed Reinforcement Corporation; HRC 670 HeadLock (IAPMO-UES 0177).
    - d. nVent Electric plc.; Lenton Terminator (IAPMO-UES 0188).
    - e. nVent Electric plc.; Lenton Ultimate (IAPMO-UES 0188)

## 2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: Smooth bars used to dowel across slab-on-grade construction joints shall conform to ASTM A 615, Grade 40 or ASTM A 36, plain-steel bars. Cut bars true to length with ends square and free of burrs.
- B. Dowel Bar Sleeves: Plastic or gage metal (26 gauge minimum) sleeves with an inside diameter of 1/16 inch greater than the dowel bar that it encases, that have the strength, durability, and design to provide free movement of the dowel relative to the concrete slab and that are specifically manufactured for this purpose.
- C. Alternate Slab-on-Grade Joint Load Transfer Systems: A system that consists of flat, ASTM A 36 plate that is saw cut into a square or rectangular shape and is embedded into or encased by a plastic sleeve that allows movement in both lateral directions but not in the vertical direction. Acceptable systems are manufactured by PNA Construction Technologies with products known by the names "Diamond Dowel System" and "PD<sup>3</sup> Basket" and Greenstreak Group Inc. with products known as "Speed Plate" and "Double-Tapered Basket".
- D. Tie Wire: Tie wire shall be annealed steel tie wire, minimum 16 gauge.
  - a. Tie wire in architecturally exposed concrete shall be plastic coated or stainless steel.
  - b. Tie wire for epoxy-coated reinforcement shall be epoxy-coated.



- c. Tie wire for galvanized reinforcement shall be galvanized.
- E. Holding Wire: Holding wire shall conform to ASTM A 82 or ASTM A 1064.
- F. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Use wire bar type supports complying with CRSI recommendations.
  - 1. Slabs-on-Grade: Use precast concrete bar supports (dobies) or supports with sand plates or horizontal runners designed for use on ground.
  - 2. Spread Footing Bottom Reinforcement: Use precast concrete bar supports (dobies) or chairs designed for soil-supported slabs.
  - 3. Mat Foundation: Use precast concrete bar supports (dobies), chairs designed for soil-supported slabs, or cast-in-place concrete curbs.
  - 4. Exposed to View Concrete: Provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

## 2.4 ALTERNATES:

- 1. Products Requiring International Code Council (ICC) Evaluation Service Reports:
  - a. For those products listed in Part 2 as requiring Evaluation Service Reports (ESRs), alternate products that do not have ESRs will be considered by the Engineer only if valid research reports or test data from an independent and approved agency is provided and use of the product receives prior approval from the Building Official.

## PART 3 - EXECUTION

### 3.1 FABRICATION AND DELIVERY

- A. Bending and Forming: Fabricate bars of indicated sizes and accurately form to shapes and lengths indicated and required, by methods not injurious to materials. Do not heat reinforcement for bending. Bars shall be free from injurious defects, have a workman-like finish with no excessive rust and/or pitting, and have no unusual kinks or bends.
- B. Marking and Shipping: Bundle reinforcement and tag in accordance with Section 7.4.5 of the CRSI "Manual of Standard Practice." Transport and store at site so as not to damage material. Keep sufficient supply of tested, approved, and proper reinforcement at the site to avoid delays. Maintain reinforcing bars free of mud, dirt, grease, or other coating.

### 3.2 PLACING REINFORCEMENT

- A. Comply with CRSI recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports and as herein specified.
- B. Before placing reinforcement and again before concrete is placed, clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by chairs, runners, bolsters, spacers, and hangers as required. Exercise particular care to maintain proper distance and clearance between parallel bars and between bars and forms. Provide spreaders and spacers to hold steel in position. Support steel at proper height upon approved chairs.
- D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set tie wires so ends are directed into concrete, not toward exposed concrete surfaces.

- E. Support of Wall Reinforcing Steel:
  - 1. It is the responsibility of the contractor to ensure that all reinforcing assemblies have adequate strength and stability to resist loads imposed during construction.
- F. Support of Spread Footing Reinforcing Steel:
  - 1. Bottom Steel: Support bottom reinforcing mat to provide the specified clearance to the bars. Spacing between supports shall not exceed 4'-0" centers each way.
  - 2. Top Steel: Support top reinforcing on steel angle frames braced in both directions or on special standee support bars. Spacing between supports shall not exceed 4'-0" centers each way. The depth of the supports shall provide the specified clearance from the bars to the top of the concrete. The design of the support steel shall be the responsibility of the Contractor.
- G. Install welded wire reinforcement in as long lengths as practicable. Provide lap splice for wires of adjoining pieces per ACI 318 Chapter 25.5.3 or 25.5.4 and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.
- H. Coordinate with other trades and expedite materials and labor to avoid omissions and delay.
- I. Install waterproof membrane or vapor retarder as specified prior to placing steel for concrete slabs-on-grade.
- J. Extend reinforcement continuous through construction joints unless otherwise shown on the drawings.
- K. Slab-on-Grade Joint Dowel Bars: Support slab-on-grade joint dowel bars independently of support for slab reinforcement on soil supported slab bolsters or specially manufactured cradles such that dowel bar remains parallel to slab surface and at right angles to joint during concreting operations. Lightly coat the exposed end of the dowel with a paraffin-base lubricant, asphalt emulsion, form oil, or grease or use a dowel bar sleeve.
- L. Alternate Slab-on-Grade Joint Load Transfer Systems: Install the alternate load transfer system in accordance with the manufacturer's instructions such that the largest plane of the flat plate is parallel to the plane of the subgrade on which the slab is bearing.
- M. Provide and place additional reinforcing steel at all sleeves and openings in beams, slabs, and walls as specified on the drawings. Where sleeves or openings not shown on the drawings interrupt the reinforcement, consult with Engineer for instructions for placing and splicing of bars. Provide required additional reinforcing steel at no additional cost to the Owner.
- N. Do not bend reinforcement that is embedded partially in concrete except in locations noted on the drawings or approved by the Engineer.

### **3.3 SPLICING REINFORCING STEEL**

- A. Provide splices as indicated on the drawings. Splice reinforcing bars only at locations shown on the structural drawings and approved shop drawings. Unauthorized or unscheduled splices not approved by the Engineer in writing will not be accepted.
- B. All lap splices in reinforcing steel shall be contact lap splices unless detailed otherwise on the drawings.
- C. Maintain proper cover and spacing between reinforcing bars at splices.
- D. Lap unscheduled reinforcing bars not otherwise specified with a Class B lap splice. Lap welded wire reinforcement per ACI 318 Chapter 25.5.3 or 25.5.4.
- E. Manufacturer of mechanical tension splice shall be present for first day's installation.

**3.4 WELDING REINFORCING STEEL**

- A. Welding reinforcing steel is permitted only where specifically shown on the drawings. All welding shall conform to AWS D1.4. Only weldable reinforcing steel conforming to ASTM A 706 or deformed bar anchors conforming to ASTM A 1064 shall be permitted. ASTM A 615 bars may not be welded for structural use.
- B. Tack welding of reinforcement shall not be permitted.
- C. Fusion welding of preassembled cages shall be permitted only under the following conditions:
  - 1. Written approval is received from the Building Official and the Engineer.
  - 2. Fusion welding of holding wires to ties, stirrups, and hoops in beams, columns and grade beams to preassemble reinforcing cages is permissible. The holding wire area shall not exceed five percent of the beam, column, or grade beam cross sectional longitudinal steel area. Fusion welding is not allowed to longitudinal reinforcing steel in any beam, column, or grade beam.
  - 3. Fusion welding of holding wires to the ends of the reinforcing steel placed in spread footings or mats is permitted if the fusion weld occurs within six bar diameters of the free end of the bar. Fusion welding is not allowed at the end of coupled, T-headed, or weld spliced bars.
  - 4. Fusion welding of holding wires shall not occur on a bent portion of a reinforcing bar. Bars shall not be bent where a fusion weld occurs.

**3.5 SHRINKAGE AND TEMPERATURE REINFORCEMENT**

- A. Provide shrinkage and temperature reinforcement as indicated on the drawings at right angles to main top and bottom bars for all structural slabs unless detailed otherwise on the drawings.

**3.6 PLACEMENT OF WELDED WIRE REINFORCEMENT**

- A. Wherever welded wire reinforcement is specified as reinforcement in pan-formed beams or slabs, it shall be continuous and properly lapped per ACI 318 Chapter 25.5.3 or 25.5.4 across the entire concrete surface and not interrupted by beam or girders.

**3.7 REINFORCEMENT IN COMPOSITE STEEL DECK SLAB**

- A. Composite steel deck slabs shall be reinforced as indicated on the drawings.
- B. Extra Reinforcement over Girders: Provide additional reinforcing steel over interior girders as shown on the drawings.
- C. Placement of Slab Reinforcement: Provide bolsters, high chairs, and/or additional reinforcing as shown in details on the drawings to support the reinforcing with the clear cover shown on the drawings.

**3.8 REINFORCEMENT AROUND OPENINGS IN COMPOSITE STEEL DECK SLABS**

- A. For all openings in steel deck not framed with structural steel and greater than 10" in width in either direction, provide additional reinforcing steel as shown in details on the drawings.

**3.9 REINFORCEMENT IN GRADE BEAMS**

- A. Provide reinforcing in grade beams as shown on the drawings.
- B. Bar Support for Grade Beam Cages: Grade beam bottom steel shall be supported at 5'-0" maximum centers using beam bolsters that provide bottom cover to the reinforcing steel as noted on the drawings. Beam bolsters used shall be designed and manufactured for support on soil.

**3.10 REINFORCEMENT IN TOPPING SLABS**

- A. Provide reinforcing in topping slabs as shown on the drawings.

**3.11 REINFORCEMENT IN HOUSEKEEPING PADS**

- A. Provide welded smooth wire reinforcement 6 x 6 W2.9 x W2.9 minimum in all housekeeping pads supporting mechanical equipment unless detailed otherwise on the drawings.
- B. Provide reinforcing in housekeeping pads as shown on the drawings.

**3.12 MECHANICAL AND PLUMBING REQUIREMENTS**

- A. Refer to Mechanical and Plumbing Drawings for concrete requiring reinforcing steel. Such reinforcement shall be furnished as part of the work of this section.

**3.13 FIELD QUALITY CONTROL**

- A. Field Testing and Inspection: Refer to Specification **014529 “Structural Testing and Inspections”** for testing and inspection requirements associated with concrete reinforcing.

END OF SECTION

THIS IS INTENTIONALLY LEFT BLANK

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 03 30 00 – CAST-IN-PLACE CONCRETE****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

**1.2 SUMMARY**

- A. Section includes all labor, materials, services, equipment, and hardware required in conjunction with or related to the forming, delivery, and pouring of all cast-in-place concrete work. Concrete paving and walks are specified in Division 32. Architectural Concrete, Precast Concrete, Post-Tensioned Concrete and special requirements for Tilt-Up Concrete are specified in other Division 03 sections.
- B. Related Requirements:
  - 1. Specification **014000 “Quality Requirements”** for requirements of material testing and inspection.
  - 2. Specification **014529 “Structural Testing and Inspections”** for inspection requirements associated with cast-in-place concrete.
  - 3. Specification 031000 “Concrete Forming and Accessories” for forming associated with cast-in-place concrete.
  - 4. Specification 032000 “Concrete Reinforcing” for reinforcement for cast-in-place concrete.
  - 5. Specification 072616 “Below-Grade Vapor Retarders.”

**1.3 REFERENCES**

- A. Reference Standards:
  - 1. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:
    - a. ACI 117, “Specifications for Tolerances for Concrete Construction and Materials.”
    - b. ACI 301, “Specifications for Structural Concrete.”
    - c. ACI 305.1, “Specification for Hot Weather Concreting.”
    - d. ACI 318, “Building Code Requirements for Structural Concrete.”
    - e. ACI 355.4, “Qualification of Post-Installed Adhesive Anchors in Concrete.”
    - f. CRSI, “Manual of Standard Practice.”

**1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Quality Control: The Contractor is responsible for quality control, including workmanship and materials furnished by subcontractors and suppliers.
  - 2. Document Conflict and Precedence: In case of conflict among documents, including architectural and structural drawings and specifications, notify the Architect/Engineer prior to submitting proposal. In case of conflict between and/or among the structural drawings and specifications, the strictest interpretation shall govern, unless specified otherwise in writing by the Architect/Engineer.
  - 3. Materials and installed work may require testing and retesting, as directed by the governing building code or the Architect/Engineer, at any time during progress of work.
    - a. The Contractor shall provide adequate notification to the Owner’s Testing Agency of construction operations including the project schedule to allow the Testing Agency to schedule inspections. Failure to notify sufficiently may result in additional costs

- incurred by the Testing Laboratory that may be back-charged to the Contractor by the Owner.
- b. The Contractor shall cooperate with laboratory personnel, provide access to the work, and provide access to manufacturer's operations.
  - c. The Contractor shall make adequate arrangement with the Owner's Testing Agency for inspection of material stockpiles and facilities.
  - d. The Contractor shall provide to the laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.
  - e. The Contractor shall furnish casual labor, equipment, and facilities as required for sampling and testing by the laboratory and otherwise facilitate the required inspections and tests.
  - f. Inspection or testing by the Owner does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents. Tests not specifically indicated to be done at the Owner's expense, including retesting of rejected materials and installed work, shall be done at the Contractor's expense. See Structural Testing and Inspections section of the Specifications.
4. Responsibility for Selection and Use of Concrete Admixtures and Chemical Treatments: The Contractor shall be responsible for selecting admixtures and surface treatments that are compatible with the intended use of the concrete including all final surface treatments called for within this or other specifications or on the structural or architectural drawings. The Contractor is responsible for following the manufacturer's instructions for the use of their product including abiding by any limitations placed by the manufacturer on the use of any of its products.
- B. Preinstallation Meetings:
1. Design Mixture Conference: At least 30 days prior to submittal of design concrete mixtures, the Contractor shall hold a meeting or telephone conference to review the detailed requirements for preparing the design concrete mixtures. Participants shall include representatives from the Contractor, Owner's Testing Laboratory, Concrete Supplier, Architect, and Engineer.
  2. Pre-Concrete Conference:
    - a. At least seven days prior to beginning concrete work, the Contractor shall conduct a meeting to review the proposed design mixtures and to discuss required methods and procedures to produce concrete construction of the required quality. Also, review requirements for submittals, status of coordinating work and availability of materials. Establish work progress schedule and procedures for materials inspection, testing, and certifications. The contractor shall send a pre-concrete conference agenda to all attendees seven days prior to the scheduled date of the conference.
    - b. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:
      - 1) Contractor's Superintendent.
      - 2) Laboratory responsible for the concrete design mix.
      - 3) Laboratory responsible for field quality control.
      - 4) Concrete Subcontractor.
      - 5) Ready-Mix Concrete Producer.
      - 6) Admixture Supplier.
      - 7) Concrete Pumping Contractor.
      - 8) Fiber Reinforcement Representative.
      - 9) Owner's and Architect's/Engineer's Representative.
    - c. The pre-concrete conference shall review the following items:
      - 1) Special inspection and testing and inspecting agency procedures for field quality control.
      - 2) Construction joints, control joints, isolation joints, and joint-filler strips.



- 3) Semirigid joint fillers.
  - 4) Vapor-retarder installation.
  - 5) Anchor rod and anchorage device installation tolerances.
  - 6) Cold and hot weather concreting procedures.
  - 7) Concrete finishes and finishing.
  - 8) Curing procedures.
  - 9) Forms and form-removal limitations.
  - 10) Shoring and reshoring procedures.
  - 11) Methods for achieving specified floor and slab flatness and levelness.
  - 12) Floor and slab flatness and levelness measurements.
  - 13) Concrete repair procedures.
  - 14) Concrete protection.
- d. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed to all parties concerned within five days of the meeting. One copy of the minutes shall be transmitted to the following for information purposes:
    - 1) Owner's Representative.
    - 2) Architect.
    - 3) Engineer-of-Record.
  - e. The Engineer shall be present at the conference. The Contractor shall notify the Engineer at least seven days prior to the scheduled date of the conference.
- C. Sequencing:
1. Provide for installation of inserts, hangers, metal ties, anchors, bolts, angle guards, dowels, thimbles, slots, nailing strips, blocking, grounds, and other fastening devices required for attachment of work. Properly locate in cooperation with other trades and secure in position before concrete is poured. Do not install sleeves in any concrete slabs, beams, or columns except where shown on the drawings or upon written approval of the Architect/Engineer.

## 1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items, including patching compounds, epoxies, grouts, waterstops, joint systems, curing compounds, dry-shake finish materials, hardeners, sealers, joint fillers, and others as requested by Architect/Engineer.
- B. Shop Drawings:
  1. Construction Joints: Submit drawings of proposed construction joint locations in concrete for slab-on-grade, mat foundations, structural floors, roofs and walls. Submit any additional or changed reinforcing that is required at construction joints that differs from that shown on the drawings.
  2. Openings, Sleeves, and Cores: Submit drawings of all openings to be formed, sleeved, cored, or sawcut in cast-in-place elements. Drawings shall indicate size and location of openings, sleeves, or cores.
  3. Penetrations in Beams and Joists: Submit drawings locating all horizontal and vertical penetrations in beams and joists. Drawings shall indicate location, size, orientation, and type of penetrations.
  4. Embedded Items: Submit drawings showing all items to be embedded in concrete elements, including plates, angles, bolts, and any non-structural items, such as conduit. Drawings shall indicate location, size, orientation, and type of embedded item.
- C. Samples: Submit samples of materials specified if requested by Architect/Engineer, including names, sources, and descriptions.
- D. Certificates:
  1. Material and Mill Certificates:
    - a. Provide material and mill certificates as specified herein and in the Testing Laboratory section of the Specifications. The Manufacturer and Contractor shall

sign the material and mill certificates certifying that each material item complies with specified requirements.

- E. Concrete Materials:
  - 1. Cementitious Materials:
    - a. Provide cementitious material types and certificates showing compliance with the respective ASTMs.
  - 2. Aggregates:
    - a. Provide types, sizes, pit or quarry locations, producers' names, aggregate supplier statement of compliance with ASTM C33/C33M.
    - b. Provide expansion data from ASTM C1260 or ASTM C1293 for all concrete designated C1, C2 or W1.
  - 3. Admixtures:
    - a. Provide types, brand names, producers' names, manufacturer's technical data sheets, compatibility with other admixtures, and certificates showing compliance with the respective ASTMs.
    - b. Provide certification from admixture manufacturers that chloride ion content complies with specified requirements.
  - 4. Design Mixtures:
    - a. Submit for each concrete mixture as specified in Section 2.9.
    - b. Submit shrinkage test results for all concrete identified on the drawings requiring shrinkage limits.
- F. Field Quality Control Submittals:
  - 1. Surveys: Submit report certifying that all anchor rods and reinforcing dowels into columns above are in their proper location prior to placing of concrete.
- G. Special Procedure Submittals:
  - 1. Hot Weather Concrete: Submit proposed methods of protecting concrete during hot weather conditions.
  - 2. Cold Weather Concrete: Submit proposed methods employed for cold weather placement, temperature measuring methods and protection activities.
- H. Qualification Statements: Submit certifications for adhesive anchor installers.
- I. Environmental Product Declarations:
  - 1. To encourage the use of building products that are working to minimize their environmental and health impacts, consideration will be given to products with publicly available Environmental Product Declarations. For all concrete mixtures submit one of the following that applies to the product:
    - a. Product-specific Type III EPD with internal or external review that conform to ISO 14025, and EN 15804 or ISO 21930 and has at least a cradle to gate scope.
    - b. Industry Wide Type III EPD. A letter from the product manufacturer, on manufacturer's letterhead, stating that the manufacturer, and proposed batch plants, participated in the NRMCA Industry-Wide Environmental Product Declaration.
    - c. A letter from the product manufacturer, on manufacturer's letterhead, stating that the product does not have a product specific EPD nor was a participant in an industry wide EPD.
  - 2. Submit required EPDs at time of bid.
  - 3. Concrete mixes will be evaluated with consideration to their EPDs. Reference maximum cement content, where listed, per the "Classes of Concrete Matrix" in the structural drawings.
  - 4. Upon project completion submit the volume of each concrete mix design used on the project.
- J. Minutes of Preinstallation Meetings: Submit for review.

**1.6 QUALITY ASSURANCE**

- A. Testing Laboratory Requirements: The Owner's Testing Laboratory shall:
1. Concrete Design Mixtures: Review the submitted design mixtures for conformance to the specifications and for suitability for use in the project.
  2. Preinstallation Meetings: Attend the preinstallation meetings referenced above.
  3. Review adhesive anchor installer qualifications by certification. Obtain qualification certificates.
- B. Qualifications:
1. Concrete Supplier: The concrete supplier shall have a minimum of five years of experience in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment. The supplier must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.
  2. Concrete Contractor: The concrete contractor shall have a minimum of five years of experience with installation of concrete similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful service performance.
  3. Adhesive Anchor Installers: The individuals performing the installation of adhesive anchors that are horizontally or upwardly inclined shall be certified in accordance with the ACI/CRSI Adhesive Anchor Installer Certification program.
- C. Survey for Anchor Rods and Reinforcing Steel Dowels: The Contractor shall use a qualified licensed professional engineer or licensed land surveyor to lay out the proper location of all embedded anchor rods and reinforcing steel dowels for columns above before they are encased in concrete. The surveyed locations of such elements shall be submitted to the Architect/Engineer for record, if requested.
- D. Manufacturer Representative Presence:
1. Post-installed anchors: The manufacturer's representative for each post-installed anchor product (adhesive, expansion, undercut, screw, or insert anchor) shall be present during the first day's installation of the product to provide instruction for the correct installation of each type of any to be installed in accordance with the manufacturer's recommendation and the current ICC-ES Evaluation Report.
  2. Fiber-reinforced concrete: The manufacturer's representative for each fiber type shall be present during the first pour in which the fiber is used to verify whether the dosage rate, placing, and finishing method is in accordance with the specifications and the manufacturer's instruction.
- E. Mockups: Provide mock-ups as required.

**PART 2 - PRODUCTS****2.1 CONCRETE MATERIALS**

- A. Refer to the drawings for classes and strengths of concrete required.
- B. Hydraulic Cement:
1. Use ASTM C 150, ASTM C 1157, or ASTM C 595 (excluding Type IS) unless otherwise specified. Do not use Type III cement in slabs-on-grade unless approved in advance by the Engineer.
  2. Concrete Exposed to Sulfates in Soil or Water:
    - a. Exposure Class S1: For concrete designated on the drawings as Exposure Class S1, use ASTM C 150, Type II or ASTM C 1157, Type MS.
    - b. Exposure Class S2: For concrete designated on the drawings as Exposure Class S2, use ASTM C 150, Type V or ASTM C 1157, Type HS.

- c. Alternate Cement Types for Exposure Classes S1 and S2: ASTM C 150, Type I or III cement may be used for concrete designated as Exposure Class S1 or S2 if the tricalcium aluminate ( $C_3A$ ) content is less than eight percent for Exposure Class S1 or five percent for Exposure Class S2. ASTM C 150, Type I or III cement may be used for exposure to seawater if the tricalcium aluminate content does not exceed 10 percent and the water/cementitious material ratio of the concrete mix does not exceed 0.40.
  - d. Exposure Class S3: For concrete designated on the drawings as Exposure Class S3, use ASTM C 150, Type V plus pozzolan or slag or ASTM C 1157, Type HS plus pozzolan or slag or ASTM C 595, Type IP (HS) or Type IS (HS). The amount of pozzolan or slag added or in a blended mix shall be such that has been determined by service record to improve sulfate resistance when used with Type V cement or the amount that when tested according to ASTM C 1012 meets the criteria of Table 26.4.2.2(c) in ACI 318-14.
3. Use one brand of cement, for each class of concrete, throughout the project, unless approved otherwise by the Architect/Engineer and the Owner's Testing Laboratory. Submit mill certificates certifying conformance to this specification for each brand and type of cement.
  4. Testing of cement in lieu of mill certificate submittal will be required if:
    - a. The cement has been in storage at the mixing site for over 30 days.
    - b. It is suspected by the Owner, Architect, Engineer, or Owner's Testing Laboratory that the cement has been damaged in storage or in transit or is in any way defective.
- C. Low-alkali cement: Cement that has the additional requirement that equivalent alkalis ( $Na_2O + 0.658K_2O$ ) do not exceed 0.60% according to ASTM C 150-00, Table 2.
- D. Expansive Cement: ASTM C 845, Type [G or K] [G, K, M, or S].
- E. Fly Ash: ASTM C 618, Class C or F.
- F. Silica Fume: ASTM C 1240, Amorphous Silica.
- G. Slag Cement: ASTM C 989, Grade 100 or 120 or ASTM C 595, Type IS or Type S.
- H. Normalweight Aggregates: ASTM C 33, and as herein specified. Submit material certificates from aggregate supplier or test results from an independent testing agency certifying conformance to this specification for each source of aggregate.
1. Concrete identified on the drawings as Exposure Class C1, C2 or [P1/W1] must meet the Durability Requirements outlined in Section 2.9E.
- I. Water: Comply with the requirements of ASTM C 1602.
- J. Cementitious materials, aggregate, and water must be extracted or recovered as well as manufactured within 500 miles of the project site.

## 2.2 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
1. Subject to compliance with requirements, provide one of the following products and manufacturers:
    - a. GCP Applied Technologies; Darex or Daravair series.
    - b. Master Builder Solutions; MasterAir VR 10, MasterAir AE 90, MasterAir AE 200.
    - c. Sika Corporation; Sika AER.
    - d. The Euclid Chemical Company; Air Mix, AEA-92, Eucon Air 30 or Eucon Air 40.
- B. Water-Reducing Admixture: ASTM C 494, Type A. See maximum permissible chloride ion content in concrete specified below.
1. Subject to compliance with requirements, provide one of the following products and manufacturers:
    - a. Master Builder Solutions; MasterPozzoloth Series or MasterGlenium Series.
    - b. Sika Corporation; Plastocrete 161.

- c. The Euclid Chemical Company; Eucon WR-75, Eucon WR-91, Eucon NW or Eucon LW.
  - d. GCP Applied Technologies; WRDA series, Zyla Series.
- C. Mid-Range Water-Reducing Admixture: ASTM C 494, Type A and Type F. See maximum permissible chloride ion content in concrete specified below.
  - 1. Subject to compliance with requirements, provide one of the following products and manufacturers:
    - a. Master Builders Solutions; MasterPolyheed Series or MasterGlenium Series.
    - b. The Euclid Chemical Company; Eucon MR, Eucon X-15 or Eucon X-20.
    - c. Sika Corporation; SikaPlast-300 GP.
    - d. GCP Applied Technologies; Daracem or Mira series.
- D. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F or Type G. See maximum permissible chloride ion content in concrete specified below.
  - 1. Subject to compliance with requirements, provide one of the following products and manufacturers:
    - a. GCP Applied Technologies; ADVA or Daracem Series.
    - b. Master Builders Solutions; MasterRheobuild 1000 or MasterGlenium Series.
    - c. Sika Corporation; Sikament.
    - d. The Euclid Chemical Company; Eucon 37/1037, Plastol series, Eucon SP or Eucon RD2.
- E. Water-Reducing, Accelerator Admixture (Non-Corrosive, Non-Chloride): ASTM C 494, Type C or E. See maximum permissible chloride ion content in concrete specified below.
  - 1. Subject to compliance with requirements, provide one of the following products and manufacturers:
    - a. GCP Applied Technologies; Polarset, Lubricon NCA, Daraset 400, or DCI.
    - b. Master Builders Solutions; MasterSet FP 20 or MasterSet AC 534.
    - c. The Euclid Chemical Company; Accelguard 80/90, Accelguard NCA, or Accelguard AcN.
    - d. Sika Corporation; Plastocrete 161FL.
- F. Water-Reducing, Retarding Admixture: ASTM C 494, Type D. See maximum permissible chloride ion content in concrete specified below.
  - 1. Subject to compliance with requirements, provide one of the following products and manufacturers:
    - a. GCP Applied Technologies; Daratard series, or Zyla R.
    - b. Master Builders Solutions; MasterPozzolith R series, or MasterSet DELVO series.
    - c. Sika Corporation; Plastiment.
    - d. The Euclid Chemical Company; Eucon Retarder series.
- G. Viscosity Modifying Admixture: Used to enhance plastic concrete properties such as workability, pumpability, and stability for "Self-Consolidating Concrete".
  - 1. Master Builders Solutions; MasterMatrix VMA series.
  - 2. The Euclid Chemical Company; Eucon SL or Viscrol.
  - 3. Sika Corporation; VisoCrete series.
  - 4. GCP Applied Technologies; VMAR series.
- H. Shrinkage Reducing Admixture.
  - 1. Subject to compliance with requirements, provide one of the following products and manufacturers:
    - a. For Air-Entrained Concrete:
      - 1) GCP Applied Technologies; Eclipse 4500.
      - 2) The Euclid Chemical Company; Eucon SRA.
      - 3) Master Builders Solutions; MasterLife CRA 007.
    - b. For Non Air-Entrained Concrete
      - 1) GCP Applied Technologies; Eclipse Floor 200.
      - 2) Master Builders Solutions; MasterLife SRA 20

- I. Crystalline-Forming Waterproofing Admixture: A powder admixture capable of producing concrete that is water tight under hydrostatic pressure up to seven atmospheres when tested in accordance with Corps of Engineers test CRD-C48 and capable of sealing cracks up to 0.4 mm.
  - 1. Products: Subject to compliance with requirements, provide the following at dosage rates per manufacturer's recommendation:
    - a. ICS/Penetron International/Ltd; Penetron Admix.
    - b. Kryton International, Inc.; Krystol Internal Membrane (ESR-1515).
    - c. Xypex Chemical Corporation; Xypex Admix C1000 or C500.
    - d. Sika Corporation; Sika WT-215P
    - e. Master Builders Solutions; MasterLife 300C
    - f. The Euclid Chemical Company; Eucon Vandex AM-10
- J. Moisture Vapor Reduction Admixture: Acceptable products include:
  - 1. Barrier One, Inc.; Barrier-1.
  - 2. USC Technologies, Inc.; Aridus.
  - 3. Concure Systems; Concure Systems Admixture.
  - 4. Specialty Products Group; Vapor Lock VL 20/20.
  - 5. ISE Logik Industries; MVRA 900.
- K. Calcium Chloride: Calcium chloride is not permitted.
- L. Certification: Written conformance to all the above-mentioned requirements and the chloride ion content of the admixture as tested by an accredited laboratory will be required from the admixture manufacturer at the time of design mixture review by the Engineer.

### 2.3 WATERSTOPS

- A. Provide waterstops at all construction joints and other joints in all foundation walls below grade and where shown on the drawings. Size to suit joints and factory fabricate corners, intersections, and directional changes. The selected waterstop products shall be appropriate for the specific joint condition as specified by the manufacturer, including number of layers of reinforcement, minimum concrete thickness and minimum concrete cover.
  - 1. Products:
    - a. Swell Hydrophilic Waterstops:
      - 1) Manufacturers: GCP Applied Technologies; ADCOR ES or ADCOR 500S.
    - b. Preformed Plastic Waterstops: Comply with Federal Specifications SS-S-210A "Sealing Compound for Expansion Joints".
      - 1) Manufacturers: Henry Corporation; Synko-Flex Waterstop
    - c. Bentonite Waterstops:
      - 1) Manufacturers: CETCO; Bentonite Waterstop-RX.

### 2.4 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate or Aluminum Granule Finish: Provide fused aluminum-oxide granules, or crushed emery, as abrasive aggregate for slip-resistive finish. The emery aggregate shall contain not less than 50% aluminum oxide and not less than 20% ferric oxide. The aluminum aggregate material shall contain not less than 95% fused aluminum-oxide granules. Use material that is factory-graded, packaged, rustproof, and non-glazing, and is unaffected by freezing, moisture, and cleaning materials.
  - 1. Subject to compliance with requirements, provide one of the following:
    - a. Dayton-Superior Corporation, Inc; Emery Non-Slip.
    - b. L&M Construction Chemicals, Inc.; Grip-It or Grip-It AO.
    - c. Master Builders Solutions; MasterTop 120SR
- B. Colored, Mineral Aggregate, Dry Shake Surface Hardener: Packaged, dry, combination of materials, consisting of portland cement, graded quartz aggregate, coloring pigments (if required)

and plasticizing admixtures. Use coloring pigments that are finely ground, non-fading mineral oxides, interground with cement. Color, as selected by Architect, unless otherwise indicated.

1. Products: Subject to compliance with requirements, provide one of the following:
    - a. The Euclid Chemical Company; Surfex.
    - b. L&M Construction Chemicals, Inc.; QuartzPlateFF.
    - c. L.M. Scofield Company; Lithochrome.
    - d. BASF Corporation; MasterTop 100.
    - e. Dayton-Superior Corporation, Inc; Quartz-Tuff.
    - f. US Mix Co.; US Spec Dense Top.
    - g. SpecChem, LLC; Quartz Floor Hardener.
  2. Submit manufacturer's certification that product conforms to the requirements specified.
- C. Metallic Aggregate Hardener Finish: Packaged dry, combination of materials consisting of Portland Cement, specially processed and graded iron aggregate, coloring pigments (if required) and plasticizing admixtures. The hardener shall be formulated, processed, and packaged under stringent quality control. Use coloring pigments that are finely ground, non-fading mineral oxides inter-ground with cement. Color as selected by Architect unless otherwise indicated.
1. The Euclid Chemical Company; Euco-Plate HD.
  2. Master Builders Solutions; MasterTop 200.
  3. Dayton-Superior Corporation, Inc; Ferro Tuff.
- D. Non-Oxidizing Metallic Floor Hardener: Packaged dry, combination of materials consisting of portland cement, non-rusting aggregate and plasticizing admixtures.
1. The Euclid Chemical Company; Diamond-Plate.
  2. Master Builders Solutions; MasterTop 210COR.

## 2.5 CURING MATERIALS

- A. Liquid Membrane-Forming Curing and Curing and Sealing Compounds:
1. Water-Based Dissipating Resin Type Curing Compound: Curing Compound shall be a dissipating resin type, which chemically breaks down after approximately four weeks. Membrane forming compound shall meet ASTM C 309, Types 1 or 1D, Class B with a VOC content less than 350 grams per liter.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) The Euclid Chemical Company; Kurez DR VOX.
      - 2) L&M Construction Chemicals; L&M Cure R.
      - 3) Dayton-Superior Company; Clear Resin Cure J11W.
      - 4) W.R. Meadows, Inc; 1100-Clear.
      - 5) US Mix Co.; US Spec Maxcure Resin Clear.
      - 6) SpecChem LLC; SpecRez.
    - b. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with any covering or surface treatments to be applied. Submit any instructions that must be followed prior to any subsequent surface treatments and floor coverings.
  2. High Solids, Water-Based Acrylic Curing and Sealing Compound with Moderate Yellowing Characteristics: Water-Based membrane-forming curing and sealing compound conforming to ASTM C 1315, Type 1, Class B, classified as low odor with a VOC content less than 350 grams per liter. Do not apply to surfaces that are to receive subsequent cementitious toppings, sealers, hardeners, ceramic tile, resilient flooring, vinyl-backed carpet, wood, terrazzo, epoxy overlays or adhesives, or other coating or finishing products.
    - a. Products: Subject to compliance with above requirements, provide one of the following products or equivalent products:
      - 1) Dayton-Superior; Cure & Seal 1315 J22WB.
      - 2) The Euclid Chemical Company; Super Aqua-Cure VOX.
      - 3) L&M Construction Chemicals; Dress & Seal, 30 WB.
      - 4) Master Builders Solutions; Masterkure CC 1315.
      - 5) SpecChem LLC; Cure & Seal WB 25.

- b. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with any covering or surface treatments to be applied. Submit any instructions that must be followed prior to any subsequent surface treatments.
      3. High Solids, Water-Based, Non-Yellowing Curing and Sealing Compound: Water based membrane-forming curing and sealing compound, acrylic type, complying with ASTM C 1315, Type 1, Class A classified as low odor with a VOC content less than 350 grams per liter. Do not apply to surfaces that are to receive subsequent cementitious toppings, sealers, hardeners, ceramic tile resilient flooring, vinyl-backed carpet, wood, terrazzo, epoxy overlays or adhesives, or other coating or finishing products.
        - a. Products: Subject to compliance with requirements, provide one of the following:
          - 1) The Euclid Chemical Company; Super Diamond Clear VOX.
          - 2) L&M Construction Chemicals; Lumiseal WB Plus.
          - 3) Master Builders Solutions; MasterKure CC 1315.
          - 4) Dayton-Superior Corporation; Cure & Seal 1315EF
          - 5) W.R. Meadows, Inc; Vocomp 30.
          - 6) SpecChem LLC; Cure & Seal WB 30.
        - b. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with any covering or surface treatments to be applied. Submit any instructions that must be followed prior to any subsequent surface treatments.
- B. Evaporation Control: Monomolecular film forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss in hot, dry, or windy weather conditions.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. The Euclid Chemical Company; Eucobar.
    - b. L&M Construction Chemicals; E-Con.
    - c. Master Builders Solutions; BASF Corporation; MasterKure ER 50.
    - d. Dayton-Superior Corporation; Aqua Film (J74).
    - e. Sika Corporation; SikaFilm.
    - f. W.R. Meadows, Inc; Sealtight Evapre.
    - g. US Mix Co.; US Spec Monofilm ER.
    - h. SpecChem LLC; SpecFilm RTU.
  2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all coverings and surface treatments to be applied. Submit any instructions that must be followed prior to any subsequent surface treatments.
- C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately nine ounces per square yard, complying with AASHTO M 182, Class 2.
- D. Moisture-Retaining Cover: One of the following, complying with ANSI/ASTM C 171:
  1. Waterproof paper.
  2. Polyethylene film.
  3. Polyethylene-coated burlap.
  4. Polyethylene-coated natural cellulose fabric such as Greenstreak Group, Inc.; Aquacure.
  5. Cover for Industrial Slab: Provide a low permeance moisture-retaining cover that allows a moisture loss of no more than one pound per square yard in 72 hours when tested in accordance with ATSM C 156 for industrial slabs. The material shall be non-staining and meet with requirements of ASTM C 171.

## 2.6 LIQUID FLOOR TREATMENTS

- A. Chemical Hardener: Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than two pounds of fluosilicates per gallon.



1. Products: Subject to compliance with requirements, provide one of the following:
    - a. The Euclid Chemical Company; Surfhard.
    - b. Master Builders Solutions; MasterKure HD 300WB.
    - c. L&M Construction Chemicals; Fluohard.
    - d. SpecChem LLC; Spec-O-Lith.
  2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all coverings or surface treatments to be received. Submit any instructions that must be followed prior to any subsequent surface treatments.
- B. Chemical Curing/Floor Hardener Compound: Sodium silicate based compound that reacts with concrete constituents to harden the surface, resulting in a surface having a maximum abrasion coefficient of 0.25 cubic centimeters per square centimeter when tested in accordance with ASTM C 418.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. The Euclid Chemical Company; Eucosil.
    - b. Master Builders BASF Corporation; MasterKure HD 100WB.
    - c. Dayton-Superior Corporation; Densifier J13.
    - d. L&M Construction Chemicals; Chem Hard.
    - e. W.R. Meadows, Inc; Med-Cure.
    - f. US Mix Co.; US Spec Permasil.
  2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all coverings and surface treatments to be applied. Submit any instructions that must be followed prior to any subsequent surface treatments.
- C. Liquid Sealer/Densifier: High performance, deeply penetrating concrete densifier that is an odorless, colorless, VOC-compliant, non-yellowing silicate-based solution containing a minimum solids content of 20%, 50% of which is silicate.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. The Euclid Chemical Company; Euco Diamond Hard.
    - b. L&M Construction Chemicals; Seal Hard.
    - c. W.R. Meadows, Inc; Liqui-Hard.
- D. Water and Chloride Ion Repelling Penetrating Sealer: Clear, solvent based Silane or Siloxane penetrating sealer which reacts chemically with the concrete surface to function as a Chloride Ion screen with a minimum 90% factor when tested in accordance with NCHRP #244, Series II, 100% solids, and applied in accordance with the manufacturer's recommendation.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Master Builders Solutions; MasterProtect H 1000.
    - b. Lyntal International, Inc.; Iso-flex 618-100 CRS.
    - c. Evonik Industries; Protectosil Chem-Trete BSM-400.
    - d. SpecChem, LLC; SpecSilane 100.
- E. Water and Chloride Ion Repelling Penetrating Sealer: Clear, solvent free, Silane penetrating sealer which reacts chemically with the concrete surface to function as a Chloride Ion screen with a minimum 83% factor when tested in accordance with NCHRP #244, Series II and applied in accordance with the manufacturer's recommendation.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. 40% solids:
      - 1) Master Builders Solutions; MasterProtect H 400.
      - 2) Lyntal International, Inc.; Iso-flex 618-40 WB.
      - 3) SpecChem, LLC; SpecSilane WB 40.
    - b. 100% solids:
      - 1) Evonik Industries; Protectosil BHN.

- F. Moisture Vapor Reduction Sealer: ASTM C 1315 Type 1 Class A, ASTM C 309 Type 1 Class A, penetrating product to have no less than 34% solids content, leaving no sheen. Acceptable products include:
1. Creteseal; CS2000 Spray Apply System.

## 2.7 RELATED MATERIALS

- A. Post-Installed Anchors:
1. Qualified Products:
    - a. Mechanical Anchors: Only anchors having passed Acceptance Criteria 193 for use in cracked concrete and resisting wind and seismic loads shall be approved for use. Reports from the following organizations are acceptable:
      - 1) ICC Evaluation Service Report.
      - 2) IAPMO Uniform Evaluation Services.
    - b. Adhesive Anchoring Systems: Only adhesive anchor systems that comply with the latest revision of ICC-ES Acceptance Criteria 308 for use in cracked concrete and resisting wind and seismic loads shall be approved for use. Reports from the following organizations are acceptable:
      - 1) ICC Evaluation Service Report.
      - 2) IAPMO Uniform Evaluation Services.
  2. Alternate Anchor Approval: Install only anchors identified on the drawings by manufacturer and product. Substitutions using products approved by this Specification may be permitted provided complete design calculations are signed and sealed by a registered professional engineer licensed in the state where the project is located and furnished to the Engineer for review and approval prior to commencement of work. The Contractor shall request design criteria for all conditions where a product substitution is considered. Failure to obtain approval for an anchor substitution may result in the request by the Engineer to remove installed anchors and replace with the product specified on the drawings at the Contractor's expense.
  3. Installation: All installation of post-installed anchors shall be in accordance with the Manufacturer's Printed Installation Instructions (MPII).
  4. Interior Use: All anchors for use in interior conditioned environments free of potential moisture shall be manufactured from carbon steel zinc plated in accordance with Federal Specification QQ-Z-325C, Type II, Class 3.
  5. Exterior or Exposed Use: All anchors for use in exposed or potentially wet environments or for attachment of exterior cladding materials shall be galvanized or stainless steel. Galvanized anchors shall conform to ASTM A 153. Stainless steel anchors shall be manufactured from 300 series stainless steel.
  6. Nuts and Washers: Nuts and washers shall be furnished from the manufacturer and used with the anchors.
  7. Anchor Types:
    - a. Expansion and Undercut Anchors in Concrete:
      - 1) Type: All expansion and undercut anchors in concrete shall be wedge type expansion, sleeve type expansion, or undercut type anchors.
      - 2) Acceptable Products and Manufacturers – Normalweight and Sand-Lightweight Concrete Not on Corrugated Steel Deck:
        - a) Hilti, Inc.; Kwik Bolt TZ2 (ESR-4266).
        - b) Hilti, Inc.; HDA Undercut Anchor (ESR-1546).
        - c) Hilti, Inc.; HSL-4 Heavy Duty Sleeve Anchor (ESR-4386).
        - d) Simpson Strong-Tie Co., Inc.; Strong-Bolt 2 Wedge Anchor (ESR-3037).
        - e) USP Structural Connectors; DUC Undercut Anchor (ESR-1970).
        - f) Dewalt; Power Stud+ SD1 Expansion Anchor (ESR-2818).
        - g) Dewalt; Power Stud+ SD2 Anchor (ESR-2502).
        - h) Dewalt; CCU+ Undercut Anchor (ESR-4810).

- i) Dewalt; Power-Bolt+ Sleeve Anchor (ESR-3260)
- j) MKT Metall-Kunststoff-Technik; SRS TZ Anchor (ESR-2461).
- 3) Acceptable Products and Manufacturers – Normalweight and Sand-Lightweight Concrete on Corrugated Steel Deck:
  - a) Hilti, Inc.; Kwik Bolt TZ2 (ESR-4266).
  - b) Simpson Strong-Tie Co., Inc.; Strong-Bolt 2 Wedge-Anchor (ESR-3037).
  - c) Dewalt; Power Stud+ SD1 Expansion Anchor (ESR-2818).
  - d) Dewalt; Power Stud+ SD2 Anchor (ESR-2502).
- b. Screw and Insert Anchors in Concrete:
  - 1) Acceptable Products and Manufacturers:
    - a) Hilti, Inc.; KWIK HUS-EZ Anchor (ESR-3027).
    - b) Simpson Strong-Tie Co., Inc.; Titen HD (ESR-2713).
    - c) Dewalt; Snake+ Anchor (ESR-2272).
    - d) Dewalt; Screw-Bolt+ (ESR-3889).
- c. Adhesive Anchoring Systems in Concrete:
  - 1) Chemical anchoring of anchors, rods, or reinforcing steel is not allowed for fire-rated assemblies, unless specified provided for in the drawings.
  - 2) Consult with the manufacturer for the minimum temperature of the concrete substrate allowed.
  - 3) Only personnel trained to install adhesive anchors and certified in accordance with the ACI/CRSI Adhesive Anchor Installer Certification Program shall install adhesive anchors, including reinforcing steel.
  - 4) All anchors installed horizontally or upwardly inclined require continuous inspection.
  - 5) All adhesive anchors shall be installed in concrete having a minimum age of 21 days at the time of anchor installation.
  - 6) Acceptable Products and Manufacturers:
    - a) Hilti, Inc.; HIT-HY 200 V3 (ESR-4868).
    - b) Hilti, Inc.; HIT-RE 500 V3 (ESR-3814)
    - c) ITW Red Head; EPCON G5 (ESR-1137).
    - d) ITW Red Head; EPCON S7 (ESR-2308).
    - e) Dewalt; Pure220+ (ESR-5144).
    - f) Dewalt; Pure110+ (ESR-3298).
    - g) Dewalt; AC200+ (ESR-4027).
    - h) Simpson Strong-Tie; SET-XP Adhesive (ESR-2508).
    - i) Simpson Strong-Tie; SET-3G Adhesive (ESR-4057).
    - j) Simpson Strong-Tie; AT-XP (IAPMO ER-263).
  - 7) These products may not be used in concrete cast over corrugated deck.
  - 8) Threaded Rods Chemically Anchored in Concrete:
    - a) Type: Threaded rods installed in holes using a chemical anchoring process shall have a 45° chiseled end on the embedded end.
    - b) Interior Application: Meet the requirements of ASTM A 307, A 36 or A 193, grade B7.
    - c) Exterior Application: Meet the requirements of ASTM A 153 galvanized steel, or F 593, Group 1 or 2, condition CW stainless steel.
  - 9) Steel Reinforcing Bars:
    - a) Reinforcing steel installed shall comply with ASTM A 615 or ASTM A706 unless noted otherwise in the structural drawings. The embedded portions of reinforcing bars must be straight, and free of mill scale, rust, mud, oil and other coatings that may impair the bond with the adhesive.
    - b) Reinforcing bars must not be bent after installation except as permitted in the structural drawings. Heating of reinforcing bars to facilitate field bending is not permitted.

- B. Bonding Compound: Polyvinyl acetate or acrylic base, for use in cosmetic and/or nonstructural repairs.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Acrylic or Styrene Butadiene:
      - 1) Dayton-Superior Corporation; Acrylic Bonding Agent J40.
      - 2) The Euclid Chemical Company; SBR Latex, Akkro-7T.
      - 3) GCP Applied Technologies; Daraweld C.
      - 4) BASF Corporation; MasterEmaco A 400
      - 5) Sika Corporation; SikaLatex.
      - 6) W.R. Meadows, Inc; Acry-Lok.
      - 7) US Mix Co.; US Spec Acrylcoat.
      - 8) SpecChem, LLC; Strong Bond Acrylic Bonder.
    - b. Polyvinyl Acetate (Interior Use Only):
      - 1) The Euclid Chemical Company; Tammsweld.
      - 2) L&M Construction Chemicals; Primer One.
      - 3) Dayton-Superior Corporation; PVA Bonding Agent J41.
      - 4) SpecChem, LLC; SpecWeld.
      - 5) W.R. Meadows, Inc; Intralok.
- C. Epoxy Products: Two-component material suitable for use on dry or damp surface, complying with ASTM C 881.
1. Products for Crack Repair:
    - a. Sika Corporation; Sikadur 35 Hi Mod LV – injection type.
    - b. Sika Corporation; Sikadur 52 – injection type.
    - c. Sika Corporation; Sikadur 55 SLV – gravity feed.
    - d. The Euclid Chemical Company; Dural Injection Gel.
    - e. Dayton-Superior Corporation, Inc; Sure-Inject (J56 or J56SLV).
    - f. BASF Corporation; MasterInject 1000.
    - g. Simpson Strong-Tie Co., Inc.; ETI-LV or ETI-GV – injection type.
    - h. Unitex; Pro-Poxy 100 or Pro-Poxy 50.
    - i. Adhesives Technology; Crackbond LR 321 or Crackbond LR 321 LPL.
    - j. W.R. Meadows, Inc; Rezi-Weld LV.
    - k. SpecChem LLC; SpecPoxy 1000.
  2. Products for Epoxy Mortar Patches:
    - a. Sika Corporation; Sikadur Lo-Mod LV.
    - b. Dayton-Superior Corporation; Sure Patch.
    - c. BASF Corporation; MasterInject 1500.
    - d. Unitex; Pro-Poxy 2500.
    - e. W.R. Meadows, Inc; Rezi-Weld 1000.
    - f. SpecChem, LLC; SpecPoxy Binder.
  3. Products for Epoxying Steel Plates to Concrete: Conform to ASTM C 881-13, Type IV, Grade 3, Class A, B, & C except gel times.
    - a. Sika Corporation; Sikadur 31 Hi-Mod Gel.
    - b. Dayton-Superior Corporation, Inc; Sure Anchor J50 or Sure Bond J58
    - c. BASF Corporation; MasterEmaco ADH 1420.
    - d. Unitex; Pro-Poxy 300.
    - e. The Euclid Chemical Company; Duralcrete Gel.
    - f. SpecChem, LLC; SpecPoxy 3000.
- D. Reglets: Where resilient or elastomeric sheet flashing or bituminous membrane is terminated in reglets, provide reglets of not less than 26 gauge galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.
- E. Contraction and Construction Joint-Filler Material for Slabs-on-Grade: Provide a two-component semi-rigid, 100% solids epoxy having a minimum Shore A Hardness of 80 when tested in accordance with ASTM D 2240. Subject to compliance with requirements, provide one of the following:

1. The Euclid Chemical Company; Euco 700.
  2. Dayton-Superior Corporation, Inc.; Sure Fil J52
  3. BASF Corporation; MasterSeal CR 190.
  4. Metzger/McGuire Co.; MM-80.
  5. W.R. Meadows, Inc; Rezi-Weld Flex.
  6. SpecChem, LLC; SpecPoxy CJ.
- F. Bondbreaker for Construction Joints in Slabs-on-Grade: A dissipating bondbreaking compound containing no silicones, resins, or waxes, and that conforms to ASTM C 309. Subject to compliance with requirements, acceptable manufacturers include the following:
1. Dayton-Superior Corporation, Inc.; Sure-Lift J6WB.
  2. SpecChem, LLC; SpecTilt 100.
- G. Joint-Filler Strips for Isolation Joints in Slabs-on-Grade: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

## 2.8 REPAIR MATERIALS

- A. Self-Leveling Mortars, Underlayment Compound: Freeflowing, self-leveling, pumpable cementitious base compound. Follow manufacturer's instruction regarding the use of a bonding agent.
1. Products: Unless specified otherwise, provide one of the following:
    - a. BASF Corporation; MasterTop 110 SL.
    - b. The Euclid Chemical Company; Flo-Top, Super Flo-Top.
    - c. Dayton-Superior Corporation, Inc; Levelayer.
    - d. US Mix Co.; US Spec Self-Leveling Underlayment.
    - e. The Euclid Chemical Company; Level Magic Lightweight.
    - f. SpecChem, LLC; SpecFlow.
- B. Polymer Patching Mortar: Polymer and microsilica modified cementitious-based compounds.
1. Products:
    - a. Horizontal Application:
      - 1) The Euclid Chemical Company; Thin Top Supreme, Concrete Top Supreme.
      - 2) Sika Corporation; Sikatop 121 Plus or Sikatop 122 Plus.
      - 3) BASF Corporation; MasterEmaco T 310CI.
      - 4) BASF Corporation; MasterEmaco N424 or N423 RS.
      - 5) US Mix Co.; US Spec H2 or NuTop.
      - 6) The Euclid Chemical Company; Speed Crete PM.
      - 7) SpecChem, LLC; RepCon H.
      - 8) Dayton-Superior Corporation; Thin Resurfacer or Special Patch.
    - b. Upwardly Inclined Application:
      - 1) The Euclid Chemical Company; Verticoat or Verticoat Supreme.
      - 2) Sika Corporation; Sikatop 123 Plus.
      - 3) BASF Corporation; MasterEmaco N 350CI.
      - 4) BASF Corporation; MasterEmaco N423 RS.
      - 5) US Mix Co.; US Spec V/O Patch CI.
      - 6) The Euclid Chemical Company; Speed Crete PM.
      - 7) SpecChem, LLC; RepCon V/O.
      - 8) Dayton-Superior Corporation; Civil/Structural VO.
- C. High Strength Flowing Repair Mortar: For forming and pouring structural members, or large horizontal repairs, provide flowable one-part, high strength microsilica polymer modified repair mortar with 3/8" aggregate. The product shall achieve 9,000 PSI at 28-days at a nine inch slump.
1. Products:
    - a. BASF Corporation; MasterEmaco T 1060.
    - b. US Mix Co.; US Spec STR Mortar.
    - c. The Euclid Chemical Company; Eucocrete.

- d. The Euclid Chemical Company; Tamms Form and Pour.
  - e. SpecChem, LLC; RepCon 928.
  - f. Dayton-Superior Corporation; Civil/Structural FPX.
- D. Anti-Corrosive Epoxy/Cementitious Adhesive: Water-based epoxy/cementitious compound for adhesion and corrosion protection of reinforcing members (20 hour maximum open time).
- 1. Products:
    - a. The Euclid Chemical Company; Duralprep A.C.
    - b. Sika Corporation; Sika Armatec 110 Epocem.
    - c. BASF Corporation; MasterEmaco P 124.
    - d. Dayton-Superior Corporation; Perma Prime 3C.

## 2.9 PROPORTIONING AND DESIGN OF CONCRETE MIXTURES

- A. The Contractor shall submit design concrete mixtures for each class of concrete indicated on the structural drawings and in the Specifications for approval by the Engineer and Owner's Testing Laboratory at least 15 working days prior to the start of construction. If required, the Contractor shall engage the services of an independent Testing Laboratory to assist in preparing the design mixtures. The Contractor shall not begin work with a particular mixture until that design mixture has been approved.
- B. The Contractor, acting in conjunction with his Concrete Supplier and his Testing Laboratory, shall submit in writing, with his design mixtures, the method used to select mixture proportions. Either of the following methods, as outlined in ACI 301, may be used:
- 1. Field Experience Method.
  - 2. Laboratory Trial Mixture Method.
- C. Required types of concrete and compressive strengths shall be as indicated on the Structural Drawings.
- D. All design mixtures shall state the following information:
- 1. Design mixture number or code designation by which the Contractor shall order the concrete from the Supplier.
  - 2. Identify design mixture usage (i.e., columns, shear walls, footings, slab-on-grade, etc.).
  - 3. Wet and dry unit weights.
  - 4. Compressive strength and associated age (28-day, 56-day, etc.).
  - 5. Aggregate type, source, size, gradation, fineness modulus.
  - 6. Cement type and brand.
  - 7. Fly ash or other pozzolan type and brand (if any).
  - 8. Admixtures including air entrainment, water reducers, high-range water reducers, accelerators, and retarders.
  - 9. Design slump or slump/flow.
  - 10. Proportions of each material used.
  - 11. Water/cementitious ratio and maximum allowable water content.
  - 12. Method by which the concrete is intended to be placed (bucket, chute, or pump).
  - 13. Required average strength qualification calculations per ACI 301 4.2.3.3a and 4.2.3.3b. Submit separate qualification calculations for each production facility that will supply concrete to the project.
  - 14. Documentation of Average Strength (Trial Mixture Data or Field Test Data) per ACI 301: When field test data is used to qualify average strength, submit separate documentation for each production facility that will supply concrete to the project.
  - 15. Field test data submitted for qualification of average strength under ACI 301 shall include copies of the Concrete Testing Agency's reports from which the data was compiled.
- E. Durability Requirements:
- 1. For concrete identified on the drawings as Exposure Classes C1, C2, or **[P1/W1]**, use one of the following options to qualify the concrete mixtures to reduce the potential of alkali-silica reaction.

- a. Use aggregate with an expansion of not more than 0.04% at one-year when tested in accordance with ASTM C1293.
  - b. Limit the total alkali content in concrete to 4.0 pounds per cubic yard of concrete for aggregate with an expansion value greater than or equal to 0.04% and less than 0.12% when test in accordance with ASTM C1293.
  - c. Limit the total alkali content in concrete to 3.0 pounds per cubic yard of concrete for aggregate with an expansion value greater than or equal to 0.12% and less than 0.24% per ASTM C1293
  - d. Limit the expansion for each aggregate to 0.10% at 16 days when tested in accordance with ASTM C1567.
- F. Supplementary Cementitious Materials: Fly ash and/or ground granulated blast-furnace slag replacement of Portland cement shall be within percentage replacement levels listed on the drawings unless noted otherwise. Every effort should be made to reduce the amount of cement to the minimum practical amount, and still achieve performance requirements contained in the Contract Documents.
1. Cement replacement shall not exceed a percentage level that has been shown by experience on other projects to exhibit satisfactory performance using materials from identical sources as proposed for this project. As an alternate, trial concrete batches can be performed to identify design mixtures that maximize cement replacement while meeting strength requirements per ACI 301 and finishability criteria.
  2. The use of fly ash or slag in architecturally exposed structural concrete shall be coordinated with the Architect, Engineer, and Contractor.
  3. Overall replacement percentages with combined fly ash and slag shall not exceed the maximum identified with slag or be less than the minimum identified with fly ash for each type of element. In addition, the replacement percentage of fly ash within the combined mixture shall not exceed the maximum identified with fly ash alone.
  4. Replacement percentages exceeding the maximum may be permitted at the discretion of the Architect, Engineer of Record, and Contractor.
  5. For concrete identified on the drawings as being subject to Exposure Class F3, the maximum amount of supplementary cementitious materials shall not exceed the limits noted in Table 4.2.2.7.b.2 "Maximum cementitious materials requirements for concrete exposed to deicing chemicals" of ACI 301.
  6. Except for Mass Concrete, the Contractor may submit for approval a revised design mixture with lower supplementary cementitious material percentages than herein specified should finishability or other issues arise due to changing weather conditions.
- G. Aggregate: Comply with the following special requirements:
1. For exposed concrete, provide aggregates from a single source.
  2. For exposed surfaces subject to Exposure Class C1 or C2, do not use aggregates containing spalling-causing deleterious substances unless the conditions outlined in the Durability Requirements are met.
  3. For slabs and other designated concrete, combined aggregate gradation shall be 8% - 18% for large top size aggregates (1 1/2 inches) or 8% - 22% for smaller top size aggregates (1 inch or 3/4 inch) retained on each sieve below the top size and above the No. 100. Deviations from this gradation may be allowed upon the approval of the Engineer subject to the following limitations:
    - a. The percent retained on two adjacent sieves shall be not less than 5%.
    - b. The percent retained on three adjacent sieves shall be not less than 8%.
    - c. If the percent retained on two adjacent sieves is less than 8%, the total percent retained on either of those sieves and the adjacent outside sieve shall be not less than 13%.
- H. Admixtures:
1. Admixtures to be used in concrete shall be subject to the approval of the Engineer and Owner's Testing Laboratory and shall be used for the purpose intended by the manufacturer to produce concrete to meet the specified requirements.

2. Quantities of admixtures to be used shall be in strict accordance with the manufacturer's instructions.
3. Air Content Requirements: For concrete subject to Exposure Class F1, F2 or F3 as noted on the drawings, use air-entrainment admixtures to provide concrete such that the air content at the point of placement shall conform to the requirements of ACI 301 Table 4.2.2.7.b "For Exposure Category F: Freezing and thawing exposures" within plus or minus 1.5%. Required air content levels may be reduced by 1.0 percent for concrete strengths above 5,000 PSI.
  - a. Interior steel troweled surfaces shall not have more than 3% total air content.
  - b. Surfaces scheduled to receive hardeners shall not have more than 3% total air content.
  - c. Air-entraining admixtures are not permitted in industrial slabs.
- I. Adjustments of Concrete Mixtures: Design mixture adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Such adjustments shall be provided at no additional cost to the Owner. Any adjustments in approved design mixtures including changes in admixtures shall be submitted in writing to the Engineer and Owner's Testing Laboratory for approval prior to field use.
- J. Shrinkage: Concrete so identified on the drawings shall be proportioned for a maximum allowable unit shrinkage as noted on the drawings, measured at 28 days after curing in lime water as determined by ASTM C 157 (using air storage). Submit results of test for each class of applicable concrete after every 500 cubic yards placed.
- K. Chloride Ion Content:
  1. Unless noted otherwise, the maximum water soluble chloride ion concentration in hardened concrete measured at ages from 28 to 42 days contributed from all ingredients including water, aggregates, cementitious materials, and admixtures shall not exceed the limits specified in ACI 318-14 Table 19.3.2.1 "Requirements for concrete by exposure class" depending on to which Corrosion Exposure Class (C0, C1 or C2) the concrete is subject as noted on the drawings. Water-soluble chloride ion tests shall conform to ASTM C 1218. One test shall be run for each class of concrete before the design mixture submittal and each time a change is made to the design mixture (such as change in aggregate type or source).
  2. The chloride ion content in all concrete used for prestressed or post-tensioned concrete shall not exceed 0.06 percent by mass of cementitious materials. For the purpose of determining chloride ion content in all concrete used for prestressed or post-tensioned concrete, mass of supplementary cementitious material shall not exceed the mass of the portland cement.
  3. The Concrete Supplier shall certify that the chloride ion content in all concrete design mixtures used on the project does not exceed the limits stated above.

## 2.10 CONCRETE MIXING

- A. Ready-Mix Concrete: Comply with requirements of ANSI/ASTM C 94 and **the Structural Testing and Inspections section of the specifications.**

## 2.11 SOURCE QUALITY CONTROL

- A. Source Inspection: Refer to Specification **014529 "Structural Testing and Inspections"** for inspection requirements associated with cast-in-place concrete.



**PART 3 - EXECUTION****3.1 SLUMP LIMIT**

- A. The slump, as measured in the field where concrete cylinders are taken, shall be within plus or minus 1-1/2 inches of the design slump noted in the approved Design Mixture submittal. Self-Consolidating Concrete shall have a slump/flow of plus or minus two inches of the design slump/flow noted on the approved Design Mixture submittal. Water may be added to the concrete in the field only to the extent that the prescribed water/cementitious ratio noted in the approved Design Mixture submittal is not exceeded. The responsibility for adding water to trucks at the job site shall rest only with the Contractor's designated representative. The Contractor is responsible that all concrete placed in the field is in conformance with the Contract Documents.

**3.2 VAPOR RETARDER INSTALLATION**

- A. Install and repair damaged vapor retarder in accordance with ASTM E 1643 and manufacturer's instructions.
- B. Lap all seams per manufacturer's instruction (6" minimum lap) and seal all joints in the field with the specified pressure sensitive tape. Heat-welded joints done in a shop prior to delivery is an acceptable method to minimize the number of field joints.
- C. Seal all pipe penetrations through the vapor retarder with a boot made from the vapor retarder material and tape or mastic.

**3.3 JOINTS IN CONCRETE**

- A. Construction Joints: Locate and install construction joints as indicated on the drawings or if not shown on drawings, located so as not to impair strength and appearance of the structure, as acceptable to Architect/Engineer.
1. Keyways: Provide keyways with a depth of one tenth of the member thickness (1 1/2" minimum or as shown on the drawings) in construction joints only where shown on the drawings.
  2. Joint Construction: Place construction joints in the center one third of suspended spans and grade beams and as shown on the drawings for slabs-on-grade and walls unless shown otherwise. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise shown on the drawings. Dowels that cross construction joints shall be supported during concreting operations so as to remain parallel with the slab or wall surface and at right angles to the joint. Submit all construction joint locations as a shop drawing submittal.
  3. Waterstops: Provide waterstops in construction joints as indicated on the Architectural and Structural Drawings. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions. Waterstops shall be installed with a minimum of 3" of concrete cover.
  4. Isolation Joints in Slabs-on-Grade: Construct isolation joints (without dowels) in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces only where specifically detailed on the drawings. Install joint-filler strips at joints where indicated. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated on the drawings. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together. Provide construction joints with dowels at all locations unless isolation joints are detailed.
- B. Contraction Joints in Slabs-on-Grade and Unbonded Topping Slabs: Install contraction joints at locations and spacings as indicated on the drawings or if not shown on drawings, located so as not to impair strength and appearance of the structure, as acceptable to Architect/Engineer.

Maximum joint spacing shall be per the drawings and be perpendicular to the slab surface. Use one of the two following methods (sawed or formed) to create the joints. Do not use the formed joint in areas subject to vehicular traffic or in industrial slabs.

1. Sawed Joints:
  - a. Primary Method: Early-Entry, dry-cut method, using Soff-Cut saws. Finisher must have documented successful experience in the use of this method prior to this project. Install cuts within one to four hours, depending on air temperature, after final finish as soon as the concrete surface is firm enough to not be torn or damaged by the blade at each saw cut location. Use 1/8 inch thick blade, cutting to a depth of one quarter of the slab thickness but not less than one inch. Cut to a depth of one third of the slab thickness for slabs reinforced with steel fibers or synthetic fibers.
  - b. Optional Method (where Soff-Cut System method equipment is not available, subject to limitations): This method may not be used when there is no dowel passing through the contraction joint. Use a conventional saw to cut joints within four to 12 hours after finishing as soon as the concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw. Complete cutting before shrinkage stresses become sufficient to produce cracking. Use 1/8 inch thick blade, cutting to a depth of one quarter of the slab thickness but not less than one inch. Cut to a depth of one third of the slab thickness for slabs reinforced with steel fibers.
2. Formed Joints: Form contraction joints by inserting premolded plastic hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. The depth is to be one quarter of the slab thickness, but not less than one inch. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
3. Joint Filler: Provide in both contraction and saw-cut construction joints when specified.
  - a. Remove dirt and debris from the joint by vacuuming immediately prior to filling joint. Clean the joint of curing compounds and sealers.
  - b. Filler material shall be applied to the joints when the building is under permanent temperature control, but no less than 90 days after slab construction.
  - c. Follow the manufacturer's recommended procedure for installing filler material. The joint filler must be flush with the adjacent concrete. A concave profile on the top of the joint filler is unacceptable and will be grounds for removal and replacement.
4. The Contractor shall protect the joints from damage caused by wheeled traffic or other sources during construction until a joint-filler material (if specified) has been installed.

### 3.4 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto unless directed otherwise by these specifications. Install reglets to receive top edge of foundation sheet waterproofing where specified by the Architect, and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles and other conditions.
- B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.
- C. Do not install sleeves in any concrete member except where shown on the structural drawings or approved by the Architect and Engineer.
- D. Securely fasten embedded plates, angles, anchor rods and other items to be built into the concrete to the formwork or hold in place with templates. Insertion of these items into concrete after concrete placement is prohibited.

**3.5 CONCRETE PLACEMENT**

- A. Pre-placement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.
- B. Concrete Batch Trip Tickets: The Contractor shall collect and retain concrete batch trip tickets. Compressive strength, slump, air content, and temperature tests shall be identified by reference to a particular trip ticket. Tickets shall contain the information specified in ASTM C 94. Each ticket shall also show the amount of water that may be added in the field for the entire batch that will not exceed the specified water cement ratio for the design mixture. The Contractor and Testing Laboratory shall immediately notify the Architect/Engineer and each other of tickets not meeting the criteria specified.
- C. Causes for Rejection of Concrete: The Contractor shall reject concrete delivered to the site for any of the following reasons:
1. Wrong class of concrete (incorrect design mixture number).
  2. Environmental condition limits shall be as follows unless appropriate provisions in concrete practices have been made for cold or hot weather:
    - a. Cold Weather: Air temperature must be 40°F and rising or the average daily temperature cannot have been lower than 40°F for three consecutive days unless the temperature rose about 50°F for at least one-half of any of those 24 hour periods.
    - b. Hot Weather: Environmental conditions must be such that cause an evaporation rate from the concrete surface of 0.2 pounds per square foot per hour or less as determined by the figure "NRMCA Nomograph for Estimating Evaporation Rate on the Basis of Menzel Formula" in Appendix A of ACI 305.1.
    - c. Concrete may be placed at other environmental condition ranges only with the approval of the job inspector for the Testing Laboratory or other duly appointed representative.
  3. Concrete with temperatures exceeding 95°F.
  4. Air contents outside the limits specified in the design mixtures.
  5. Slumps outside the limits specified.
  6. Water added to the mix that exceeds the maximum allowed water-to-cementitious material ratio.
  7. Excessive Age: Concrete shall be discharged within 90 minutes of plant departure or before it begins to set if sooner than 90 minutes and it shall be discharged before the drum has revolved 300 revolutions, unless approved by the Testing Laboratory job inspector or other duly appointed representative.
- D. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.
- E. Comply with ACI 301 and as herein specified:
1. Concrete Temperature: The maximum acceptable concrete temperature at the truck discharge point shall be 95°F.
  2. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation. Spread concrete using short-handled, square-ended shovels, or come-alongs.
  3. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
  4. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use internal vibrators of the largest size and power that can properly be used in the work.
  5. Do not vibrate Self-Consolidating Concrete.
  6. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators

to penetrate rapidly placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

7. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed. Place concrete for beams, girders, brackets, column capitals, haunches, and drop panels at the same time as concrete for slabs. Do not place concrete over columns and walls until concrete in columns and walls is no longer plastic and has been in place at least one hour.
8. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners of forms, eliminating air and stone pockets that may cause honeycombing, pitting, or planes of weakness.
9. Bring slab surfaces to correct level with straightedge and strikeoff. Use highway straightedges, bull floats, or darbies to smooth surface free of humps or hollows before excess moisture or bleedwater appears on the surface. Do not disturb slab surfaces prior to beginning finishing operations.
10. Maintain reinforcing in proper position during concrete placement operations.
11. Protect adjacent finish materials against damage and spatter during concrete placement.
12. Placing Concrete by Pump: If concrete is placed by using a pump, the grout used for pump priming must not become a part of the completed structure unless an engineered grout design mix and grout location are approved in advance by the Engineer.

### 3.6 FINISH OF FORMED SURFACES

- A. General: Formed surfaces shall have the finishes as described below and as shown on the drawings after formwork is removed and repairs made.
- B. Matching Mockup Finish: In all areas where a special finish is required or a mock-up is required below, Contractor shall prepare a 100 square foot mock-up to match the required finish. The mock-up should match the finish on a sample panel furnished to the Contractor. If a sample is not furnished, provide finish to match SF2.0 or any other finish specified for the project. Protect mock-up from damage for the duration of project. Approval of mock-up by Architect is required before proceeding with application of finish in project.
- C. Classifications and Finish Requirements:
  1. Surface Finish 1.0 (SF-1.0):
    - a. No formwork facing material is specified.
    - b. Patch voids larger than 1-1/2 inch wide or 1/2 inch deep.
    - c. Remove projections larger than 1.0 inch.
    - d. Provide surface tolerance Class D as specified in ACI 117.
    - e. Tie holes need not be patched.
  2. Surface Finish 1.1 (SF-1.1):
    - a. No formwork facing material is specified.
    - b. Patch voids larger than 1 inch wide or 1/2 inch deep.
    - c. Remove projections larger than 1/2 inch.
    - d. Provide surface tolerance Class C as specified in ACI 117.
    - e. Tie holes need not be patched.
  3. Surface Finish 2.0 (SF-2.0):
    - a. Provide specified formwork-facing material.
    - b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    - c. Patch tie holes.
    - d. Remove projections larger than 1/4 inch.
    - e. Provide surface tolerance Class B as specified in ACI 117.
    - f. Provide mock-up of concrete surface appearance.
  4. Surface Finish 2.1 (SF-2.1):
    - a. Provide specified formwork-facing material.
    - b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.

- c. Patch tie holes.
  - d. Remove projections larger than 1/4 inch.
  - e. Provide surface tolerance Class B as specified in ACI 117.
  - f. Provide specified rubbed finish after formwork removal.
  - g. Provide mock-up of concrete surface appearance.
5. Surface Finish 2.2 (SF-2.2):
    - a. Provide specified formwork-facing material.
    - b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    - c. Patch tie holes.
    - d. Remove projections larger than 1/4 inch.
    - e. Provide surface tolerance Class B as specified in ACI 117.
  6. Surface Finish 2.3 (SF-2.3):
    - a. No formwork-facing material is specified.
    - b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    - c. Patch tie holes.
    - d. Remove projections larger than 1/4 inch.
    - e. Provide surface tolerance Class B as specified in ACI 117.
  7. Surface Finish 3.0 (SF-3.0):
    - a. Provide specified formwork facing material.
    - b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    - c. Remove projections larger than 1/8 inch.
    - d. Patch tie holes.
    - e. Provide surface tolerance Class A as specified in ACI 117.
    - f. Provide mock-up of concrete surface appearance.
  8. Surface Finish 3.1 (SF-3.1):
    - a. Provide specified formwork-facing material.
    - b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    - c. Patch tie holes.
    - d. Remove projections larger than 1/8 inch.
    - e. Provide surface tolerance Class A as specified in ACI 117.
    - f. Provide specified rubbed finish after formwork removal.
    - g. Provide mock-up of concrete surface appearance.
  9. Surface Finish 3.2 (SF-3.2):
    - a. Provide specified formwork-facing material.
    - b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    - c. Patch tie holes.
    - d. Remove projections larger than 1/8 inch.
    - e. Provide surface tolerance Class A as specified in ACI 117.
  10. Surface Finish 3.3 (SF-3.3):
    - a. No formwork-facing material is specified.
    - b. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    - c. Patch tie holes.
    - d. Remove projections larger than 1/8 inch.
    - e. Provide surface tolerance Class A as specified in ACI 117.
- D. Standard Finish: Provide SF-1.0 on all concrete surfaces not exposed to view in the final condition unless otherwise specified.
- E. Exposed Finishes: Provide SF-2.0 on all concrete surfaces exposed to view in final condition unless otherwise specified.
- F. Rubbed Finishes: Remove forms as early as permitted by these specifications and perform any necessary repairs and patches. Unless otherwise specified, provide one of following finishes where rubbed concrete finish is specified or scheduled:
1. Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled or specified concrete surfaces where indicated, not later than one day after form removal. Moisten concrete

- surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.
2. Grout Cleaned Finish: Provide grout cleaned finish to scheduled or specified concrete surfaces that have received smooth-form finish treatment.
    - a. Combine one part portland cement to 1-1/2 parts sand meeting the requirements of ASTM C 144 and ASTM C 404 by volume, and 50:50 mixture of acrylic or styrene butadiene based bonding admixture and water to consistency of thick paint. Proprietary additives may be used at Contractor's option. Blend standard portland cement and white portland cement, amounts determined by trial patches, so that final color of dry grout will closely match adjacent surfaces.
    - b. Thoroughly wet concrete surfaces and apply grout to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.
  - G. Related Unformed Surfaces: At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.7 MONOLITHIC SLAB FINISHES

- A. Place, consolidate, strike off, and level concrete, eliminating high spots and low spots, before proceeding with any other finish operation. Do not add water to the surface of the concrete during finishing operation.
- B. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo and other bonded applied cementitious finish flooring material, and as otherwise indicated. After placing slabs, plane surface to tolerance specified below. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms, or rakes.
- C. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated. After screeding, consolidating and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using a hand float, a bladed power float equipped with float shoes, or a powered disk float, when the bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit the operation. Check and level surface plane to a tolerance as specified below. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- D. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint or other thin film finish coating system. After floating, begin first trowel finish operation by hand or power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a level surface to a tolerance as specified below. Grind smooth surface defects that would telegraph through applied floor covering system.
- E. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply initial trowel finish as specified above, then immediately follow with slightly scarifying surface by fine brooming.
- F. Slip-Resistive Broom Finish: Apply slip-resistive broom finish to garage floors and ramps less than 8.5% slope, exterior concrete platforms, steps, and ramps and elsewhere as indicated. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application. For concrete containing fibers, broom once only in one direction.

- G. Chemical-Hardener Finish: Apply chemical-hardener finish to interior concrete floors where indicated. Apply liquid chemical-hardener after complete curing and drying of the concrete surface. Apply proprietary chemical hardeners, in strict accordance with manufacturer's printed instructions. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.
- H. Liquid Sealer/Densifier Finish: Apply liquid sealer/densifier finish to exposed interior concrete floors where indicated. Apply after complete curing and drying of the concrete surface and in strict accordance with manufacturer's printed instructions.
- I. Penetrating Sealer Finish: Apply a chloride-and-water-repelling-penetrating-sealer finish to surfaces as described below and where indicated on the drawings. Apply liquid penetrating sealer after complete curing and drying of the concrete surface. Apply proprietary sealers in strict accordance with manufacturer's printed instructions. The Contractor shall verify the compatibility of the sealer product with the paint used to stripe parking decks and coordinate the sequencing of the sealing and striping operations. Apply to the following surfaces:
1. Sloping and horizontal surfaces of parking garages.
  2. Top surfaces of exposed exterior balconies.
- J. Slip-Resistive Aggregate Finish: Apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps, and elsewhere as indicated on the Architect's or Structural Drawings.
1. After completion of float finishing, and before starting trowel finish, uniformly spread 25 pounds of dampened slip-resistive aggregate per 100 square feet of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as herein specified.
  2. After curing, lightly work surface with a steel wire brush, or an abrasive stone, and water to expose slip-resistive aggregate.
- K. Colored, Mineral Aggregate Surface Hardener: Provide colored, mineral aggregate surface hardener to monolithic slab surface indicated.
1. Apply dry shake materials for colored wear-resistant finish at rate of not less than 100 pounds per 100 square feet, unless greater amount is recommended by material manufacturer.
  2. Cast a trial slab approximately 20 feet by 20 feet to determine actual application rate, color, and finish as acceptable to Architect/Engineer.
  3. Immediately following first floating operation using wood floats, uniformly distribute approximately two thirds of required weight of dry shake material over concrete surface, and embed by means of power floating using float shoes or pan floats. Follow floating operation with second shake application, uniformly distributing remainder of dry shake material at right angles to first application, and embed by power floating.
  4. After completion of broadcasting and floating, apply trowel finish as herein specified. Cure slab surface with curing compound recommended by dry shake hardener manufacturer. Apply curing compound immediately after final finishing.
- L. Non-Oxidizing Metallic Floor Hardener: Slabs in areas noted on the drawings shall receive an application of the non-oxidizing, metallic floor hardener applied at the rate of 150 pounds per 100 square feet. Immediately following the first floating operation using wood floats, uniformly distribute approximately two thirds of the required weight of the hardener over the concrete surface by mechanical spreader and embedded by means of power floating using float shoes or pan floats. The hardener shall be floated in and the second application made. The surface shall be floated again to bond properly the hardener to the base concrete slab. The surface shall then be troweled at least twice to a smooth dense finish.
- M. Metallic Aggregate Floor Hardener: Slabs in areas noted on the drawings shall receive an application of the metallic aggregate floor hardener applied at the rate of 150 pounds per 100 square feet. Immediately following the first floating operation using wood floats, uniformly distribute approximately two thirds of the required weight of the hardener over the concrete surface by mechanical spreader and embedded by means of power floating using float shoes or

pan floats. The hardener shall be floated in and the second application made. The surface shall be floated again to bond properly the hardener to the base concrete slab. The surface shall then be troweled at least twice to a smooth dense finish.

- N. Finish of Top of Spread Footings:
1. Top Surface below Finished Slab: The top of the footing or mat shall be screeded level and smooth with a flatness F-number,  $F_F15$  (overall),  $F_F10$  (minimum local) and a levelness F-number,  $F_L12$  (overall),  $F_L10$  (minimum local).
  2. Top Surface as Finished Slab: The top surface of a footing or mat that is to serve as the finished slab in the building shall be leveled, cured, and surface prepared as specified for the finished floor construction appropriate to the space usage as defined in the Architectural Drawings.

### 3.8 CONCRETE FINISH MEASUREMENT AND TOLERANCES

- A. Testing Procedure: ASTM E 1155.
- B. Tolerance on Floor Elevations: Construction tolerance on absolute floor elevation from the specified elevation as shown on the drawings shall be as specified below, taken from ACI 117:
1. Slab-on-Grade Construction:  $\pm 3/4"$ .
  2. Top Surfaces of Formed Slabs Measured Prior to Removal of Supporting Shores:  $\pm 3/4"$ .
  3. Top Surfaces of All Other Slabs:  $\pm 3/4"$ .
- C. Random Traffic Floor Finish Tolerances:
1. Specified overall values for flatness ( $SOF_F$ ) and levelness ( $SOF_L$ ) shall conform to the values listed below for the floor surface classification noted for each slab category noted.
    - a. Conventional:
      - 1)  $SOF_F$ : 20.
      - 2)  $SOF_L$ : 15.
    - b. Moderately Flat:
      - 1)  $SOF_F$ : 25.
      - 2)  $SOF_L$ : 20.
    - c. Flat:
      - 1)  $SOF_F$ : 35.
      - 2)  $SOF_L$ : 25.
    - d. Very Flat:
      - 1)  $SOF_F$ : 45.
      - 2)  $SOF_L$ : 35.
    - e. Super Flat:
      - 1)  $SOF_F$ : 60.
      - 2)  $SOF_L$ : 40.
  2. Minimum local values for flatness ( $MLF_F$ ) and levelness ( $MLF_L$ ) shall equal  $3/5$  of the  $SOF_F$  and  $SOF_L$  values, respectively, unless noted otherwise. The  $MLF_F$  and  $MLF_L$  values shall apply to the minimum areas bounded by the column lines and half-column lines, or the minimum areas bounded by the construction and contraction joints, whichever are the smaller areas.
  3. The  $SOF_L$  and  $MFL_L$  tolerance values shall apply only to level slabs-on-ground or to level, uncambered suspended slabs that are shored such that it cannot deflect from the time the floor is placed to the time it is measured.
  4. Slabs specified to slope shall have a tolerance from the specified slope of  $3/8"$  in 10 feet at any point.
- D. Construction Requirements to Achieve Specified Floor Finish Tolerances:
1. Forms shall be properly leveled, in good condition, and securely anchored including special attention to ends and transitions.
  2. Bearing surfaces for straightedges such as form edges or previously poured slabs shall be kept clean of laitance, sand, gravel, or other foreign elements.



3. Screeds shall be maintained in good condition with true round rolling wheels and level cutting edges. The use of optical sighting equipment such as lasers is recommended for checking levelness and straightness. The Contractor shall promptly adjust or replace equipment when test results indicate substandard work.
  4. Highway straightedges are recommended for use in lieu of bullfloats for all slab placement and finishing operations. If mineral, non-oxidizing metallic, or metallic floor hardeners are used, the slab shall be wood bullfloated immediately after the straightedge.
- E. Contractor Responsibility for Concrete Floor Finish Requirements: Floor finish requirements shown below (flatness and levelness tolerances) are minimum requirements that apply unless stricter requirements are contained in instructions for installation of applied floor products in which case the Contractor is responsible for attaining the values prescribed by the manufacturer of such products.
- F. Concrete Floor Finish Tolerance for Slab-on-Grade Construction:
1. Concrete Placement: Concrete shall be placed and screeded to predetermined marks set to elevations prescribed on the drawings.
  2. Finish Tolerances of Random Traffic Floor Surfaces:
    - a. Slabs in nonpublic areas, mechanical rooms, surfaces to receive raised computer flooring, surfaces to have thick-set tile or a topping, and parking structures: Conventional.
    - b. Carpeted Areas: Moderately Flat.
    - c. Exposed Slabs in Public Spaces, Slabs to Receive Thin-Set Flooring: Flat.
    - d. Ice or Roller rinks: Very Flat.
    - e. Floors supporting Operable Seating: Very Flat.
    - f. Gymnasium Floors Scheduled to Receive Wood Playing Floor: Very Flat.
- G. Concrete Floor Finish Tolerance for Shored, Cast-in-Place Suspended Slab Construction:
1. Concrete Placement: Formwork shall be set and securely braced so that soffits are positioned to allow scheduled concrete member sizes and thicknesses within tolerances specified in ACI 117. Concrete shall be placed and screeded to predetermined marks on the form surface conforming to elevations prescribed on the drawings.
  2. Camber: Formwork camber, as indicated on the drawings, shall be set to provide a uniform, smooth soffit profile in each direction. Minimum slab thickness, as specified on the drawings, shall be maintained throughout the slab surface to a tolerance as specified in ACI 117. Tolerance on camber shall be  $\pm 1/4"$ . Levelness F-Number tolerances specified below do not apply to areas of the floor where camber or intentional slope is shown.
  3. Finish Tolerances of Random Traffic Floor Surfaces:
    - a. Slabs in Nonpublic Areas, Mechanical Rooms, Surfaces to Receive Raised Computer Flooring, Surfaces to Have Thick-Set Tile or a Topping, and Parking Structures: Conventional.
    - b. Carpeted Areas: Moderately Flat.
    - c. Exposed Slabs in Public Spaces, Slabs to Receive Thin-Set Flooring: Flat.
  4. Extra Concrete: The contractor shall include in his bid any additional concrete required to achieve the specified slab surface finish tolerance.
- H. Concrete Floor Finish Tolerance – Unshored Steel Deck on Shored or Unshored Steel Beam or Steel Joist Floor Construction:
1. Concrete Placement: Concrete over steel deck shall be placed and screeded level and flat to the tolerance specified below, maintaining at least the minimum slab thickness at all locations as specified on the drawings. The Contractor shall increase the slab thickness as required to compensate for steel deck deflection, and in unshored beam construction, residual beam camber and beam deflection in order to achieve a level and flat floor within specified tolerances.
  2. Finish Tolerance of Random Traffic Floor Surfaces:
    - a. Slabs in Nonpublic Areas, Mechanical Rooms, Surfaces to Receive Raised Computer Flooring, Surfaces to Have Thick-Set Tile or a Topping, and Parking Structures: Conventional.
    - b. Carpeted Areas: Moderately Flat.

- c. Exposed slabs in public spaces, slabs to receive thin-set flooring: Flat.
  - d. Movie or Television studios: Super Flat.
  - e. Eighty percent (80%) of the final floor surface shall fall within an envelope of 0.75" centered about the mean elevation of all the readings. The mean elevation of all readings shall not deviate from the specified design grade by more than  $\pm 0.375$ ".
3. Extra Concrete: The Contractor shall include in his bid any additional concrete required to achieve the specified slab surface finish tolerance and to compensate for steel deck deflection, beam camber and beam deflection.
  4. Concrete Placement at Column Bays Supported on Transfer Girders or Trusses: Concrete in floor areas supported by transfer girders or trusses shall be placed and screeded to predetermined marks placed over the steel deck slab conforming to elevations as specified on the drawings. At least the minimum slab thickness, as specified on the drawings, shall be maintained throughout the slab surface. The Contractor shall conform to the  $F_F$  values specified above.
- I. Remedial Measures for Slab Finish Construction Not Meeting Specified Tolerances:
    1. Application of Remedial Measures. Remedial measures specified herein are required whenever either or both of the following occur:
      - a. The composite overall values of  $F_F$  or  $F_L$  of the entire floor installation measure less than specified values.
      - b. Any individual test section measures less than the specified absolute minimum  $F_F$  or  $F_L$  value.
    2. Modification of Existing Surface:
      - a. If, in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work can be repaired without sacrifice to the appearance or serviceability of the area, then the Contractor shall immediately undertake the approved repair method.
      - b. The Contractor shall submit for review and approval a detailed work plan of the proposed repair showing areas to be repaired, method of repair, and time to affect the repair.
      - c. Repair method(s), at the sole discretion of the Architect/Engineer or Owner's Representative, may include grinding (floor stoning), planing, retopping with self-leveling underlayment compound or repair topping, or any combination of the above.
      - d. The Architect/Engineer or Owner's Representative maintains the right to require a test repair section using the approved method of repair for review and approval to demonstrate a satisfactory end product. If, in the opinion of the Architect/Engineer or Owner's Representative, the repair is not satisfactory an alternate method of repair shall be submitted or the defective area shall be replaced.
      - e. The judgment of the Architect/Engineer or Owner's Representative on the appropriateness of a repair method and its ability to achieve the desired end product shall be final.
      - f. All repair work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.
    3. Removal and Replacement:
      - a. If, in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work cannot be satisfactorily repaired without sacrifice to the appearance or serviceability of the area, then the Contractor shall immediately commence to remove and replace the defective work.
      - b. Replacement section boundaries shall be made to coincide with the test section boundaries as previously defined.
      - c. Sections requiring replacement shall be removed by sawcutting along the section boundary lines to provide a neat clean joint between new replacement floor and existing floor.
      - d. The new section shall be reinforced the same as the removed section and doweled into the existing floor as required by the Engineer. No existing removed reinforcing steel may be used. All reinforcing steel shall be new steel.

- e. Replacement sections may be retested for compliance at the discretion of the Architect/Engineer or Owner's Representative.
- f. The judgment of the Architect/Engineer or Owner's Representative on the need for replacement shall be final.
- g. All replacement work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

### 3.9 CONCRETE CURING AND PROTECTION

#### A. General:

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Maintain concrete with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of concrete. Limit moisture loss to a maximum of 0.05 pounds per square foot per hour for concrete containing silica fume and 0.2 pounds per square foot per hour for all other concrete before and during finishing operations. If using an evaporation retarder, apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
2. Curing shall commence as soon as free water has disappeared from the concrete surface after placing and finishing. The curing period shall be seven days for all concrete except high early strength concrete that shall be cured for three days minimum.
3. Alternatively, curing times may be reduced if either of the following provisions is complied with:
  - a. If tests are made of cylinders kept adjacent to the structure and cured by the same methods, curing measures may be terminated when the average compressive strength has reached 70% of the specified compressive strength.
  - b. If the temperature of the concrete is maintained at a minimum of 50°F for the same length of time required for laboratory cured cylinders of the same concrete to reach 85% of the specified compressive strength, then curing may be terminated thereafter.
4. Curing shall be in accordance with ACI 301 procedures. Avoid rapid drying at the end of the curing period.

#### B. Curing Formed Surfaces: Where wooden forms are used, cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. When forms are removed, continue curing by one or a combination of the methods specified below, as applicable:

1. Sides and Soffits of Beams, Soffits of Slabs: Moist cure in forms or by one or a combination of Methods 1, 2, or 3 specified below. Use a liquid membrane-forming dissipating resin curing compound conforming to ASTM C 309, Type 1, class A or B for Method 3.
2. Basement Walls, Sides of Exterior Retaining Walls: Moist cure in forms or by one or a combination of Methods 1, 2, or 3 specified below. Use a liquid membrane-forming dissipating resin curing compound conforming to ASTM C 309, Type 1, class A or B for Method 3.

#### C. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by one or a combination of the methods specified below, as applicable. The Contractor shall choose a curing method that is compatible with the requirements for subsequent material usage on the concrete surface.

1. Ramps and Horizontal Surfaces of Parking Areas, Exposed Exterior Balconies: Cure using only Methods 1 or 2 as specified below.
2. Floors Directly Exposed to Vehicular or Foot Traffic [Not in Parking Areas] and Not Otherwise Receiving a Chemical Hardener or Penetrating Sealer Finish: Apply two coats of a high-solids, water-based, non-yellowing, liquid membrane-forming curing and sealing compound conforming to ASTM C 1315, Type 1, Class A in accordance with Method 3 as specified below.

3. Floors in Non-Public Spaces that are Left Exposed to View and Not Receiving Sealers or Hardeners, Floors Involved in Under-Floor Air Distribution Systems: Apply one coat of a high-solids, water-based, non-yellowing, liquid membrane-forming curing and sealing compound conforming to ASTM C 1315, Type 1, Class A or B in accordance with Method 3 as specified below.
  4. Floors that are to Receive Subsequent Cementitious Toppings, Sealers, Hardeners, Ceramic Tile, Acrylic Terrazzo, Vinyl Composition Tile, Sheet Vinyl, Linoleum, Vinyl-Backed Carpet, Rubber, Athletic Flooring, Synthetic Turf, Wood, Epoxy Overlay or Adhesive, or Other Coating or Finishing Products: Cure using Methods 2 or 3 as specified below. Use a water-based dissipating resin type curing compound conforming to ASTM C 309, Type 1, class A or B for Method 3.
  5. All Other Surfaces: Cure using Methods 1, 2, or 3 as specified below. Use a water-based dissipating resin type curing compound conforming to ASTM C 309, Type 1, class A or B for Method 3.
- D. Curing Methods:
1. Method 1 – Moisture Curing: Provide moisture curing by one of the following methods:
    - a. Keep concrete surface continuously wet by covering with water.
    - b. Continuous water-fog spray.
    - c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water, and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
  2. Method 2 – Moisture-Retaining Cover Curing: Provide moisture-retaining cover curing as follows:
    - a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Water may be added to concrete surface to prevent drying before the cover is installed, but the surface shall not be flooded with water if a non-absorptive cover is used.
  3. Method 3 – Curing or Curing and Sealing Compound: Provide curing, liquid membrane-forming curing, or curing and sealing compound as follows:
    - a. Apply specified compound to concrete slabs as soon as final finishing operations are complete (within two hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Do not allow to puddle. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period. Apply second coat for sealing two to three hours after the first coat was applied.
    - b. Do not use membrane-forming curing and sealing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glued-down carpet, vinyl composition tile, linoleum, sheet vinyl, rubber, athletic flooring, synthetic turf, or wood), paint, or other coatings and finish materials. Dissipating resin type cures are acceptable in these locations.

### 3.10 HOT WEATHER CONCRETING

- A. Definition:
1. Conditions warranting hot weather concreting practices are defined as any combination of high air temperature, low relative humidity, and wind velocity tending to impair the quality of fresh or hardened concrete or otherwise result in abnormal properties. Monitor the conditions on-site at an elevation two feet above the top surface of the planned concrete pour from one hour prior to placement and every 30 minutes thereafter until accepted curing procedures have been applied. If conditions cause an evaporation rate of 0.2

pounds per square foot per hour or greater as calculated by one of the accepted methods, then precautions shall be taken to prevent plastic shrinkage cracks from occurring. Accepted methods for determining evaporation rate include:

- a. The figure "NRMCA Nomograph for Estimating Evaporation Rate on the Basis of Menzel Formula" in Appendix A of ACI 305.1
  - b. Electronic instruments that gauge evaporation rate using the Menzel Formula.
- B. Specification: Follow hot weather concreting practices specified below when required to limit the concrete temperature at the truck discharge point to the stated maximum acceptable temperature.
- C. Records: Under hot weather conditions, the Contractor shall keep records of outside air temperature, concrete temperature at truck discharge and general weather conditions.
- D. Hot Weather Concreting Requirements: The following items, all or in part as required, shall be followed to limit the concrete temperature to the stated maximum acceptable temperature and to minimize the possibility of plastic shrinkage cracks from developing.
1. Design the concrete mixtures specifically for hot weather conditions replacing some cement with fly ash or other pozzolan and using a water reducing retarding admixture (ASTM C 494 Type D).
  2. Use the largest size and amount of coarse aggregate compatible with the job.
  3. Use sunshades and/or windbreaks.
  4. Delay construction of indoor slabs-on-grade until the walls and roof are constructed.
  5. Cool and shade aggregate stockpiles.
  6. Use ice as part of the mixing water or cool the water with liquid nitrogen. Do not place concrete that contains unmelted ice.
  7. Limit the number of revolutions at mixing speed to 125 maximum.
  8. Reduce time between mixing and placing as much as possible.
  9. Do not add water to ready-mixed concrete at the job site unless it is part of the amount required initially for the specified water-cement ratio and the specified slump.
  10. Schedule concrete placement for early morning, late afternoon, or night.
  11. Have all forms, equipment, and workers ready to receive and handle concrete.
  12. Maintain one standby vibrator for every three vibrators used.
  13. Keep all equipment and material cool by spraying with water including exteriors of forms, reinforcing steel, subgrade, chutes, conveyors, pump lines, tremies, and buggies.
  14. Protect slab concrete at all stages against undue evaporation by applying a fog spray or mist above the surface or applying a monomolecular film. Where high temperatures and/or placing conditions dictate, use water-reducing retarding admixture (Type D) in lieu of the water-reducing admixture (Type A) as directed by the Owner's Testing Laboratory.
  15. Provide continuous curing, preferably with water, during the first 24 hours using wet burlap, cotton mats, continuous spray mist, or by applying a curing compound meeting ASTM C 1315. Continue curing for three days minimum.
  16. Cover reinforcing steel with water soaked burlap so that steel temperature will not exceed ambient air temperature immediately before placement of concrete.
  17. As soon as possible, loosen forms and run water down the inside. When forms are removed, provide a wet cover to newly exposed surfaces.

### 3.11 COLD WEATHER CONCRETING

- A. Definition:
1. Concrete shall not be placed when the outside air temperature is 40°F or less unless cold weather concreting practices are followed as specified below.
  2. Cold weather concreting practices should also be followed whenever the average daily air temperature is expected to be less than 40°F for more than three successive days. The average daily air temperature is the average of the highest and lowest temperature occurring during the period from midnight to midnight. The requirement for adhering to these cold-weather concreting practices may be terminated when the air temperature is above 50° F for more than half of any 24 hour duration.

3. Cold-weather concreting practices invoked shall keep the temperature of the concrete immediately after placing within the following temperature ranges:
    - a. 55° to 75° F for sections less than 12 inches in the least dimension.
    - b. 50° to 70° F for sections 12 to 36 inches in the least dimension.
    - c. 45° to 65° F for sections 36 to 72 inches in the least dimension.
    - d. 40° to 60° F for sections greater than 72 inches in the least dimension.
  4. Concrete Protection: Protect the concrete immediately after placing and during the defined protection period such that the concrete does not freeze nor fall below the temperature levels stated in the above paragraph. For concrete not loaded during construction, the protection period shall be for a minimum of three days if cold-weather conditions persist. The time may be reduced to a minimum of two days if Type III cement or an accelerating admixture is used or if an additional 100 pounds of cement per cubic yard is added to the concrete mix. Concrete fully loaded during construction shall be protected during cold weather conditions for whatever time is required to obtain the required strength as determined by nondestructive strength tests (Windsor probe, Swiss Hammer Test) on the in-place concrete. Protect concrete surfaces from freezing for the first 24 hours even if cold-weather conditions do not officially exist due to high volatility in ambient temperatures.
  5. Protection Deficiency: If the temperature requirements during any portion of the protection period are not met but the concrete surface did not freeze, the protection period shall be extended until twice the deficiency expressed in degree-hours is made up. Deficiency degree-hours are defined as the average deficiency in temperature below the required value times the number of hours the deficiency persisted. Make-up degree hours are the average increase in temperature above the minimum value times the hours required to make up twice the deficiency degree-hours. Contact the Architect/Engineer if the concrete surface was allowed to freeze during the protection period.
  6. Protection Removal: As the protection is being removed the decrease in temperature measured at the surface of the concrete in a 24 hour period shall not exceed the following:
    - a. 50° F for sections less than 12 inches in the least dimension.
    - b. 40° F for sections 12 to 36 inches in the least dimension.
    - c. 30° F for sections 36 to 72 inches in the least dimension.
    - d. 20° F for sections greater than 72 inches in the least dimension.
  7. The maximum concrete temperature heated by artificial means at point of placement shall not exceed 90°F.
- B. Records: Under cold weather conditions, the Contractor shall keep records of outside air temperature, concrete temperature as placed and general weather conditions. The temperature record shall be taken no less than two times per 24 hour duration.
- C. Cold Weather Concreting Requirements: The following items, all or in part as required, should be followed to assure acceptable concrete in cold weather conditions:
1. Design the concrete mixture to obtain high early strength by using higher cement content, a high early strength cement (Type III), or a specified non-chloride accelerator (ASTM C 494 Type C or E).
  2. Protect the concrete during curing period using insulating blankets, insulated forms, enclosures, and/or heaters.
  3. Concrete cured in heated enclosures shall have heaters vented to prevent exposure of concrete and workmen to noxious gases.
  4. Frozen subgrade shall be thawed prior to concrete placement and snow and ice shall be removed from forms.
  5. Temperature of embedments in concrete must be heated to above 32°F prior to placing concrete
  6. Heat the mixing water and then blend hot and cold water to obtain concrete no more than 10°F above the required temperature.
  7. Heat the aggregates by circulating steam in pipes placed in the storage bins for air temperatures consistently below 32°F. When either water or aggregate is heated to over 140°F, combine them in the mixer first to obtain a maximum temperature of the mixture not to exceed 140°F in order to prevent flash set of the concrete.

8. Uniformly thaw aggregates far in advance of batching to prevent moisture variations in the stockpile.
9. Cover warmed stockpiles with tarps to retain heat.
10. Place air entraining admixture in the batch after the water temperature has been reduced by mixing with cooler solid materials.
11. Use wind screens to protect concrete from rapid cooling.
12. Place vertical pump lines inside the building, if possible, for concrete being pumped.
13. Maintain artificial heat as low as possible to reduce temperature stresses during cooling.
14. Avoid water curing of concrete except for parking garage structures. Apply the required curing compound to unformed surfaces as soon as possible to prevent drying of concrete from heated enclosures.
15. Delay form stripping as long as possible to help prevent drying from heated enclosures and to reduce damage to formed surfaces caused by premature stripping.
16. Provide triple thickness of insulating materials at corners and edges vulnerable to freezing.
17. Wrap protruding reinforcing bars with insulation to avoid heat drain from the warm concrete.
18. Gradually reduce the heat at the end of the heating period to reduce likelihood of thermal shock.

### 3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor rods for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp and finish concrete surfaces as scheduled.
- E. Adhesive Anchors: All drilled holes for adhesive anchors shall be within six degrees of perpendicular to the surface of the concrete member.

### 3.13 INVESTIGATION OF LOW CONCRETE STRENGTH TEST RESULTS

- A. Contractor Responsibility for Low Strength Concrete:
  1. If the average of any three consecutive strength tests falls below the required  $f'c$  for a class of concrete but no individual strength test is more than 500 PSI below the required  $f'c$ , the Contractor shall immediately notify the Engineer by telephone or email and take immediate steps to increase the average of subsequent strength tests.
  2. If any individual strength test falls more than 500 PSI below the required  $f'c$ , the Contractor shall immediately notify the Engineer by telephone or e-mail and take immediate steps to assure that the load-carrying capacity of the structure is not jeopardized.
- B. Additional Field Tests to Confirm Low Concrete Strengths:
  1. The cost of all investigations of low-strength concrete, as defined by any individual strength test being more than 500 PSI below the required  $f'c$ , shall be borne by the Contractor.
  2. Code-Prescribed Acceptance: The only accepted field-test methods of determining actual in-situ concrete strength is by the way of core tests as prescribed by ACI 318.
  3. Non-Destructive Tests: If any individual strength test falls more than 500 PSI below the required  $f'c$ , the Engineer may request that non-destructive field tests be performed on the

concrete in question using Swiss Hammer, Windsor Probe, or other appropriate methods as approved by the Engineer. Report the comparative test results of the suspect concrete under consideration with identical tests done on concrete of known strength and of the same class. The Engineer considers these test results as only approximate indicators of strength and may not necessarily, by themselves, resolve the low concrete strength issue. These test results will be considered as additional information by which to make an informed judgment. The Engineer reserves the right to accept the concrete based on the results of these approximate tests or order that core tests be taken as prescribed below. At the Contractor's option, the approximate non-destructive field-tests may be waived and core tests immediately initiated.

4. Core Tests: If, in the opinion of the Engineer, the likelihood of low-strength concrete is confirmed and it has been determined that the load-carrying capacity of the structure is significantly reduced as a result, the Engineer may request that core tests be taken from the area in question as directed by the Engineer. There shall be a minimum of three cores taken for each strength test more than 500 PSI below the required  $f_c$  in accordance with ASTM C 42. If concrete in the structure will be dry under service conditions, cores shall be air dried (temperature 60° to 80°F, relative humidity less than 60 percent) for seven days before test and shall be tested dry. If concrete in the structure will be more than superficially wet under service conditions, cores shall be immersed in water for at least 40 hours and tested wet. The Contractor shall fill all holes made by drilling cores with an approved drypack concrete.
5. Acceptance Criteria for Core Test: Concrete in an area represented by core tests shall be considered adequate if the average of three cores is equal to at least 85% of the required  $f_c$  and no single core is less than 75% of the required  $f_c$ . If approved by the Engineer, locations of erratic core strengths may be retested to check testing accuracy.
6. Load Test: If the concrete strength is not considered adequate based on core tests and the structural adequacy remains in doubt, the Engineer may order a load test as specified in ACI 318 be conducted for the questionable portion of the structure.
7. Strengthening or Demolition of the Structure: If the structural adequacy of the affected portion of the structure remains in doubt following the load test, the Engineer may order the structure to be strengthened by an appropriate means or demolished and rebuilt at the Contractor's expense.

### 3.14 CONCRETE SURFACE REPAIRS

- A. Defective Areas:
  1. Formed Surfaces: Concrete surfaces requiring repairs shall include all cracks in excess of **1/64"** in width and any other defects that affect the durability or structural integrity of the concrete. Voids, including honeycombing and rock pockets, and tie holes shall be repaired as required by the specified Surface Finish.
  2. Unformed Surfaces: Concrete surfaces requiring repair shall include all surface defects such as crazing, cracks in excess of **1/64"** in width or cracks that penetrate to reinforcement or through the member, popouts, spalling, and honeycombs.
- B. Classification:
  1. Structural Concrete Repair: Major defective areas in concrete members that are load carrying (such as shear walls, beams, joists and slabs), are highly stressed, and are vital to the structural integrity of the structure shall require structural repairs. Structural concrete repairs shall be made using a two-part epoxy bonder, epoxy mortar, or specified polymer repair mortar. The Engineer shall determine the locations of required structural concrete repairs.
  2. Cosmetic Concrete Repair: Defective areas in concrete members that are non-load carrying and minor defective areas in load carrying concrete members shall require cosmetic concrete repair when exposed to view and not covered up by architectural finishes. Cosmetic concrete repairs may be made using a polymer repair mortar and compatible bonding agent. The Architect/Engineer shall determine the locations of required cosmetic concrete repairs. Stains and other discolorations that cannot be



removed by cleaning and are exposed to view will require cosmetic repair. Cosmetic concrete repair in exposed-to-view surfaces will require Architect's approval prior to patching operation.

3. Slab Repairs: High and low areas in concrete slabs shall be repaired by removing and replacing defective slab areas unless an alternate method, such as grinding and/or filling with self-leveling underlayment compound or repair mortar is approved by the Architect/Engineer. Repair of slab spalls and other surface defects shall be made using epoxy products as specified above and as determined by the Engineer. The high strength flowing repair mortar may be used for areas greater than one inch in depth.

### **3.15 FIELD QUALITY CONTROL**

- A. Field Testing and Inspection: Refer to Specification 014529 "Structural Testing and Inspections" for testing and inspection requirements associated with cast-in-place concrete.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 03 35 43 - POLISHED CONCRETE FINISHING****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Polished concrete system.
- B. Surface treatments for concrete floors and slabs.
- C. Densifiers and hardeners.
- D. Coatings.

**1.2 RELATED REQUIREMENTS**

- A. Section 03 30 00 - Cast-in-Place Concrete: Finishing of concrete surface; curing.
- B. Section 07 92 00 - Joint Sealants.

**1.3 ABBREVIATIONS AND ACRONYMS**

- A. CPC: Concrete Polishing Council.

**1.4 REFERENCE STANDARDS**

- A. ANSI/NFSI B101.1 - Test Method for Measuring the Wet SCOF of Hard-Surface Walkways; 2022.
- B. ANSI/NFSI B101.3 - Test Method for Measuring the Wet DCOF of Hard Surface Walkways; 2020.
- C. ASTM C1353/C1353M - Standard Test Method for Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform Abraser; 2015a.
- D. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes; 2002 (Reapproved 2013).
- E. ASTM D4039 - Standard Test Method for Reflection Haze of High-Gloss Surfaces; 2009 (Reapproved 2023).
- F. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2017.
- G. ASTM D5767 - Standard Test Method for Instrumental Measurement of Distinctness-of-Image (DOI) Gloss of Coated Surfaces; 2018 (Reapproved 2023).
- H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- I. ASTM G154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials; 2016.

**1.5 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

- C. Product Data: Manufacturer's published data and installation instructions for concrete polishing system and finishing products, including manufacturer's installation instructions, information on compatibility of different products, and limitations.
- D. Product Data: Submit certification that products comply with regulations controlling use of volatile organic compounds.
- E. Maintenance Data: Provide data on maintenance and renewal of applied finishes.
- F. Installer's qualification statement.
- G. Executed warranty.
- H. Floor protection plan.

### **1.6 QUALITY ASSURANCE**

- A. Comply with national, state, and local VOC regulations.
- B. Installer Qualifications:
  - 1. Company specializing in installing products specified in this section, having completed minimum of five projects of similar size and complexity.
  - 2. Company is listed applicator of concrete finishes, having completed manufacturer's training program.

### **1.7 MOCK-UP**

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.
- C. Mock-Up Size: 50 sq ft.
- D. Locate on site where directed.
- E. Accepted mock-up panel is considered basis of quality for the finished work. Keep mock-up exposed to view for duration of concrete work.
- F. Mock-up may remain as part of work.

### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.
- B. Store materials per manufacturer's product data sheets:
  - 1. Store containers upright in cool, dry, well-ventilated place, out of the sun, at temperature between 40 degrees F and 100 degrees F.
  - 2. Protect from freezing.
  - 3. Store away from other chemicals and potential sources of contamination.
  - 4. Keep lights, fire, sparks, and heat away from container.
  - 5. Do not drop containers or slide across sharp objects.
  - 6. Do not stack pallets more than three high.
  - 7. Keep containers tightly closed when not in use.

### **1.9 FIELD CONDITIONS**

- A. Ambient Conditions:
  - 1. Apply treatments and coatings when surface and air temperature is between 40 degrees F and 95 degrees F.

2. Apply treatments and coatings when surface and air temperature is expected to remain above 40 degrees F for a minimum of eight hours after application.
3. Maintain ambient temperature of 50 degrees F minimum.
4. Apply treatments and coatings during calm wind conditions; provide adequate ventilation of enclosed or confined area.
5. Apply treatments and coatings minimum 24 hours after rain exposure; suspend application when rain is anticipated within 8 hours of application.
6. Do not apply to frozen substrate.

#### **1.10 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective work within a two-year period commencing on the Date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### **2.1 POLISHED CONCRETE SYSTEM**

- A. Polished Concrete System: Materials, equipment, and procedures designed and furnished by a single manufacturer to produce dense polished concrete of the specified sheen.
  1. Basis of Design Manufacturer: PROSOCO, Inc; Consolideck Polished Concrete System: [www.prosoco.com/consolideck/#sle](http://www.prosoco.com/consolideck/#sle).
  2. Substitutions: See Section 01 60 00 - Product Requirements.

#### **2.2 SURFACE TREATMENTS**

- A. Cutting Aid: Clear, water-based blended surfactant treatment spray-applied to wet concrete.
  1. VOC Content: 0.5 g/L or less.
  2. Product: Equivalent to PROSOCO, Inc; Consolideck First Cut: [www.prosoco.com/consolideck/#sle](http://www.prosoco.com/consolideck/#sle).
- B. Repair Material: Low-odor, liquid fill material.
  1. VOC Content: 100 g/L or less.
  2. Product: Equivalent to PROSOCO, Inc; Consolideck Grind-N-Fill: [www.prosoco.com/consolideck/#sle](http://www.prosoco.com/consolideck/#sle).
- C. Cleaner: Pre-densifier concrete cleaner for existing slab surfaces.
  1. Product: Equivalent to PROSOCO, Inc; Consolideck Cleaner/Degreaser: [www.prosoco.com/consolideck/#sle](http://www.prosoco.com/consolideck/#sle).

#### **2.3 DENSIFIERS AND HARDENERS**

- A. Liquid Densifier and Hardener: Penetrating chemical compound, reacts with concrete, filling pores, hardening, and dustproofing.
  1. Composition: Lithium silicate.
  2. VOC Content: 50 g/L or less.
  3. Abrasion Resistance: Greater than 50 percent improvement compared to untreated sample in accordance with ASTM C1353/C1353M.
  4. Treated Material Slip Resistance: High traction range when tested according to ANSI/NFSI B101.1 and ANSI/NFSI B101.3.
  5. Adhesion: Greater than 10 percent increase in pull-off strength compared to untreated sample when tested according to ASTM D4541.
  6. Water Vapor Transmission: Zero perms compared to untreated sample when tested according to ASTM E96/E96M Method B.

7. UV Stability: No degradation or yellowing when tested in accordance with ASTM G154.
8. Product: Equivalent to PROSOCO, Inc; Consolideck  
LS: [www.prosoco.com/consolideck/#sle](http://www.prosoco.com/consolideck/#sle).

## 2.4 STAIN MATERIALS

- A. Penetrating Stain:
1. Water-based, acrylic latex, penetrating stain with colorfast pigments
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide AmeriPolish, Inc.; Classic Dye or comparable product by one of the following:
      - 1) Americrete, Inc.
      - 2) Bomanite Co.
      - 3) Butterfield Color, Inc.
      - 4) H&C® Decorative Concrete Products; a brand of Sherwin-Williams Co.
      - 5) Scofield, a Business Unit of Sika Corporation.
      - 6) SuperStone, Inc.
    - b. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
    - c. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
    - d. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 16.5 mcg/cu. m or 13.5 ppb, whichever is less.
    - e. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
    - f. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.5 COATINGS

- A. Coatings, General:
1. Treated Material Slip Resistance: High traction range when tested according to ANSI/NFSI B101.1 and ANSI/NFSI B101.3.
  2. Stain Resistance: No adverse effect when tested according to ASTM D1308.
  3. UV Stability: No degradation or yellowing when tested according to ASTM G154.
- B. Clear Coating:
1. High Gloss: Film forming protective treatment.
    - a. Composition: Lithium silicate.
    - b. Adhesion: Greater than 10 percent increase in pull off strength compared to untreated sample when tested according to ASTM D4541.
    - c. Product: Equivalent to PROSOCO, Inc; Consolideck  
LSGuard: [www.prosoco.com/consolideck/#sle](http://www.prosoco.com/consolideck/#sle).
  2. Penetrating Sealer:
  3. Low Gloss: Solvent-based penetrating clear protective treatment.
    - a. VOC Content: 100 g/L or less.

- b. Product: Equivalent to PROSOCO, Inc; Consolideck Concrete Protector  
SB: [www.prosoco.com/consolideck/#sle](http://www.prosoco.com/consolideck/#sle).

### **PART 3 - EXECUTION**

#### **3.1 INSTALLERS**

- A. Execute using manufacturer-approved installer:

#### **3.2 EXAMINATION**

- A. Verify that floor surfaces are clean and free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes and allow complete curing before application of concrete hardener and densifier. See Section 07 92 00.

#### **3.3 GENERAL**

- A. Apply materials in accordance with manufacturer's instructions.

#### **3.4 CURING OF CONCRETE SLAB**

- A. See Section 03 30 00 Cast In Place Concrete.

#### **3.5 PREPARATION**

- A. Protect adjacent non-coated areas from drips, overflow, and overspray; avoid contact with metal, glass, and painted surfaces; immediately remove excess material.
- B. Correct variations in slab texture and color prior to application of hardener-densifier.

#### **3.6 CONCRETE POLISHING**

- A. Grind and polish in multiple passes with each full pass in direction perpendicular to previous pass.
- B. Fill gaps, voids, and pop-outs during grinding operation.
- C. Apply densifier and hardener at specified rates and intervals.
- D. Final Polished Concrete Aggregate Exposure: Not to exceed CPC Class A - Cement Fines; cement fines, 85 to 95 percent; fine aggregates, 5 to 15 percent based on visual observation of overall area of polished floor versus Polished Concrete Aggregate Exposure Chart.
- E. Final Polished Concrete Appearance: CPC Level 4 - Highly Polished, image clarity value 70 to 100 percent with haze index less than 10.

#### **3.7 CONCRETE STAINS**

- A. Newly placed concrete shall be at least 30 days old before staining.
- B. Prepare surfaces in accordance with manufacturer's written instructions and as follows:
  - 1. Clean concrete thoroughly by scraping, applying solvents or stripping agents, sweeping and pressure washing, or scrubbing with a rotary floor machine and detergents recommended by stain manufacturer. Rinse until water is clear and allow surface to dry.
    - a. Do not use acidic solutions to clean surfaces.

2. Test surfaces with droplets of water. If water beads and does not penetrate surface, or penetrates only in some areas, profile surfaces by acid etching. Retest and continue profiling surface until water droplets immediately darken and uniformly penetrate concrete surfaces.
  3. Apply acidic solution to dampened concrete surfaces, scrubbing with uncolored, acid-resistant nylon-bristle brushes until bubbling stops and concrete surface has texture of 120-grit sandpaper. Do not allow solution to dry on concrete surfaces. Rinse until water is clear. Control, collect, and legally dispose of runoff.
  4. Neutralize concrete surfaces and rinse until water is clear. Test surface for residue with clean white cloth. Test surface in accordance with ASTM F710 to ensure pH is between [7 and 8.
- C. Scoring: Score decorative jointing in concrete surfaces 1/16 inch (1.6 mm) deep with diamond blades to match pattern indicated. Rinse until water is clear. Score before staining.
1. Joint Width: 3/8 inch (10 mm).
- D. Allow concrete surface to dry before applying stain. Verify readiness of concrete to receive stain in accordance with ASTM D4263 by tightly taping 18-by-18-inch (450-by-450-mm), 4-mil- (0.1-mm-) thick polyethylene sheet to a representative area of concrete surface. Apply stain only if no evidence of moisture has accumulated under sheet after 16 hours.
- E. Reactive Stain: Apply reactive stain to concrete surfaces in accordance with manufacturer's written instructions and as follows:
1. Apply stain by uncolored bristle brush, roller, or high-volume, low-pressure sprayer and immediately scrub into concrete surface with uncolored, acid-resistant nylon-bristle brushes in continuous, circular motion. Do not spread stain after fizzing stops. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
  2. Remove stain residue after four hours by wet scrubbing with commercial-grade detergent recommended by stain manufacturer. Rinse until water is clear. Control, collect, and legally dispose of runoff.
- F. Penetrating Stain: Apply penetrating stain to concrete surfaces in accordance with manufacturer's written instructions and as follows:
1. Apply first coat of stain to dry, clean surfaces by airless sprayer or by high-volume, low-pressure sprayer.
  2. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
  3. Rinse until water is clear. Control, collect, and legally dispose of runoff.

### 3.8 PROTECTIVE TREATMENT

- A. Apply coatings in accordance with manufacturer's instructions. Match approved mock-ups for color, texture, sealing, and workmanship.
- B. Apply manufacturer's recommended protective treatment material to clean, dry slab after mechanically polishing.
- C. High gloss protective treatment:
- D. Clean spills on slab surfaces immediately, with manufacturer's recommended chemicals and absorptive materials.
- E. No haze, white residue, streaking, or burnish marks permitted.

### 3.9 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.



- B. Defective Concrete: Repair or replace concrete not complying with required lines, details, dimensions, tolerances, or specified requirements at no additional cost to Owner.
- C. Final Polished Concrete Appearance: Test image clarity value and haze index prior to application of sealer at a rate of three tests per 1000 sq ft of polished concrete.
- D. Image clarity: Test with Image Clarity Meter in accordance with ASTM D5767.
- E. Haze index: Test with Glossmeter in accordance with ASTM D4039.
- F. Match approved mock-ups for texture, appearance, and workmanship.

### **3.10 PROTECTION**

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.
- B. Protect finished surface as required and as recommended by manufacturer of polishing system until Date of Substantial Completion.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 03 41 34 – PRECAST PRETENSIONED CONCRETE SEATING UNITS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

**1.2 SUMMARY**

- A. Section includes all labor, material and equipment to fabricate, deliver and erect all precast concrete seating units, structures, parts thereof and materials necessary to complete the precast concrete seating units as described by the Drawings, General Notes and these specifications.
- B. Related Requirements:
  - 1. Specification **014000** “**Quality Requirements**” for requirements of material testing and inspection.
  - 2. Specification 014529 “Structural Testing and Inspections” for inspection requirements associated with cast-in-place concrete.
  - 3. Specification **031000** “Concrete Forming and Accessories” for forming associated with cast-in-place concrete.
  - 4. Specification **032000** “Concrete Reinforcing” for reinforcement for cast-in-place concrete.

**1.3 REFERENCES**

- A. Reference Standards:
  - 1. Codes and References: Comply with provisions of following, except where more stringent requirements are shown or specified. For codes and standards for which no specific version is referenced, the version that is referenced in the applicable building code shall govern, or, if there is no reference in the building code, the latest version of the code or standard shall govern:
    - a. Governing Building Code – Refer to General Notes.
    - b. ACI 301, “Specifications for Structural Concrete.”
    - c. ACI 318, “Building Code Requirements for Structural Concrete.”
    - d. PCI MNL-116, “Manual for Quality Control for Plants and Production of Structural Precast Concrete Products.”
    - e. PCI MNL-117, “Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.”
    - f. PCI MNL-120, “PCI Design Handbook, Precast and Prestressed Concrete.”
    - g. PCI MNL-135, “Tolerance Manual for Precast and Prestressed Concrete Construction.”
    - h. CRSI, “Manual of Standard Practice.”
    - i. AWS D1.1, “Structural Welding Code – Steel.”
    - j. AWS D1.4, “Structural Welding Code – Reinforcing Steel”
    - k. Local building code, with supplements.
  - 2. Applicable Standards:
    - a. ASTM A 36.
    - b. ASTM A 82.
    - c. ASTM A 108.
    - d. ASTM A 153.
    - e. ASTM A 185.
    - f. ASTM A 307.

- g. ASTM A 416.
- h. ASTM A 1064.
- i. ASTM A 49.
- j. ASTM A 536.
- k. ASTM A 572.
- l. ASTM A 615.
- m. ASTM A 706.
- n. ASTM A 722.
- o. ASTM A 767.
- p. ASTM A 775.
- q. ASTM C 33.
- r. ASTM C 42.
- s. ASTM C 109.
- t. ASTM C 150.
- u. ASTM C 260.
- v. ASTM C 330.
- w. ASTM C 494.
- x. ASTM C 496.
- y. ASTM C 1107.
- z. ASTM D 145.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

##### A. Coordination:

1. Quality Control: The Contractor is responsible for quality control, including workmanship and materials furnished by subcontractors and suppliers.
2. Document Conflict and Precedence: In case of conflict among documents, including architectural and structural drawings and specifications, notify the Architect/Engineer prior to submitting proposal. In case of conflict between and/or among the structural drawings and specifications, the strictest interpretation shall govern, unless specified otherwise in writing by the Architect/Engineer.
3. Materials and installed work may require testing and retesting, as directed by the governing building code or the Architect/Engineer, at any time during progress of work.
  - a. The Contractor shall provide adequate notification to the Owner's Testing Agency of construction operations including the project schedule to allow the Testing Agency to schedule inspections. Failure to notify sufficiently may result in additional costs incurred by the Testing Laboratory that may be back-charged to the Contractor by the Owner.
  - b. The Contractor shall cooperate with laboratory personnel, provide access to the work, and provide access to manufacturer's operations.
  - c. The Contractor shall make adequate arrangement with the Owner's Testing Agency for inspection of material stockpiles and facilities.
  - d. The Contractor shall provide to the laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.
  - e. The Contractor shall furnish casual labor, equipment, and facilities as required for sampling and testing by the laboratory and otherwise facilitate the required inspections and tests.
  - f. Inspection or testing by the Owner does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents. Tests not specifically indicated to be done at the Owner's expense, including retesting of rejected materials and installed work, shall be done at the Contractor's expense. Reference **014529 "Structural Testing and Inspections"** section of the Specifications.

4. Responsibility for Selection and Use of Concrete Admixtures and Chemical Treatments:  
The Contractor shall be responsible for selecting admixtures and surface treatments that are compatible with the intended use of the concrete including all final surface treatments called for within this or other specifications or on the structural or architectural drawings. The Contractor is responsible for following the manufacturer's instructions for the use of their product including abiding by any limitations placed by the manufacturer on the use of any of its products.
- B. Preinstallation Meetings:
  1. Pre-Concrete Conference:
    - a. At least seven days prior to beginning concrete work, the Contractor shall conduct a meeting to review the proposed methods of fabrication and erection of structural precast concrete. Also, review requirements for submittals, status of coordinating work and availability of materials. Establish work progress schedule and procedures for materials inspection, testing, and certifications. The contractor shall send a pre-concrete conference agenda to all attendees seven days prior to the scheduled date of the conference.
    - b. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:
      - 1) Contractor's Superintendent.
      - 2) Laboratory responsible for the concrete design mix.
      - 3) Laboratory responsible for field quality control.
      - 4) Precast Concrete Subcontractor.
      - 5) Ready-Mix Concrete Producer.
      - 6) Owner's and Architect's/Engineer's Representative.
    - c. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by him to all parties concerned within five days of the meeting. One copy of the minutes shall be transmitted to the following for information purposes:
      - 1) Owner's Representative.
      - 2) Architect.
      - 3) Engineer-of-Record.
    - d. The Engineer shall be present at the conference. The Contractor shall notify the Engineer at least seven days prior to the scheduled date of the conference.

## 1.5 SUBMITTALS

- A. Certification and Test Reports: Submit manufacturer's specifications and instructions for manufactured materials and products. Include manufacturer's and plant's certifications and laboratory test reports for the following:
  1. PCI Plant Certification.
  2. Concrete mix designs, including sources of coarse, fine and lightweight aggregates as well as admixtures.
  3. Prestressing strand mill certificates.
  4. Mill certificates for reinforcing bars and welded wire mesh.
  5. Mill certificates for high strength reinforcing bars.
  6. Structural steel mill certificates.
  7. Welder and welding operator certifications.
  8. Calibrations of prestressing jacks.
  9. Calibration of cylinder testing machine.
  10. Mill certificates for cement.
  11. Cylinder test reports on concrete for all precast units.

- B. Shop Drawings: Submit for review by the Architect/Engineer detailed shop drawings as follows:
1. Erection Drawings:
    - a. Dimensioned seating unit plans, elevations and sections drawn to scale and showing identification of each precast seating unit.
    - b. Complete connection details showing size, type and grade of all plates, inserts and anchors. Show proper welding symbols in accordance with AWS D1.1.
    - c. Description of all loose and cast-in hardware, plates, inserts, etc.
    - d. Erection sequence and handling requirements.
    - e. All dead, live and other applicable loads used in the design.
  2. Production Drawings for all precast seating units:
    - a. Member elevations and sections showing all dimensions.
    - b. Finishes.
    - c. Size, type, grade and location of all reinforcing steel including that required for handling and erection.
    - d. Prestress forces and number of strands.
    - e. Concrete strengths at release for prestressed members and 28 day design strength.
    - f. Size, type and location of all cast-in plates, inserts and other hardware.
    - g. Size, type and location of all drain holes and other openings.
    - h. Size, type and location of all expansion blockouts.
    - i. Size, type and location of all lifting and handling devices.
    - j. Estimated cambers at time of erection.
    - k. Method of transportation.
  3. Field Installed Seating Unit Attachment Drawings: Submit a drawing showing the method and proposed location for attaching all stadium seats to the precast seating units.
  4. Equipment Hung From Precast Seating Units: Submit shop drawings and calculations showing location and method of attachment of all ceilings, subroofs, pipes, ducts and other equipment hung from the precast seating units. Shop drawings and calculations shall be sealed by a professional engineer who is licensed in the state where the project is located.
    - a. No pipe, ducts or other equipment shall be hung from the precast seating units without written approval of the Architect/Engineer.
  5. All shop drawings submitted shall be sealed by a professional engineer who is licensed in the state where the project is located.
- C. Design Calculations:
1. Precast Seating Unit Design: Provide for review by the Architect/Engineer complete design calculations for dead load, live load, lifting and erection loads. The design shall consider that the precast seating units will undergo unsymmetric bending and torsion for dead (self weight) load and unsymmetric bending for live load. Calculations shall show design for all connections at the member ends and to each adjoining member.
    - a. Details shown on the contract drawings shall be considered minimum requirements that shall be increased or modified as required for actual design forces. Refer to General Notes on the structural drawings for design loads.
    - b. Calculations shall be prepared by or under the direct supervision of a professional engineer licensed in the state where the project is located. All members designed by computer shall have calculations include a documentation of the computer program identifying method of solution, all input data and output for each unit. At least one unit shall be correspondingly designed by hand and submitted with the computer data for verification. All calculations shall be neat, well organized and bound. Partial, incomplete or unstamped calculations will be rejected.
  2. Design Modifications: Design modifications may be made as necessary to meet field conditions and to ensure proper fitting of the work, but only with the prior written approval of the Architect/Engineer for each occurrence. Provide complete design calculations and drawings for required or anticipated design modifications in accordance with these specifications.

**D. Samples**

1. Submit all samples of materials as requested by the Architect and specified herein in accordance with requirements of the Division 1, General Requirements and obtain written approval from the Architect before ordering materials.
2. Finish samples: Submit two 12"x12"x2" thick samples of concrete to indicate color, texture, and finish for approval in accordance with the Division 1, General Requirements.
3. Prepare two full-size samples of a structural precast concrete bay unit for Architect's inspection at production plant prior to start of installation work, and after Architects review of finish samples. Acceptable full-size samples may be incorporated in job installation as follows.
  - a. One approved full-size panel shall be identified and installed in the project for the purpose of judging the installed units. One approved full-size panel shall be retained at the production plant for the fabricator to judge completed panels prior to shipment. The full-size panel retained at the production plant may be the last panel incorporated into the project.
4. Submit samples of anchors, dowels, and bearing pads and all other materials requested by the Architect.

**1.6 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Companies specializing in providing structural precast and/or precast prestressed concrete seating units and services normally associated with the industry for at least 5 years.
  1. Companies shall be participants in the PCI Plant Certification Program and, upon request, written evidence shall be submitted to show experience, qualifications and adequacy of plant capability and facilities for performance of contract requirements. Compliance with this provision is subject to verification by the Architect/Engineer.
- B. Erector Qualifications: Regularly engaged for at least 2 years in the erection of precast structural concrete similar to the requirements of this project. Upon request, provide written evidence that equipment and personnel are adequate and qualified for performance of contract requirements.
- C. Welder and Welding Machine Operator Qualifications: All field and plant welders shall be certified in accordance with AWS D1.1 for the type of welding required.
- D. Plant Quality Control: Provide copies of plant quality control program describing procedures for the following:
  1. Verifying size and placement of reinforcing steel and prestressing strand.
  2. Tensioning and de-tensioning operations.
  3. Verifying sizes and critical dimensions of members.
  4. Verifying position of plates, inserts and other embedded items.
  5. Verifying squareness of forms and positioning of blockouts.
  6. Final inspecting of products prior to shipment.

If units are produced at locations other than precast concrete fabricating plants, maintain procedures and conditions for quality control which are equivalent to plant production.

**1.7 REQUIREMENTS FOR AISLE STEPS**

- A. All aisle steps shall be cast-in-place. Precast aisle steps are not permitted. See the drawings.

**1.8 DELIVERY, STORAGE AND HANDLING**

- A. Store precast concrete seating units at manufacturer's plant or project site to prevent cracking, distortion, staining, or other physical damage, and so that markings are visible. Lift and support units at designated lift points. Do not use upper member of stacked tier as storage area for shorter member or heavy equipment. Deliver units to project site in such quantities and at such times to assure continuity of installation.

**PART 2 - PRODUCTS****2.1 FORMWORK**

- A. Provide forms and, where required, form facing materials of metal, plastic, wood, or other acceptable material that is non-reactive with concrete and will produce required finished surfaces. Rust-stained or excessively worn forms that would impair the quality of the finished surface are not acceptable. Comply with recommendations set forth in ACI Standard 347, Recommended Practice for Concrete Formwork.
- B. Accurately construct forms mortar-tight and of sufficient strength to withstand pressures due to concrete placing operations, temperature changes, and when prestressed, the pretensioning and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines, and dimensions indicated on the approved shop drawings within specified fabrication tolerances.
- C. Unless forms for plant-manufactured prestressed concrete units are stripped prior to detensioning, design forms so that stresses are not induced from precast units due to deformation of concrete under prestress or to movement during detensioning.

**2.2 REINFORCING MATERIALS**

- A. Reinforcing Bars: ASTM A 615, Grade 60. All reinforcing steel that requires welding shall conform to ASTM A 706.
- B. Welded Wire Fabric: ASTM A 185.
- C. Deformed Steel Wire: ASTM A 1064.
- D. Welded Deformed Steel Wire Fabric: ASTM A 1064.
- E. Prestressing Tendons: Uncoated, 7-wire, stress-relieved strand; ASTM A 416, Grade 270K.
- F. Prestressing Bars: ASTM A 722.
- G. Supports for Reinforcement:
  - 1. Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting or fastening reinforcing, complying with CRSI recommendations.
  - 2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are either plastic protected or all plastic (CRSI Class 1) or stainless steel protected (CRSI Class 2).

**2.3 CONCRETE MATERIALS**

- A. Portland Cement: ASTM C 150, Type I or Type III, or as otherwise specified on the drawings.
  - 1. Use only one brand and type of cement throughout the project, unless otherwise acceptable to the Architect/Engineer.
- B. Aggregates:
  - 1. Gravel or crushed stone: ASTM C 33. Provide from a single source for exposed concrete.
- C. Water: Potable or free from foreign materials in amounts harmful to concrete and embedded steel.



- D. Admixtures:
1. Air-Entraining Admixture: ASTM C 260, Provide air entrainment as specified in Table 19.3.3.1. of ACI 318-14 in all exposed concrete.
    - a. Subject to compliance with requirements, provide one of the following products and manufacturers:
      - 1) W.R. Grace & Co.; Darex-AEA or Daravair.
      - 2) Master Builders; MBAE90 or Micro-Air.
      - 3) Sika Corporation; Sika AER.
      - 4) The Euclid Chemical Company, Inc.; Air Mix or AEA-92.Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.
  2. Water-Reducing Admixture: ASTM C 494, Type A
    - a. Subject to compliance with requirements, provide one of the following products and manufacturers:
      - 1) Master Builders; Pozzolith 322N or Polyheed 997.
      - 2) Sika Chemical Corp.; Plastocrete 161.
      - 3) The Euclid Chemical Company, Inc.; Eucon WR-75 or WR-91.
      - 4) W.R. Grace & Co.; WRDA with Hycol.Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.
  3. Fly Ash: not permitted.
  4. Calcium Chloride: not permitted

## 2.4 CONNECTION MATERIALS

- A. Steel Plates: ASTM A 36.
- B. Steel Shapes: ASTM A 36.
- C. Anchor Bolts: Non-headed type with tensile strength requirements conforming to ASTM A 36, unless otherwise indicated. Provide regular hexagon nuts and carbon steel washers.
- D. High Strength Anchor Bolts: Non-headed type made from threaded round stock conforming to ASTM A 572 Grade 50 or A572 Grade 42 as shown on the drawings or high-strength bars conforming to ASTM A 722. Where grade is not specifically shown, ASTM A572 Grade 50 anchor bolts shall be furnished.
- E. Weldable Reinforcing Bars: ASTM A 706.
- F. Headed Studs: ASTM A 108, 60,000 psi minimum tensile strength.
- G. Deformed Bar Anchors: ASTM A 1064, 70,000 psi minimum yield strength.
- H. Prestressing Steel Bars: ASTM A 722.
  1. Approved Manufacturer: Dywidag Systems International, USA, Inc.
- I. Threaded Rods: ASTM A 36.
- J. Welding Electrodes: Comply with AWS D1.1.
- K. Ductile Iron Inserts: ASTM A 536.
  1. Approved Manufacturers:
    - a. Dayton/Richmond Concrete Accessories.
    - b. Hohmann & Barnard, Inc.
- L. Ferrule Wing Inserts: Provide from the following products:
  1. Meadow Burke Products; FX-19 Ferrule Wing Insert.
  2. Dayton/Richmond Concrete Accessories; F-62, Flared Thin Slab Ferrule Insert.

- M. Corrosion Protection of Steel Units: All items shall be hot-dipped galvanized in accordance with ASTM A 153. Touch-up after field welding with zinc-rich coating as manufactured by Sherwin-Williams (Zinc-Clad 5 B69 A 45) or ZRC Cold Galvanizing Compound. Exposed surfaces of all plates embedded in concrete shall be painted with zinc-rich coating specified above after the field connection is complete.

## 2.5 GROUT MATERIALS

- A. Non-Metallic Non-Shrink Grout: Premixed, non-corrosive, non-staining product containing Portland cement, silica sands, shrinkage compensating agents, and fluidity improving compounds. Conform to ASTM C 1107. Provide the minimum strength as shown below as determined by grout cube test at 28 days.
- B. Attain 28 day compressive strength as determined by grout cube tests conforming to ASTM C 109 in accordance to the following:
1. 6,000 psi for supporting concrete up to 3,000 psi.
  2. 8,000 psi for supporting concrete between 3,000 psi and 4,000 psi.
  3. Unless noted otherwise on the drawings, grout strength on supporting concrete greater than 4000 psi shall be 8000 psi.
- C. Follow manufacturer's directions and recommendations for mixing and placing grout.
- D. Grout to be similar in color to that of surrounding concrete.
- E. Acceptable non-shrink grouts:
1. Sonneborn-ChemRex, Inc.; SonogROUT 10k
  2. L&M Construction Chemicals, Inc.; Crystex and DuragROUT.
  3. Dayton-Superior Corporation; Sure Grip High Performance Grout and 1107 Advantage Grout.
  4. Master Builders Technologies; Masterflow 713 and Set Grout.
  5. U.S. Grout Corp.; Five Star Grout.
  6. The Euclid Chemical Company; NS Grout.

## 2.6 BEARING PADS

- A. Elastomeric Pads:
1. Type: Provide structural grade chloroprene bearing pads with Shore A durometer hardness of  $60 \pm 5$  and having a minimum thickness of 1/2", unless otherwise shown on the drawings. Bearing pads provided shall conform to 1998 AASHTO "LRFD Bridge Construction Specifications", Section 18.
  2. Design: Design of bearing pads shall conform to the 1998 AASHTO "LRFD Bridge Design Specification", Section 14, Division 1.
  3. Size pads so that both surfaces are in complete contact with the bearing pads. The design bearing pressure shall not exceed 800 psi under total service load, and 500 psi under dead load. Pads greater than 1 1/4" in thickness shall be laminated with steel plates (min. 1/16" thick) molded into the material.
  4. Provide beveled, plain elastomeric bearing pads between non-parallel load surfaces.
  5. Approved manufacturers of elastomeric pads:
    - a. Con-Serv, Inc.
    - b. Seismic Energy Co.

Other manufacturers will be acceptable only with Engineer approval.

- B. Tetrafluoroethylene (TFE) Slide Bearings:
1. Glass-filled virgin Teflon slide bearings as shown on the drawings and as manufactured by:
    - a. Con-Serv, Inc.
    - b. Seismic Energy Co.Other manufacturers will be acceptable only with Engineer approval.

**2.7 EPOXY MORTAR PATCH**

- A. General Requirements: Two-component material suitable for use on dry or damp surface, complying with ASTM C 881, for use in concrete repairs. The color of the patch shall match the surface color of the precast concrete unit.
- B. Products for Epoxy Mortar Patches:
  - 1. Sika Chemical Corporation; Sikadur Lo-Mod LV.
  - 2. The Euclid Chemical Company; Euco 452 LV.
  - 3. Dayton-Superior; Sure Grip Epoxy Grout (J-54).

**2.8 SEALER**

- A. Water-Based Silicate Sealer: Provide a water-based silicate solution that acts to cure and seal the concrete surface.
- B. Product: Subject to compliance with requirements supply the following:
  - 1. Curecrete Chemical Company, Inc.; Ashford Formula.

**PART 3 - EXECUTION****3.1 FABRICATION**

- A. General: Fabricate precast concrete units complying with manufacturing and testing procedures, quality control recommendations and dimensional tolerances of PCI MNL-116 and MNL-117, unless stricter requirements are specified herein or on the drawings.
- B. Proportioning and Design of Mixes:
  - 1. Prepare design mixes for each type of concrete required.
  - 2. Design mixes may be prepared by an independent testing facility or by qualified precast manufacturing personnel, at precast manufacturer's option.
  - 3. Proportion mixes by either laboratory trial mixture or field experience methods, complying with ACI 301 and ACI 318, using materials to be employed on the project for each type of concrete required..
  - 4. Submit written reports to Architect/Engineer of proposed mix for each type of concrete at least 30 days prior to start of precast unit production. Do not begin concrete production until mixes and evaluations have been reviewed and approved by Architect/Engineer and Owner's testing laboratory.
  - 5. Mix design adjustments may be requested when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Laboratory test data for revised mix designs and strength results must be submitted to and accepted by Architect/Engineer and Owner's testing laboratory before using in the work.
  - 6. Produce normal weight concrete consisting of specified portland cement, aggregates, admixtures and water to produce the following properties:
    - a. Compressive Strength at 28 days: 5,000 psi minimum at 28 days, or as required by design or as noted on the drawings.
    - b. Release Strength: The minimum release strength for prestressed units shall be 3500 psi.
    - c. Drying Shrinkage Limit: 0.03% at 28 days.
  - 7. Produce lightweight concrete consisting of specified portland cement, aggregates, admixtures and water to produce the following properties:
    - a. Compressive Strength: 5,000 psi minimum at 28 days, or as required by design or as noted on the drawings.
    - b. Air-dry density: Not less than 110 nor more than 116 pounds per cubic foot.
    - c. Release Strength: The minimum release strength of prestressed members shall be 3500 psi unless noted otherwise and permitted by design.
    - d. Drying Shrinkage Limit: 0.03% at 28 days.

- C. Admixtures:
1. Comply with ACI 212.2R.
  2. Use air-entraining admixture in concrete unless otherwise indicated.
  3. Use water-reducing admixtures in strict compliance with manufacturer's directions. Admixtures to increase cement dispersion, or provide increased workability for low-slump concrete, may be used subject to Architect/Engineer's approval.
  4. Use amounts as recommended by admixture manufacturer for climatic conditions prevailing at time of placing. Adjust quantities of admixtures as required to maintain quality control.
- D. Embedded Items: Accurately position and secure cast-in anchorage devices. Locate anchorages where they do not affect position of reinforcement or placing of concrete. Do not relocate bearing plates or reinforcing steel in units unless approved in writing by the Architect/Engineer. Provide and coordinate the placement of embeds required for equipment or components hung from precast units.
- E. Reinforcement Installation:
1. Clean reinforcement of loose rust and mill scale, earth and other materials which reduce or destroy bond with concrete.
  2. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as specified by CRSI Manual of Standard Practice.
  3. Place reinforcement to obtain at least the minimum coverages for concrete protection as specified in the drawings. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
  4. Place reinforcement clear of the depth required for the installation of stadium seat anchors.
- F. Tensioning: Pretensioning of tendons for prestressed concrete may be accomplished either by single strand tensioning method or multiple-strand tensioning method. Comply with PCI MNL-116 requirements.
- G. Concrete Placement: Place concrete in a continuous operation to prevent formation of seams or planes of weakness in precast units, complying with requirements of ACI 301. Thoroughly consolidate placed concrete by internal and/or external vibration without dislocation or damage to reinforcement and embedded items.
- H. Identification:
1. Provide permanent markings to identify pick-up points and orientation in the structure, complying with markings indicated on final shop drawings. Imprint date of casting on each precast unit on a surface which will not show in finished structure.
- I. Curing:
1. Cover all precast and precast/prestressed concrete members with tarpaulins or other suitable means immediately after casting.
  2. Curing by low-pressure steam, by steam vapor, by radiant heat and moisture, or other similar process may be employed to accelerate concrete hardening and to reduce curing time.
- J. Detensioning:
1. Delay detensioning of prestressed units until concrete has attained design release strength, as established by test cylinders.
  2. If concrete has been heat-cured, perform detensioning while concrete is still warm and moist to avoid dimensional changes which may cause cracking or undesirable stresses in concrete.

3. Detensioning of prestressed tendons may be accomplished either by gradual release of tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
- K. Finishes:
1. Formed Surfaces: Provide normal plant run finish in well-maintained forms that impart a smooth finish to concrete. Small surface holes caused by air bubbles, normal form joint marks, and minor chips and spalls may be acceptable, but no major or unsightly imperfections, honeycomb, or structural defects will be permitted.
  2. Unformed Surface at Underside of Seating Units: Provide trowel finish to unformed surfaces unless otherwise indicated. Consolidate concrete, bring to proper level with a straightedge, and float and trowel to a smooth uniform finish.
  3. Finish of Treads and Risers: For units cast top side up, provide a steel troweled finish followed by a light broom finish parallel to the length of the unit. For units cast top side down, provide a light sandblast on the tread area to produce a non-skid surface before delivery to the job site.
  4. Finish of Ends of Units: Strands shall be recessed  $\frac{3}{4}$ " minimum and recess shall be filled with non-shrink, non-metallic grout. Sandblast ends to provide a proper surface for sealant adhesion.
  5. Holes: Cast-in all holes required for precast seating units and show on shop drawings. Do not cut holes of any size in precast units without written authorization of Architect/Engineer.
- L. Joint Widths: Unless shown otherwise on the drawings, provide joint widths as follows:
1. Member Ends:  $\frac{3}{4}$ ".
  2. Horizontal Joint Between Members (Tread to Riser):  $\frac{1}{2}$ ".
  3. At Expansion Joints: Refer to the drawings.
- M. Slope on Seating Tread: Provide a slope on the seating treads of  $\frac{1}{2}$ ", starting at the base of the riser and sloping down.

### 3.2 QUALITY ASSURANCE

- A. General: The Owner may employ a separate testing laboratory to evaluate precast manufacturer's quality control and testing methods. Owner's testing facility shall be allowed access to materials storage areas, concrete production equipment, and concrete placement and curing facilities, and shall be provided with samples of materials and concrete mixes as may be requested for additional testing and evaluation.
- B. Fabrication Tolerances: Provide fabrication tolerances as follows:
1. Length:  $\pm\frac{1}{2}$ ".
  2. Width:  $\pm\frac{1}{4}$ ".
  3. Depth:  $\pm\frac{1}{4}$ ".
  4. Flange Thickness (tread):  $+\frac{1}{4}$ ",  $-\frac{1}{8}$ ".
  5. Web Thickness (Riser):  $\pm\frac{1}{8}$ ".
  6. Position of Tendons:  $\pm\frac{1}{4}$ ".
  7. Position of Bearing Plates, Cast-In Plates:  $\pm\frac{1}{2}$ ".
  8. Bearing Plates, Tipping and Flushness:  $\pm\frac{1}{8}$ ".
  9. Camber (Variation from Design):  $\pm\frac{1}{4}$ " per 10 ft. but  $\pm\frac{1}{2}$ " max.
  10. Camber, Differential for Adjacent Units:  $\frac{1}{4}$ " per 10 ft. but  $\frac{1}{2}$ " max.
  11. Other tolerances not specified above shall be in accordance with PCI MNL-116.

Precast units having dimensions not conforming to specified tolerances will be rejected if appearance or function of the structure is adversely affected. Repair, or remove and replace rejected units as required to comply with contract documents. All repairs must be approved by the Architect/Engineer.

- C. Concrete Test Cylinders: Make test cylinders as follows:
1. Minimum of two (2) per bed for each pour to verify specified release strength.
  2. Minimum of two (2) per 50 cubic yards for each class of concrete to verify 28-day strength but not less than one set per day's operation.
  3. Minimum of two (2) to verify release strength and two (2) for 28-day strength for small units or individual pieces.
  4. Test cylinders shall be cured with and by the same methods as the members they represent.
- D. Acceptance Criteria of Concrete Strength: The compressive strength level of an individual class of concrete shall be considered satisfactory if both the following requirements are met:
1. The average of all sets of three consecutive strength tests equal or exceed the required  $f'c$ .
  2. No individual strength test falls below the required  $f'c$  by more than 500 psi.
  3. If criterion 1 above is not met but criterion 2 above has been, the Contractor shall immediately notify the Engineer by telephone or email and take immediate steps to increase the average of subsequent strength tests.
- E. Strength of Units: The strength of precast units will be considered potentially deficient requiring the unit to be either further tested or replaced if the manufacturing processes fail to comply with any of the requirements which may affect the strength of the precast units, including but not limited to the following conditions:
1. Failure to meet compressive strength tests requirements. Concrete strength will be considered deficient if a cylinder strength test falls more than 500 psi below the required  $f'c$ . All units cast from the concrete that is represented by the low strength test shall be considered potentially deficient and subject to tests or replacement.
  2. Reinforcement, reinforcement placing, and pretensioning and detensioning of tendons of prestressed concrete not conforming to specified fabrication requirements.
  3. Visual evidence of cracks exceeding .02 inches wide, excessive negative camber, or deflection in excess of calculated anticipated amounts.
  4. Concrete curing and protection of precast units not as specified.
  5. Precast units damaged during storage, transportation, handling or erection.
- F. Investigation of Low Concrete Strength: When there is evidence that the strength of precast concrete units does not meet specification requirements, the Owner's testing service shall take cores from hardened concrete for compressive strength determination, complying with ASTM C 42 and as follows:
1. Take at least 3 representative cores from precast units of suspect strength from locations directed by the Architect/Engineer.
  2. Test cores in a saturated-surface-dry condition in accordance with ACI 318 if concrete will be wet during use of completed structure.
  3. Test cores in an air-dry condition in accordance with ACI 318 if concrete will be dry during use of completed structure.
  4. Strength of concrete for each series of cores will be considered satisfactory if their average compressive strength is at least 85% of 28-day design compressive strength and no individual test is less than 75% of the required  $f'c$ .
  5. Test results will be reported in writing (PDF format) on same day that tests are made, with copies to Owner, Architect, Engineer, Contractor and precast manufacturer. Include in test reports the project identification name and number, date, name of precast concrete manufacturer name of concrete testing service, identification letter, number and type of member or members represented by core tests, design compressive strength, compression breaking strength and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to the horizontal plane of concrete as placed, and moisture condition of core at time of testing.
  6. Where core test results are satisfactory and precast units are acceptable for use in work, fill core holes solid with non-shrink patching mortar or epoxy based mortar as directed by Architect/Engineer and finish to match adjacent concrete surfaces.

- G. X-Rays: The Architect/Engineer may order x-rays taken of any member if there is sufficient doubt about the proper existence or location of reinforcing steel, embedded items, or strands.
- H. Load Tests: The Architect/Engineer may order a load test of the member in the plant or in the field if there is sufficient evidence to question the structural integrity of the member.
- I. Finish Tolerance: The top concrete surface shall have the specified finish and be free of honeycombs, spalls and voids in excess of 1/4" deep. Defects exceeding these criteria, provided the structural capacity is not impaired, shall be cause for repair by patching with a two-part epoxy mortar or rejection of the unit. Patching shall be done only when acceptable to Architect/Engineer. The patch shall match the color, texture and finish of the original unit. All concrete surface repairs except minor surface blemishes less than 1/4" deep must be noted in quality control reports and submitted for Architect/Engineer review and approval for each occurrence prior to erection. Patches not conforming to these requirements may be a cause for rejection of the unit.
- J. Products Not Meeting Specifications: Precast units that do not conform to all specified requirements including strength, tolerances, both fabrication and erection, and finishes shall be rejected and replaced with units meeting all requirements of the Contract Documents, unless approval by the Architect/Engineer is obtained in writing for an authorized repair.
- K. Authorized Repairs: No structural or architectural repair shall be made to any precast unit either in the plant or in the field without written documented approval for each occurrence in the form of a letter or drawing from the Architect/Engineer. Unauthorized repair details shall not be allowed.

### 3.3 INSTALLATION

- A. General:
  - 1. Examine supporting structure and conditions under which precast concrete work is to be erected and provide written notification of conditions detrimental to proper and timely completion of work. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Erector.
  - 2. General Contractor shall monitor all phases of erection to ensure the work is in conformance with the contract documents.
  - 3. Erect members by means of suitable lifting devices at points provided by the manufacturer.
  - 4. Provide temporary shoring and bracing as required to ensure stability during erection. The erector shall brace unsymmetrical sections during erection and pouring of topping slabs to prevent rotation and instability regardless of whether it is specified on the erection drawings. The responsibility for bracing such members shall rest solely with the Erector.
  - 5. Properly align, plumb and level precast units. Level out variations between adjacent members by shimming, loading or any other feasible method recommended by the manufacturer and acceptable to the Architect/Engineer.
  - 6. Provide accurate placement and alignment of anchor bolts, plates or dowels in supporting structural elements.
  - 7. Provide true, level bearing surfaces on all field placed foundations, bearing walls and other supporting members.
  - 8. Bearing Pads: Install specified bearing pads as precast units are being erected and maintain in correct position until precast units are placed.
- B. Erection Tolerances:
  - 1. Plan Location:  $\pm 1"$ .
  - 2. Tread Elevation at Member Ends:  $\pm 1/4"$ .
  - 3. End Joint Width:  $\pm 1/2"$ .
  - 4. Joint Width between Tread and Riser of Adjacent Units:  $\pm 1/2"$ .
  - 5. Differential Top Elevation Between Units: no greater than 1/4".

6. Bearing Length (Span Direction):  $\pm 3/4"$ .
  7. Bearing Width:  $\pm 1/2"$ .
  8. Other tolerances not specified above shall conform to PCI MNL 120 Part 8.
- C. Field Welding:
1. Perform welding in compliance with AWS D1.1 and D1.4.
  2. Protect units from damage by field welding operations and provide non-combustible shields as required.
  3. Remove all lifting loops and touch-up paint all galvanized field welded connections as specified.
  4. Repair damaged metal surfaces by cleaning and applying a coat of liquid galvanizing repair compound to galvanized surfaces and primer compatible with painted surfaces.
- D. Grouting Joints: After precast units have been set and secured, grout at specified locations shown on the drawings as follows:
1. Provide non-shrink non-metallic grout.
  2. Provide forms or other acceptable method to retain grout in place until sufficiently hard to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, plumb, and level with adjacent concrete surfaces. Keep grouted joints damp for not less than 48 hours after initial set. Promptly remove excess grout material and spillage from exposed surfaces before it hardens.
- E. Powder-Actuated Fasteners and Expansion Anchors: Do not use powder-actuated fasteners or expansion anchors in precast seating units except as submitted and approved on shop drawings or other submittal.
- F. Damage to Units during Installation: Damage to precast units sustained during installation resulting in spalls deeper than 1/4 inch and cracks exceeding .01 inch in width shall be immediately reported to the Architect/Engineer. Units thus damaged shall be subject to repair or replacement as directed by the Architect/Engineer. Repairs of spalls shall be done using a two-part epoxy mortar patch that shall match the color, texture, and finish of the original unit. Cracks shall be repaired using an epoxy injection process.

### 3.4 ACCEPTANCE

- A. Field Inspection: Acceptance of erected precast prestressed concrete will be made by the Architect/Engineer for general conformance with the plans and specifications.
- B. Defective Work: Precast concrete units which do not conform to specified requirements, including strength, tolerances, and finishes, shall be repaired or replaced with precast concrete units that meet requirements of this section as directed by the Architect/Engineer. The Contractor shall also be responsible for the cost to any other work affected by or resulting from corrections to precast concrete work.

END OF SECTION



**SECTION 03 45 00 – PRECAST ARCHITECTURAL CONCRETE****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

**1.2 SUMMARY**

- A. Section includes all labor, material, and equipment to cast, fabricate, deliver, and erect all architectural precast concrete as shown on the Architectural Drawings and in schedules.
- B. Related Requirements:
1. Specification **014000** “**Quality Requirements**” for requirements of material testing and inspection.
  2. Specification 014529 “Structural Testing and Inspections” for inspection requirements associated with cast-in-place concrete.
  3. Specification **031000** “Concrete Forming and Accessories” for forming associated with cast-in-place concrete.
  4. Specification **032000** “Concrete Reinforcing” for reinforcement for cast-in-place concrete.
- C. Architectural Precast Concrete shall include the following unit types:
1. Plain smooth faced concrete units.
  2. Exposed aggregate units (integral, not surface applied aggregate).
  3. Special formed and textured units.
- D. Precast prestressed structural concrete units are specified under another section of Division 03.
- E. Caulking, sealants, and gaskets are specified in Division 07.

**1.3 REFERENCES**

- A. Reference Standards:
1. Codes and Standards: Comply with provisions of following, except where more stringent requirements are shown or specified. For codes and standards for which no specific version is referenced, the version that is referenced in the applicable building code shall govern, or, if there is no reference in the building code, the latest version of the code or standard shall govern:
    - a. ACI 301, “Specifications for Structural Concrete.”
    - b. ACI 318, “Building Code Requirements for Structural Concrete.”
    - c. PCI MNL-116, “Manual for Quality Control for Plants and Production of Structural Precast Concrete Products.”
    - d. PCI MNL-117, “Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.”
    - e. PCI MNL-120, “PCI Design Handbook, Precast and Prestressed Concrete.”
    - f. PCI MNL-135, “Tolerance Manual for Precast and Prestressed Concrete Construction.”
    - g. CRSI, “Manual of Standard Practice.”
    - h. AWS D1.1, “Structural Welding Code – Steel.”
    - i. AWS D1.4, “Structural Welding Code – Reinforcing Steel”
    - j. Local building code, with supplements.

**1.4 ADMINISTRATIVE REQUIREMENTS****A. Coordination:**

1. **Quality Control:** The Contractor is responsible for quality control, including workmanship and materials furnished by subcontractors and suppliers.
2. **Document Conflict and Precedence:** In case of conflict among documents, including architectural and structural drawings and specifications, notify the Architect/Engineer prior to submitting proposal. In case of conflict between and/or among the structural drawings and specifications, the strictest interpretation shall govern, unless specified otherwise in writing by the Architect/Engineer.
3. **Materials and installed work may require testing and retesting, as directed by the governing building code or the Architect/Engineer, at any time during progress of work.**
  - a. The Contractor shall provide adequate notification to the Owner's Testing Agency of construction operations including the project schedule to allow the Testing Agency to schedule inspections. Failure to notify sufficiently may result in additional costs incurred by the Testing Laboratory that may be back-charged to the Contractor by the Owner.
  - b. The Contractor shall cooperate with laboratory personnel, provide access to the work, and provide access to manufacturer's operations.
  - c. The Contractor shall make adequate arrangement with the Owner's Testing Agency for inspection of material stockpiles and facilities.
  - d. The Contractor shall provide to the laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.
  - e. The Contractor shall furnish casual labor, equipment, and facilities as required for sampling and testing by the laboratory and otherwise facilitate the required inspections and tests.
  - f. Inspection or testing by the Owner does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents. Tests not specifically indicated to be done at the Owner's expense, including retesting of rejected materials and installed work, shall be done at the Contractor's expense. Reference **014529 "Structural Testing and Inspections"** section of the Specifications.
4. **Responsibility for Selection and Use of Concrete Admixtures and Chemical Treatments:** The Contractor shall be responsible for selecting admixtures and surface treatments that are compatible with the intended use of the concrete including all final surface treatments called for within this or other specifications or on the structural or architectural drawings. The Contractor is responsible for following the manufacturer's instructions for the use of their product including abiding by any limitations placed by the manufacturer on the use of any of its products.

**B. Preinstallation Meetings:**

1. **Pre-Concrete Conference:**
  - a. At least seven days prior to beginning concrete work, the Contractor shall conduct a meeting to review the proposed methods of fabrication and erection of structural precast concrete. Also, review requirements for submittals, status of coordinating work and availability of materials. Establish work progress schedule and procedures for materials inspection, testing, and certifications. The contractor shall send a pre-concrete conference agenda to all attendees seven days prior to the scheduled date of the conference.
  - b. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:
    - 1) Contractor's Superintendent.
    - 2) Laboratory responsible for the concrete design mix.
    - 3) Laboratory responsible for field quality control.
    - 4) Precast Concrete Subcontractor.

- 5) Ready-Mix Concrete Producer.
  - 6) Owner's and Architect's/Engineer's Representative.
- c. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by him to all parties concerned within five days of the meeting. One copy of the minutes shall be transmitted to the following for information purposes:
- 1) Owner's Representative.
  - 2) Architect.
  - 3) Engineer-of-Record.
- d. The Engineer shall be present at the conference. The Contractor shall notify the Engineer at least seven days prior to the scheduled date of the conference.

## 1.5 SUBMITTALS

- A. Certification and Test Reports: Submit manufacturer's specifications and instructions for manufactured materials and products. Include manufacturer's and plant's certifications and laboratory test reports for the following:
1. PCI Plant Certification.
  2. Concrete mix designs, including sources of coarse, fine and lightweight aggregates as well as admixtures and fly ash.
  3. Prestressing strand mill certificates.
  4. Mill certificates for reinforcing bars and welded wire mesh.
  5. Mill certificates for high strength reinforcing bars.
  6. Structural steel mill certificates.
  7. Welder and welding operator certifications.
  8. Calibrations of prestressing jacks.
  9. Calibration of cylinder testing machine.
  10. Mill certificates for cement.
  11. Cylinder test reports on concrete for all precast units.
  12. Compressive strength test reports for structural grout.
  13. Certification from the bearing pad manufacturer verifying conformance with standards set forth in Division 2, Section 25 of AASHTO Standard Specification for Highway Bridges.
  14. Certification from manufacturer of slide bearing assemblies verifying conformance with ASTM D 1457.
  15. Manufacturer's identification number as an approved fabricator in accordance with the City of Houston Policy Memorandum Relative to Fabricators, Prefabricated Construction and Certifying Agencies, Revision 1 issued November 4, 1982.
- B. Product Data: Submit manufacturer's specifications, data and instructions for manufactured materials and products. Include manufacturer's certifications and laboratory test reports as required.
- C. Shop Drawings: Submit shop drawings showing complete information for fabrication and installation of precast concrete units.
1. Indicate member dimensions and cross-section, location, size and type of reinforcement, including special reinforcement and lifting devices necessary for handling and erection.
  2. Indicate erection procedure for precast units, sequence of erection, and required handling equipment.
  3. Show layout, dimensions, and identification of each precast unit corresponding to sequence and procedure of installation.
  4. Indicate welded connections by AWS standard symbols. Detail inserts, connections, and joints including accessories and construction at openings in precast unit.
  5. Show location and details of anchorage devices that are to be embedded in other construction.

6. Coordination with Structural Steel Detailer: Prior to the start of the structural steel shop drawings, the precaster shall furnish the Architect/Engineer a set of shop drawings showing the location of all gravity and lateral connections to the structure. The General Contractor shall furnish this information to the structural steel detailer, after it has been approved by the Architect/Engineer, and prior to the completion of structural steel shop drawings.
- D. Design Calculations: The Precaster's design of all precast elements shall be submitted for Engineer approval. Such calculations shall be performed by or under the direct supervision of a registered professional engineer in the state where the project is located. The calculations shall be bound with the Engineer's signature, seal, and date stamped on the cover sheet. Calculations shall be indexed by precast element and arranged in a logical orderly fashion. Incomplete submittals will be rejected. Where computer aided design is submitted, the input data shall be included and output must be clear. At least one hand calculation shall be submitted for each member type designed by computer.
- E. Samples: Submit samples (minimum 3) approximately 12" X 12" and of appropriate thickness, to illustrate quality, color, and texture of surface finish prior to commencement of production. One will be returned to the General Contractor and one to the precaster prior to production. All approved samples shall be initialed by the Architect.
  1. Submit samples of cast-in gaskets, anchorages, and other attachments and accessories as requested by Architect.
  2. Prepare a full-size sample of each required architectural precast concrete unit for the Architect's inspection at production plant or on site prior to start of installation work, and after Architects review of finish samples. Acceptable full-size samples may be incorporated in job installation.

## 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications:
  1. Firms which have a minimum of 2 years successful experience in the fabrication of architectural precast concrete units, similar to units required for this project, will be acceptable. Fabricator must have sufficient production capacity to produce, transport, and deliver required units without causing delay in the work.
  2. The precast concrete producer shall be a participant in the PCI Plant Certification Program and, upon request, shall submit written evidence to show experience, qualifications and adequacy of plant capability and facilities for performance of contract requirements. Compliance with this provision is subject to verification by the Architect/Engineer.
- B. Fabrication Qualifications: Produce precast concrete units at fabrication plant engaged primarily in manufacturing of similar units, unless plant fabrication or delivery to site is impractical.
  1. If units are not produced at precast concrete fabricating plant, maintain procedures and conditions for quality control equivalent to plant production.
- C. Design Responsibility:
  1. Design: The design and detailing of all Architectural Precast Concrete and their connections shall be the responsibility of the precast fabricator. This shall include all bolts, plates, braces, weld sizes, and any embedded items in both precast and the structural frame for all connections between the precast and the support frame. The design shall be performed by or under the direct supervision of a registered professional engineer in the state where the project is located. Design calculations, stamped by the registered engineer, shall be submitted for Engineer review.
    - a. Design modifications may be made only as necessary to meet field conditions and to ensure proper fitting of the work, and only as acceptable to the Architect. Maintain general design concept shown without increasing or decreasing sizes of members or altering profiles and alignment shown. Provide complete design

calculations and drawing prepared and stamped by a registered professional engineer in the state where the project is located.

2. Design Procedure: Design calculations shall consider and show stress from dead load of panel, wind load, and erection loads. Wind loads shall be as specified in the project General Notes of the structural drawings or as shown on the architectural drawings.
- D. Erector Qualifications: Regularly engaged for at least 2 years in the erection of architectural precast structural concrete similar to the requirements of this project. Upon request, provide written evidence that equipment and personnel are adequate and qualified for performance of contract requirements.
- E. Welder and Welding Machine Operator Qualifications: All field and plant welders shall be certified in accordance with AWS D1.1 for the type of welding required.

## 1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver precast concrete units to project site in such quantities and at such times to assure continuity of installation. Any storage of units at the project site shall be done so as to prevent cracking, distortion, warping, staining, or other physical damage and so that markings are visible. Lift and support units only at designated lifting or supporting points as shown on final shop drawings.

## PART 2 - PRODUCTS

### 2.1 FORMWORK

- A. Provide forms and, where required, form facing materials of metal, plastic, wood, or other acceptable material that is non-reactive with concrete and will produce required finished surfaces. Rust-stained or excessively worn forms that would impair the quality of the finished surface are not acceptable. Comply with recommendations set forth in ACI Standard 347, Recommended Practice for Concrete Formwork.
- B. Accurately construct forms mortar-tight and of sufficient strength to withstand pressures due to concrete placing operations, temperature changes, and when prestressed, the pretensioning and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines, and dimensions indicated on the approved shop drawings within specified fabrication tolerances.
- C. Unless forms for plant-manufactured prestressed concrete units are stripped prior to detensioning, design forms so that stresses are not induced from precast units due to deformation of concrete under prestress or to movement during detensioning.

### 2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, except all reinforcing steel required to be welded shall conform to ASTM A 706.
- B. Galvanized Reinforcing Bars: ASTM A 767, Class II.
- C. Epoxy Coated Reinforcing Bars: ASTM A 775.
- D. Steel Wire: ASTM A 82, plain, cold-drawn steel.
- E. Welded Wire Fabric: ASTM A 185.
- F. Deformed Steel Wire: ASTM A 1064.
- G. Welded Deformed Steel Wire Fabric: ASTM A 1064
- H. Prestressing Tendons: Uncoated, 7-wire, stress-relieved strand; ASTM A 416, Grade 270K.

- I. Prestressing Bars: ASTM A 722.
- J. Supports for Reinforcement:
  - 1. Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting or fastening reinforcing, complying with CRSI recommendations.
  - 2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI Class 1) or stainless steel protected (CRSI Class 2).

### 2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III.
  - 1. Use only one brand and type of cement throughout the project, unless otherwise acceptable to Architect.
  - 2. Use "buff" color portland cement for facing concrete mix to match Architect's control sample.
  - 3. Use "White" portland cement for facing concrete mix to match Architect's control sample.
  - 4. Standard "gray" portland cement may be used for non-exposed back-up concrete.
- B. Coarse Aggregate: ASTM C 33; hard, durable, carefully selected and graded; free of material causing staining or reacting with cement.
  - 1. Use aggregates from same sources as those used in Architect's control sample.
- C. Fine Aggregate: ASTM C 33; manufactured sand of same material as coarse aggregate, unless otherwise acceptable to Architect.
- D. Water: Drinkable, free from foreign materials in amounts harmful to concrete and embedded steel.
- E. Air-Entraining Admixture: ASTM C 260.
- F. Admixtures:
  - 1. Air-Entraining; complying with ASTM C 260 and as manufactured by:
    - a. Dayton Superior Corp.
    - b. Gifford-Hill & Co., Inc.
    - c. W. R. Grace & Co.
    - d. Master Builders
  - 2. Water-Reducing; complying with ASTM C 494, Type A and as manufactured by:
    - a. Gifford-Hill & Co.
    - b. W. R. Grace & Co.
    - c. Monier Resources
  - 3. Fly Ash; complying with ASTM C 618 and as manufactured by:
    - a. Monier Resources
    - b. Ash Management System
  - 4. Calcium Chloride; Not permitted

### 2.4 CONNECTION MATERIALS

- A. Steel Plates: ASTM A 36.
- B. Steel Shapes: ASTM A 36.
- C. Anchor Bolts: Non-headed type with tensile strength requirements conforming to ASTM A 36, unless otherwise indicated. Provide regular hexagon nuts and carbon steel washers
- D. High Strength Anchor Bolts: Non-headed type made from threaded round stock conforming to ASTM A 572 Grade 50 or A572 Grade 42 as shown on the drawings or high-strength bars conforming to ASTM A 722. Where grade is not specifically shown, ASTM A 572 Grade 50 anchor bolts shall be furnished.

- E. Weldable Reinforcing Bars: ASTM A 706.
- F. Headed Studs: ASTM A 108, 60,000 psi minimum tensile strength.
- G. Deformed Bar Anchors: ASTM A 1064, 70,000 psi minimum yield strength.
- H. Prestressing Steel Bars: ASTM A 722.
  - 1. Approved Manufacturer: Dywidag Systems International, USA, Inc.
- I. Threaded Rods: ASTM A 36.
- J. Welding Electrodes: Comply with AWS D1.1.
- K. Ductile Iron Inserts: ASTM A 536.
  - 1. Approved Manufacturers:
    - a. Richmond Screw Anchor Company, Inc.
    - b. Hohman & Barnard, Inc.
    - c. Dayton Superior Corporation.
- L. Corrosion Protection of Materials: Shop prime all items that are cast in the supporting concretes and concrete units. All other connection material shall be hot dip galvanized in accordance with ASTM A 153. Touch-up after field welding with zinc-rich coating as manufactured by Sherwin-Williams (Zinc-Clad 5 B69 A 45) or ZRC Cold Galvanizing Compound. Exposed surfaces of all plates embedded in concrete shall be painted with zinc-rich coating specified above after the field connection is complete.

## 2.5 BEARING PADS

- A. Elastomeric Pads:
  - 1. Provide structural grade chloroprene bearing pads with Shore A durometer hardness of  $60 \pm 5$  and having a minimum thickness of 3/8" for tees, 1/2" for beams, and 1/4" for slabs, unless otherwise shown on the drawings. Bearing pads provided shall conform to Standard Specifications for Highway Bridges inclusive of all Interim Specifications up to date adopted by the American Association of State Highway and Transportation Officials.
  - 2. Design bearing pads in accordance with recommendations set forth in PCI Design Handbook, Fourth Edition.
  - 3. Size pads so that both surfaces are in complete contact with the bearing pads. The design bearing pressure shall not exceed 800 psi under total service load, and 500 psi under dead load. Pads greater than 1 1/4" in thickness shall be laminated with steel plates (min. 1/16" thick) molded into the material.
  - 4. Provide beveled, plain elastomeric bearing pads between non-parallel load surfaces.
  - 5. Approved manufacturers of elastomeric pads:
    - a. Oil States Industries, Inc.
    - b. Scougal Rubber Co., Inc.
    - c. Con-Serv, Inc.
    - d. JVI Inc.
    - e. Tulsa Rubber Co.
    - f. Old North Manufacturing Co.
- B. Tetrafluoroethylene (TFE) Slide Bearings:
  - 1. Glass-filled virgin Teflon slide bearings as shown on the drawings and as manufactured by:
    - a. EGC Corporation
    - b. Con-Serv, Inc.
    - c. Fluorocarbon

## 2.6 GROUT MATERIALS

- A. Nonshrink Grout: All base plates, bearing plates, and concrete bearing joints shall be grouted with non-shrink non-metallic grout as specified herein. Provide premeasured, prepackaged, non-metallic, non-corrosive, non-staining material requiring only the addition of water complying with the following:
1. Corps of Engineers Specification for Nonshrink Grout (CRD-C621).
  2. Attain 28 day compressive strength as determined by grout cube tests conforming to ASTM C 109 in accordance to the following:
    - a. 6,000 psi for supporting concrete up to 3,000 psi.
    - b. 8,000 psi for supporting concrete between 3,000 psi and 4,000 psi.
    - c. 10,000 psi for supporting concrete greater than 4,000 psi.
  3. Follow manufacturer's directions and recommendations for mixing and placing grout.
  4. Grout to be similar in color to that of surrounding concrete.
  5. Acceptable non-shrink grouts:
    - a. Gifford Hill Co.; Supreme.
    - b. L&M Construction Chemicals; Crystex.
    - c. U.S. Grout Corp.; Five Star Grout.
- B. Sand Cement Grout: Provide sand cement grout for grouting all pockets and blockouts in precast members and in grouting prestressed ducts where specified on the drawings. Sand cement grout shall consist of Portland Cement (ASTM C 150 Type I or III), sand (ASTM C 33), and water. Proportions by weight shall be one part cement, 2 1/4 to 2 1/2 parts sand, and the minimum amount of water required to obtain a workable mix. Minimum compressive strength shall be 3500 PSI at 28 days. Admixtures to accelerate the set or prevent freezing may be utilized, except the use of admixtures containing chlorides will not be permitted.

## PART 3 - EXECUTION

### 3.1 FABRICATION

- A. General: Fabricate precast concrete units complying with manufacturing and testing procedures, quality control recommendations and dimensional tolerances of PCI MNL-116 and MNL-117, and as specified for types of units required.
- B. Proportioning and Design of Mixes:
1. Prepare design mixes for each type of concrete required.
  2. Design mixes may be prepared by an independent testing facility or by qualified precast manufacturing personnel, at precast manufacturer's option.
  3. Proportion mixes by either trial batch or field experience methods, using materials to be employed on the project for each type of concrete required, complying with ACI 211.1 or ACI 211.2.
  4. Submit written reports to Architect/Engineer of proposed mix for each type of concrete at least 30 days prior to start of precast unit production. Do not begin concrete production until mixes and evaluations have been reviewed and approved by Architect/Engineer and Owner's testing laboratory.
  5. Mix design adjustments may be requested when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Laboratory test data for revised mix designs and strength results must be submitted to and accepted by Architect/Engineer and Owner's testing laboratory before using in the work.
  6. Produce normal weight concrete consisting of specified portland cement, aggregates, admixtures and water to produce the following properties:
    - a. Compressive Strength at 28 days: 5,000 psi minimum at 28 days, or as required by design or as noted on the drawings.
    - b. Release Strength: The minimum release strength for prestressed units shall be 3500 psi.



7. Produce lightweight concrete consisting of specified portland cement, aggregates, admixtures and water to produce the following properties:
    - a. Compressive Strength: 5,000 psi minimum at 28 days, or as required by design or as noted on the drawings.
    - b. The split cylinder strength factor ( $F_{ct}/(f_c)^{0.5}$ ) shall not be less than 5.7 and a drying shrinkage limit of 0.03% at 28 days.
    - c. Air-dry density: Not less than 110 nor more than 116 pounds per cubic foot.
    - d. Release Strength: The minimum release strength of prestressed members shall be 3500 psi.
  8. Cure compression test cylinders using the same methods as will be used for the precast concrete work.
- C. Admixtures:
1. Comply with ACI 212.2R.
  2. Use air-entraining admixture in concrete unless otherwise indicated.
  3. Use water-reducing admixtures in strict compliance with manufacturer's directions. Admixtures to increase cement dispersion, or provide increased workability for low-slump concrete, may be used subject to Architect/Engineer's approval.
  4. Use amounts as recommended by admixture manufacturer for climatic conditions prevailing at time of placing. Adjust quantities of admixtures as required to maintain quality control.
- D. Embedded Items: Accurately position and secure cast-in anchorage devices. Locate anchorages where they do not affect position of reinforcement or placing of concrete. Do not relocate bearing plates or reinforcing steel in units unless approved in writing by the Architect/Engineer.
- E. Reinforcement Installation:
1. Clean reinforcement of loose rust and mill scale, earth and other materials which reduce or destroy bond with concrete.
  2. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as specified by CRSI Manual of Standard Practice.
  3. Place reinforcement to obtain at least the minimum coverages for concrete protection as specified in the drawings. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- F. Tensioning: Pretensioning of tendons for prestressed concrete may be accomplished either by single strand tensioning method or multiple-strand tensioning method. Comply with PCI MNL-116 requirements.
- G. Concrete Placement: Place concrete in a continuous operation to prevent formation of seams or planes of weakness in precast units, complying with requirements of ACI 304 and ACI 309. Thoroughly consolidate placed concrete by internal and/or external vibration without dislocation or damage to reinforcement and embedded items.
- H. Identification:
1. Provide permanent markings to identify pick-up points and orientation in the structure, complying with markings indicated on final shop drawings. Imprint date of casting on each precast unit on a surface which will not show in finished structure.
- I. Curing:
1. Cover all precast and precast/prestressed concrete members with tarpaulins or other suitable means immediately after casting.
  2. Curing by low-pressure steam, by steam vapor, by radiant heat and moisture, or other similar process may be employed to accelerate concrete hardening and to reduce curing time.

3. Test cylinders shall be cured with and by the same methods as the members they represent.
  4. Make test cylinders as follows:
    - a. Minimum of two (2) per bed for each pour to verify specified release strength.
    - b. Minimum of two (2) per 50 cubic yards for each class of concrete to verify 28-day strength but not less than one set per days operation.
    - c. Minimum of two (2) to verify release strength and two (2) for 28-day strength for small units or individual pieces.
- J. Detensioning:
1. Delay detensioning of prestressed units until concrete has attained design release strength, as established by test cylinders.
  2. If concrete has been heat-cured, perform detensioning while concrete is still warm and moist to avoid dimensional changes which may cause cracking or undesirable stresses in concrete.
  3. Detensioning of prestressed tendons may be accomplished either by gradual release of tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
- K. Finishes:
1. Architectural Surface Finishes:
    - a. Abrasive blast finish, using abrasive grit, equipment, application techniques and cleaning to expose aggregate and surrounding matrix surfaces, to match Architect's control sample.
    - b. Exposed aggregate finish, using chemical retarding agents applied to concrete forms, with washing and brushing procedures after form removal to match Architect's control sample.
    - c. Bushhammer finish, using power and hand tools and cleaning procedures to match Architect's control sample.
    - d. Smooth surface finish free of pockets, sand streaks, and honeycomb, with uniform color and texture to match Architect's control sample.
    - e. Textured surface finish imparted by form liners or inserts to provide surfaces free of pockets, streaks and honeycomb, with uniform color and texture to match Architect's control sample.
    - f. As-cast or float finish for unexposed surfaces.
  2. Other Formed Surfaces: Provide normal plant run finish in forms that impart a smooth finish to concrete. Small surface holes caused by air bubbles, normal form joint marks, and minor chips and spalls may be acceptable, but no major or unsightly imperfections, honeycomb, or structural defects will be permitted.
  3. Other Unformed Surfaces: Provide trowel finish to unformed surfaces unless otherwise indicated. Consolidate concrete, bring to proper level with a straightedge, and float and trowel to a smooth uniform finish.

### 3.2 FABRICATION TOLERANCES

- A. Provide fabrication tolerances as follows:
1. Standard tolerances according to PCI MNL-116 and 117 and Part 8 of the PCI Design Handbook, Fourth Edition unless stricter requirements are specified on the drawings.
  2. Areas or members with special tolerances are indicated on the plans.
  3. Precast units having dimensions not conforming to specified tolerances will be rejected if appearance or function of the structure is adversely affected. Repair, or remove and replace rejected units as required to comply with contract documents. All repairs must be approved by the Architect/Engineer.

### 3.3 INSTALLATION

- A. General:
1. Examine supporting structure and conditions under which precast concrete work is to be erected and provide written notification of conditions detrimental to proper and timely completion of work. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Erector.
  2. General Contractor shall monitor all phases of erection to ensure the work is in conformance with the contract documents.
  3. Erect members by means of suitable lifting devices at points provided by the manufacturer.
  4. Deliver anchorage items which are to be embedded in other construction before start of such work. Provide setting diagrams, templates, instructions and directions as required for installation.
  5. Properly align, plumb and level precast units. Level out variations between adjacent members by shimming, loading or any other feasible method recommended by the manufacturer and acceptable to the Architect/Engineer.
  6. Provide accurate placement and alignment of anchor bolts, plates or dowels in supporting structural elements.
  7. Provide true, level bearing surfaces on all field placed foundations, bearing walls and other supporting members.
  8. Bearing Pads: Install specified bearing pads as precast units are being erected and maintain in correct position until precast units are placed. Bearing pads must be placed under all precast floor members unless specifically detailed otherwise on the drawings.
  9. Do not install precast units until concrete has attained its 28 day design strength.
- B. Erection Tolerances: Install precast concrete members plumb, level, and in alignment within PCI MNL-17 and PCI Design Handbook, Part 8, Fourth Edition specified limits of erection tolerances. Provide temporary supports and bracing as required to maintain position, stability and alignment as members are being permanently connected.
1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses. Deflections of the supporting frame may occur as panels are erected, necessitating readjustment, alignment, and possibly resetting of certain panels to meet specified tolerances. It is the responsibility of the precast erector to consider such deflection, whether specifically indicated on the drawings or not, and provide for same in the erection process at no additional cost to the Owner.
  2. Anchor units in final position by bolting, welding, grouting, or as otherwise indicated. Remove temporary shims, wedges, and spacers as soon as possible after anchoring is completed.
  3. At bolted connections use lock washers or other acceptable means to prevent loosening of nuts.
  4. At welded connections apply rust inhibitive coating on damaged areas, same as shop applied material. Use galvanizing repair coating on galvanized surfaces.
- C. Field Welding:
1. Perform welding in compliance with AWS D1.1 and D1.4.
  2. Protect units from damage by field welding operations and provide non-combustible shields as required.
  3. Remove all lifting loops and touch-up paint all galvanized field welded connections as specified.
  4. Repair damaged metal surfaces by cleaning and applying a coat of liquid galvanizing repair compound to galvanized surfaces and primer compatible with painted surfaces.
- D. Accessories: Install clips, hangers, and other accessories required for erection of precast units to supporting members and back-up materials.

- E. Cleaning: Clean exposed facings to remove dirt and stains which may be on units after erection and completion of joint treatments. Wash and rinse in accordance with precast manufacturer's recommendations. Protect other work from damage due to cleaning operations. Do not use cleaning materials or processes which could change the character of exposed concrete finishes.

### 3.4 DAMAGED OR MISCAST UNITS

- A. Any units that are noticeably cracked from the process of lifting, handling, or any other reason shall be replaced by the Contractor at no additional cost to the Owner.
- B. Concrete units which are not formed as shown on the drawings or are out-of-tolerance or show a defective finish shall be considered as not conforming with the intent of this specification and shall be removed from the job and replaced by the Contractor at no additional cost to the Owner.

### 3.5 CONCRETE SURFACE REPAIRS

- A. Classification:
  - 1. Structural Repair: Major defective areas including cracks, spalls, or honeycombs that affect the structural integrity of the unit shall require a structural repair using a two part epoxy bonder and/or epoxy mortar. Location of structural repairs shall be at the discretion of the Architect/Engineer.
  - 2. Cosmetic Repair: Minor defective areas in units that do not affect the structural integrity of the unit shall require a cosmetic repair using a non-shrink patching mortar and bonding agent. Location of cosmetic repairs shall be at the discretion of the Architect and Engineer.
- B. Method: The method of repair shall be approved by the Architect/Engineer after samples are submitted for review by the Contractor.
- C. Waiver: Permission to patch or repair any area shall not be considered as a waiver of the Architect's right to require complete removal of the defective work if the repair does not, in the opinion of the Architect, satisfactorily restore the quality and appearance of the work.

### 3.6 PERFORMANCE REQUIREMENTS

- A. Conduct inspections, perform testing, and make repairs or replace unsatisfactory precast units as required.
  - 1. Limitations as to the amount of patching which will be permitted are subject to acceptance of Architect.
- B. In addition to above, in-place precast units may be rejected for any one of the following:
  - 1. Exceeding the specified installation tolerances.
  - 2. Damaged during construction operations.
  - 3. Exposed-to-view surfaces which develop surface finish deficiencies.
  - 4. Other defects as listed in PCI MNL-117.
- C. Products Not Meeting Specifications: Precast units that do not conform to all specified requirements including strength, tolerances, both fabrication and erection, and finishes shall be rejected and replaced with units meeting all requirements of the Contract Documents, unless approval by the Engineer, Architect and Owner is obtained in writing for an authorized repair.
- D. Authorized Repairs: No structural or architectural repair shall be made to any precast unit either in the plant or in the field without written documented approval for each occurrence in the form of a letter or drawing from the Engineer, Architect, and Owner. Unauthorized repair details shall not be allowed.

END OF SECTION

**SECTION 04 20 00 - UNIT MASONRY****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Concrete masonry units.
  - 2. Face brick.
  - 3. Mortar and grout.
  - 4. Steel reinforcement bars.
  - 5. Masonry joint reinforcement.
  - 6. Ties and anchors.
  - 7. Embedded flashing.
  - 8. Miscellaneous masonry accessories.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for furnishing steel lintels for unit masonry.
  - 2. Section 07 62 00 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.
  - 3. Section 07 92 00 "Joint Sealants" for perimeter joints, frames, and openings.

**1.2 DEFINITIONS**

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

**1.3 PRECONSTRUCTION TESTING**

- A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
  - 1. Clay Masonry Unit Test: For each type of unit required, according to ASTM C 67 for compressive strength.
  - 2. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
  - 3. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
  - 4. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
  - 5. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

**1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

- B. Shop Drawings: For the following:
  - 1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
  - 2. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315-2017 "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.
  - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
  - 4. Shop drawings showing control and expansion joint locations, reinforcing, and detailing.
- C. Samples: For each type and color of the following:
  - 1. Exposed CMUs.
  - 2. Face brick, in the form of straps of five or more bricks.
  - 3. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.
  - 4. Weep holes and vents.
  - 5. Accessories embedded in masonry.
  - 6. Joint sealants sample: include all sealant colors.

## 1.6 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
  - 1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- B. Qualification Data: For testing agency.
- C. Material Certificates: For each type of the following:
  - 1. Masonry units.
    - a. Include data on material properties and material test reports substantiating compliance with requirements.
    - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
    - c. For exposed brick, include test report for efflorescence in accordance with ASTM C 67/C 67M.
    - d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
  - 2. Integral water repellent used in CMUs.
  - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  - 4. Grout mixes. Include description of type and proportions of ingredients.
  - 5. Mill Certificates: Steel producer's certificates of mill analysis tensile, and bend test for reinforcing steel required for Project.
  - 6. Joint reinforcement.
  - 7. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
  - 1. Mortar mix proportions for type of mortar required to achieve specified compressive strength of masonry.
  - 2. Mix designs and mortar tests performed in accordance with ASTM C 270
  - 3. Grout mix proportions according to ASTM C 476 for the types of grout required for the work.
  - 4. Mix designs and grout tests performed in accordance with ASTM C 476.

- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with Tables 1 and 2 in ACI 530.1-2013/ASCE 6/TMS 602.
- F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

## 1.7 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Installers: All masonry flashing installers must complete the International Masonry Institute Flashing Upgrade training course.
  - 2. Testing Agency Qualifications: Qualified in accordance with ASTM C 1093 for testing indicated.
  - 3. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
  - 4. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
  - 5. Masonry Standard: Comply with ACI 530.1-2013/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

## 1.8 MOCKUPS

- A. Mockups: Upon Contractor pricing and Owner approval of mockup to be included in the contract, build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Prior to construction, location of mockup to be approved by Owner.
  - 1. Build mockups for typical exterior wall with face brick approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.
    - a. Include a sealant-filled joint at least 16 inches long in exterior wall mockup.
    - b. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
    - c. Include air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.
  - 2. Erect mockups adjacent and parallel to other approved exterior mockup systems.
  - 3. Clean exposed faces of mockups with masonry cleaner as indicated.
  - 4. Protect accepted mockups from the elements with weather-resistant membrane.
  - 5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
    - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
    - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
  - 6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination."

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. At the time of delivery, the linear shrinkage of masonry units shall not exceed 0.065 percent.
- E. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- F. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

#### 1.10 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
  - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1-2013/ASCE 6/TMS 602.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
  - 1. When ambient temperature exceeds 100 degrees F or 90 degrees F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.
  - 2. Comply with hot-weather preparation and construction provisions of ACI 530.1-2013/ASCE 6/TMS 602.



**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Obtain exposed masonry units from single source for each material type.
- B. For exposed masonry units and cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to provide design of Structural reinforcement and the masonry Structural Design.
- B. Seismic Performance: Masonry to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7 and as indicated on Structural Drawings.
- C. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days as indicated on Structural Drawing (General Notes)
  - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1-2013/ASCE 6/TMS 602.
  - 2. Determine net-area compressive strength of masonry by testing masonry prisms in accordance with ASTM C 1314.

**2.3 UNIT MASONRY, GENERAL**

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance- ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

**2.4 CONCRETE MASONRY UNITS**

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
  - 2. Provide bullnose units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C 90.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength as indicated on Structural Drawings (General Notes).
  - 2. Density Classification: Normal weight unless otherwise indicated.
  - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
  - 4. Exposed Faces: Provide color and texture selected by Architect from manufacturer's full range.

**2.5 BRICK**

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
  3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
  4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: Facing brick complying with ASTM C 216 or hollow brick complying with ASTM C 652, Class H40V (void areas between 25 and 40 percent of gross cross-sectional area).
1. Products: Subject to compliance with requirements, provide the following:
  2. Modular, as indicated on Drawings.
  3. Grade: SW.
  4. Type: FBS.
  5. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested in accordance with ASTM C 67/C 67M.
  6. Efflorescence: Provide brick that has been tested in accordance with ASTM C 67 and is rated "not effloresced."
  7. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
  8. Application: Use where brick is exposed unless otherwise indicated.
  9. Color and Texture: As selected by Architect.

## 2.6 MORTAR AND GROUT MATERIALS

- A. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- B. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. Use only pigments with a record of satisfactory performance in masonry mortar.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Davis Colors; True Tone Mortar Colors.
    - b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
    - c. Solomon Colors, Inc.; SGS Mortar Colors.
- C. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
  3. White-Mortar Aggregates: Natural white sand or crushed white stone.
  4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- D. Aggregate for Grout: ASTM C 404.
- E. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, ASTM C 1384, and recommended by manufacturer for use in masonry mortar of composition indicated.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Euclid Chemical Company (The); Accelguard 80.
    - b. GCP Applied Technologies; Morset.
    - c. Sonneborn Products, Master Builders Solution; Trimix-NCA.
- F. Water: Potable.

**2.7 REINFORCEMENT**

- A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Heckmann Building Products, Inc.; #374: Steel-Wich.
    - b. Hohmann & Barnard, Inc.; RB Rebar Positioner.
    - c. Wire-Bond, Figure 8 Rebar Positioners.
- C. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.
  - 1. Interior Walls: Hot-dip galvanized carbon steel.
  - 2. Exterior Walls: Stainless steel.
  - 3. Wire Size for Side Rods: 0.187-inch diameter.
  - 4. Wire Size for Cross Rods: 0.148-inch diameter.
  - 5. Wire Size for Veneer Ties: 0.148-inch diameter.
  - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
  - 7. Provide in lengths of not less than 10 ft., with prefabricated corner and tee units.
- D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
- E. Masonry-Joint Reinforcement for Multiwythe Masonry:
  - 1. Ladder type with one side rod at each face shell of hollow masonry units more than 4 inches wide, plus one side rod at each wythe of masonry 4 inches wide or less.
  - 2. Tab type, ladder with one side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe, but with at least 5/8-inch cover on outside face.
  - 3. Adjustable (two-piece) type, ladder with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.

**2.8 TIES AND ANCHORS**

- A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
  - 1. Stainless Steel Wire: ASTM A580/A580M, Type 316.
- C. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.
- D. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
  - 1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units.
  - 2. Where wythes do not align or are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
  - 3. Wire: Fabricate from 1/4-inch- diameter, stainless steel wire.
- E. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter stainless steel wire.
  2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.25-inch- diameter, stainless steel wire.
- F. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.062-inch-thick, stainless steel sheet.
  2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.25-inch- diameter, stainless steel wire.
- G. Partition Top Anchors: See Structural Drawings typical masonry details.
- H. Rigid anchors can be used to connect T-intersections of CMU shear walls in lieu of masonry bonding or bond beams. They are also often used at T-intersections of other CMU walls, although masonry bonding and T-shaped masonry-joint reinforcement may be used.
- I. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.
- J. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
    - a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
    2. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.25-inch-diameter, stainless steel wire unless otherwise indicated.
    3. Contractor's Option: Unless otherwise indicated, provide any of the following types of anchors:
    4. Screw-Attached, Seismic Masonry-Veneer Anchors; Units consisting of wire tie and a metal anchor section
      - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        - 1) Hohmann & Barnard, HB-213.
        - 2) Wire-Bond; RJ-711.
      - b. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches wide by 3 inches high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section
    5. Screw-Attached, Seismic Masonry-Veneer Anchors; Units consisting of a wire tie and a metal anchor section.
      - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        - 1) Hohmann & Barnard, Inc.; DW-10.
      - b. Anchor Section: Sheet metal plate, 1-1/4 inches wide by 9 inches long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch wide by 5-1/2 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie.
    6. Screw-Attached, Seismic Masonry-Veneer Anchors; Units consisting of a wire tie and a metal anchor section:
      - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        - 1) Dayton Superior Corporation, Dur-O-Wal Division; D/A 210 with D/A 700-708.
        - 2) Heckmann Building Products Inc.; 315-D with 316.

- 3) Hohmann & Barnard, Inc.; DW-10HS.
    - 4) Wire-Bond; 1004, Type III.
  - b. Anchor Section: Sheet metal plate, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch wide by 3-5/8 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie.
- 7. Screw-Attached, Seismic Masonry-Veneer Anchors; Units consisting of a wire tie and a metal anchor section.
  - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) Hohmann & Barnard, Inc.; DW-10-X.
  - b. Anchor Section: Gasketed sheet metal plate, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch wide by 6 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie. Provide anchor manufacturer's standard, self-adhering, modified bituminous gaskets manufactured to fit behind anchor plate and extend beyond pronged legs.
- 8. Screw-Attached, Seismic Masonry-Veneer Anchors; Units consisting of a wire tie and a metal anchor section.
  - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) Heckmann Building Products Inc.; Pos-I-Tie.
    - 2) Hohmann & Barnard; Thermal 2-Seal Tie.
    - 3) Wire-Bond; SureTie WS.
  - b. Anchor Section: Corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed, washer head that covers hole in sheathing.
- 9. Slip-in, Masonry-Veneer Anchors; Units consisting of wire tie section and an anchor section designed to interlock with metal studs and be slipped into place as sheathing is installed.
  - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) Hohmann & Barnard, Inc.; AA308.
  - b. Wire-Type Anchor: Bent wire anchor section with an eye to receive the wire tie. Wire tie has a vertical leg that slips into the eye of anchor section and allows vertical adjustment. Both sections are made from 3/16-inch, hot-dip galvanized wire.
- 10. Stainless Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed.
  - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) Dayton Superior Corporation, Dur-O-Wal Division; Stainless Steel SX Fastener.
    - 2) ITW Buildex; Scots long life Tekes.

## 2.9 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.
- B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch, galvanized steel sheet.

- C. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.
- D. Postinstalled Anchors: Torque-controlled expansion anchors or chemical anchors.
  - 1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.
  - 3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

## 2.10 EMBEDDED FLASHING MATERIALS

- A. Flexible Flashing: Use one of the following unless otherwise indicated:
  - 1. Stainless Steel Core Flexible Flashing with Drainage Fabric: Engineered System, with high resistance to damage, composite sheet with a stainless steel core, non-asphalt adhesive polymer fabric laminated to one face of sheet, and non-woven drainage fabric laminated to opposing face with non-asphalt adhesive.
    - a. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.003 inch (0.28 mm) thick. Recycled content: 60%.
    - b. Provide manufacturer's standard inside- and outside-corner units.
    - c. Products: Subject to compliance with requirements, provide one of the following:
      - 1) York Manufacturing, Inc.; Multi-Flash SS.
      - 2) STS Coatings, Inc.; Gorilla Flash Stainless Fabric.
      - 3) Hohmann & Barnard: Mighty-Flash.
  - 2. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 40 mil.
    - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
      - 2) Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
      - 3) Fiberweb, Clark Hammerbeam Corp.; Aquafash 500.
      - 4) GCP.; Perm-A-Barrier Wall Flashing.
      - 5) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
      - 6) Hohmann & Barnard, Inc.; Textroflash or Sando Seal.
      - 7) W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
      - 8) Polyguard Products, Inc.; Polyguard 300.
    - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

**Elastomeric Thermoplastic Flashing:** Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - 1) DuPont; Thru-Wall Flashing.
  - 2) Hohmann & Barnard, Inc.; Flex-Flash.
  - 3) Hyload, Inc.; Hyload Cloaked Flashing System.
  - 4) Mortar Net USA, Ltd.; Total Flash.
- 4. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D4637/D4637M, 40 mil thick.

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - 1) Carlisle Coatings & Waterproofing; Pre-Kleened EPDM Thru-Wall Flashing.
  - 2) Firestone Specialty Products; FlashGuard.
  - 3) Heckmann Building Products Inc.; No. 81 EPDM Thru-Wall Flashing.
  - 4) Hohmann & Barnard, Inc.; Epra-Max EPDM Thru-Wall Flashing.
- B. Application: Unless otherwise indicated, use the following:
  - 1. Where flashing is indicated to receive counterflashing, use metal flashing.
  - 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
  - 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge or flexible flashing with a metal drip edge.
  - 4. Where flashing is fully concealed, use metal flashing or flexible flashing.
- C. Drainage Plane Flashing: Fabricate from stainless steel elastomeric membrane and drainage membrane to shapes indicated, including weep tabs, termination bar, and drip edge. Provide flashing materials as follows:
  - 1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 316, 0.016 inch thick.
  - 2. Elastomeric Membrane: EPDM complying with ASTM D4637/D4637M TPO, 40 mil (1.0 mm).
  - 3. Fabricate continuous flashings in sections 60 inches long, minimum.
  - 4. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- D. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Mortar Net USA, Ltd.; Blok-Flash.
- E. Solder and Sealants for Sheet Metal Flashings:
  - 1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless steel sheet manufacturer.
  - 2. Elastomeric Sealant: ASTM C 920, chemically curing silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.
- F. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- G. Termination Bars for Flexible Flashing: Stainless steel bars 1/8 inch by 1 inch.

## 2.11 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

- D. Weep/Cavity Vents: Use one of the following unless otherwise indicated:
1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
    - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Advanced Building Products Inc.; Mortar Maze Cell Vents.
      - 2) CavClear/Archovations, Inc.; CavClear Weep Vents.
      - 3) Heckmann Building Products Inc.; No. 85 Cell Vents.
      - 4) Hohmann & Barnard, Inc.; QV Quadro-Vents.
      - 5) Mortar Net USA, Ltd.; Mortar Net Weep Vents.
      - 6) Wire-Bond; #3601 Cell Vent.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Products: Subject to compliance with requirements, provide products by one of the following:
    - a. Advanced Building Products Inc.; Mortar Maze Cell Vents.
    - b. CavClear/Archovations, Inc.; CavClear Weep Vents.
    - c. Heckmann Building Products Inc.; No. 85 Cell Vents.
    - d. Hohmann & Barnard, Inc.; QV Quadro-Vents.
    - e. Mortar Net USA, Ltd.; Mortar Net.
    - f. Wire-Bond; #3601 Cell Vent.
  2. Provide the following configuration:
    - a. Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.
    - b. Strips, not less than 1-1/2 inches (38 mm) thick and 10 inches (250 mm) high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
    - c. Sheets or strips, full depth of cavity and installed to full height of cavity.
    - d. Sheets or strips not less than 1-1/2 inches (38 mm) thick and installed to full height of cavity, with additional strips 4 inches (100 mm) high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from clogging with mortar.
- F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
    - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
    - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
    - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.
- G. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
    - b. EaCo Chem, Inc.
    - c. ProSoCo, Inc.



**2.12 MORTAR AND GROUT MIXES**

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
  2. Use portland cement-lime mortar unless otherwise indicated.
  3. For exterior masonry, use portland cement-lime mortar.
  4. For reinforced masonry, use portland cement-lime mortar.
  5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
1. For masonry below grade or in contact with earth, use Type S.
  2. For reinforced masonry, use Type N.
  3. For mortar parge coats, use Type S or Type N.
  4. For exterior, above-grade, load-bearing, non-load-bearing walls, and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
  5. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- D. Pigmented Mortar: Use colored cement product.
1. Pigments do not exceed 10 percent of portland cement by weight.
  2. Mix to match Architect's sample.
  3. Application: Use pigmented mortar for exposed mortar joints with the following units:
    - a. Decorative CMUs.
    - b. Face brick.
    - c. Cast stone trim units.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
1. Mix to match Architect's sample.
  2. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:
    - a. Decorative CMUs.
    - b. Face brick.
    - c. Cast stone trim units.
- F. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1-2013/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
  2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 3000 psi.
  3. Provide grout with a slump of 8 to 11 inches as measured in according to ASTM C 143/C 143M.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
  - 2. Verify that foundations are within tolerances specified.
  - 3. Verify that reinforcing dowels are properly placed.
  - 4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
  - 1. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested in accordance with ASTM C 67/C 67M. Allow units to absorb water so they are damp but not wet at time of laying.

### 3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
  - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
  - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
  - 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
  - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
  - 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
  - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.

5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
  6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
  7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
- C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
  2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
  3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
  4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
  5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

### 3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated on Drawings, lay exposed masonry in running bond pattern; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
  1. Install compressible filler in joint between top of partition and underside of structure above.
  2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors, and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.

3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 84 46 "Fire-Resistive Joint System."

### 3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs and hollow brick as follows:
  1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
  2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
  3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
  4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
  1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

### 3.6 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:
  1. Individual Metal Ties: Provide ties as indicated installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. of wall area spaced not to exceed 24 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
    - a. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) ties.
    - b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) ties to allow for differential movement regardless of whether bed joints align.
  2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.
    - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes or tab-type reinforcement.
    - b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties.
    - c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.
  3. Header Bonding: Provide masonry unit headers extending not less than 3 inches into each wythe. Space headers not more than 8 inches clear horizontally and 16 inches clear vertically.
  4. Masonry-Veneer Anchors: Comply with requirements for anchoring masonry veneers.
- B. Bond wythes of cavity walls together using bonding system indicated on Drawings.

- C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- D. Apply air barrier to face of backup wythe to comply with Section 07 27 26 "Fluid-Applied Membrane Air Barriers."
- E. Installing Cavity Wall Insulation: See Section 07 21 00 – Thermal Insulation.

### 3.7 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
  1. Space anchors as indicated, but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

### 3.8 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
  1. Space reinforcement not more than 16 inches o.c.
  2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
  3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### 3.9 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control, isolation, construction and expansion joints (in walls and where located in supporting slab) without provision to allow for in-plane wall or partition movement.
- B. Locate joints according to approved Shop Drawings.
  1. Place control joints according to National Concrete Masonry Association TEK 10 "Crack Control in Concrete Masonry Walls", Table 4.
  2. Shop Drawings must show all control, isolation, construction and expansion joints (in walls and where located in supporting slab) and masonry must acknowledge all movement joints. Notify Architect of any movement joints not shown on Shop Drawings including movement joints or other joints occurring in Field due to in-place construction.
- C. Form control joints in concrete masonry as follows:
  1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
  2. Install preformed control-joint gaskets designed to fit standard sash block.
  3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.

4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.
- D. Form expansion joints in brick as follows:
1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
  2. Build flanges of factory-fabricated, expansion-joint units into masonry.
  3. Build in compressible joint fillers where indicated.
  4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 07 92 00 "Joint Sealants."
- E. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 "Joint Sealants," but not less than 3/8 inch.
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

### 3.10 LINTELS

- A. Install steel lintels where indicated.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

### 3.11 FLASHING, WEEP HOLES, AND CAVITY VENTS

- A. General: Install embedded flashing and weeps in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
  1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
  2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 4 inches, and through inner wythe to within 1/2 inch of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches on interior face.
  3. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 4 inches, and 1-1/2 inches into the inner wythe. Form 1/4-inch hook in edge of flashing embedded in inner wythe.
  4. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under building paper or building wrap, lapping at least 4 inches
  5. At lintels and shelf angles, extend flashing 6 inches minimum into masonry at each end. At heads and sills, extend flashing 6 inches minimum at ends and turn up not less than 2 inches to form end dams.
  6. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
  7. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.

8. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
  9. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
  10. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.
- E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing.
1. Use specified weep/cavity vent products to form weep holes.
  2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
  3. Space weep holes 24 inches o.c. unless otherwise indicated.
- F. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- G. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form vents.
1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

### 3.12 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1-2013/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in ACI 530.1-2013/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  2. Limit height of vertical grout pours to not more than 60 inches.

### 3.13 FIELD QUALITY CONTROL

- A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

- B. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.
- C. Inspections: Level 1 special inspections according to the "International Building Code."
  - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- D. Testing Prior to Construction: One set of tests.
- E. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- F. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C 140/C 140M for compressive strength.
- G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C 780.
- H. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C 109C/ C 109M for compressive strength ASTM C 1506 for water retention and ASTM C 91 for air content.
- I. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C 1019.

### **3.14 REPAIRING, POINTING, AND CLEANING**

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  - 6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-2A.
  - 7. Clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

### **3.15 MASONRY WASTE DISPOSAL**



- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  - 1. Crush masonry waste to less than 4 inches in each dimension.
  - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 20 00 "Earth Moving."
  - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 04 21 13 – ADHERED BRICK VENEER****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Thin brick veneer systems adhered to waterproofing and concrete masonry units.
- B. Related Sections:
  - 1. Section 05 40 00 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs.
  - 2. Section 06 16 00 "Sheathing" for wall sheathing.
  - 3. Section 07 27 26 "Fluid-Applied Membrane Air Barriers" for wall sheathing joint treatment and water-resistive barrier applied over wall sheathing.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For veneer, accessories, and manufactured products.
- B. Samples for Initial Selection: For colored pointing mortar and other items involving color selection.
- C. Samples for Verification:
  - 1. For veneer indicated. Include at least four Samples in each set and show the full range of color and other visual characteristics in completed Work.
  - 2. For each color of mortar required.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Material Test Reports:
  - 1. Veneer Unit Test Reports: For each variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous five years.
- C. Sample Warranty: For mortar manufacturer's special warranty.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: A firm or individual experienced in installing adhered veneer assemblies similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.
- B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Build mockups for veneer in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.
  - 2. Protect accepted mockups from damage and soiling.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- B. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, in a dry location, or in covered weatherproof dispensing silos.

## 1.7 FIELD CONDITIONS

- A. Protection of Veneer Assembly: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed veneer assemblies when construction is not in progress.
  1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining veneer face.
  1. Protect base of walls from rain-splashed mud and mortar splatter using coverings spread on the ground and over the wall surface.
  2. Protect sills, ledges, and projections from mortar droppings.
  3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  4. Turn scaffold boards near the wall on edge at end of each day to prevent rain from splashing mortar and dirt on completed veneer assembly.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace veneer units damaged by frost or freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

## 1.8 COORDINATION

- A. Advise installers of other work about specific requirements for placement of flashing and similar items to be built into veneer assembly.

## 1.9 WARRANTY

- A. Special Warranty: Mortar manufacturer's standard form in which manufacturer agrees to repair or replace components of adhered veneer that fail in materials, workmanship, or adhesion within specified warranty period.
  1. Warranty Period: Fifteen (15) years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 THIN BRICK

- A. Products: Subject to compliance with requirements, provide the following unless otherwise noted on Drawings:
  1. Alaska White Velour by Belden Brick.

2. Endicott Clay Products Co.
  3. Echelon Masonry; an Oldcastle Company.
- B. Thin Brick: Not less than 1/2 inch or more than 1 inch thick, and as follows:
1. Dimensional Tolerances: Plus 0 inch or minus 1/16 inch for any dimension 8 inches or less and plus 0 inch or minus 3/32 inch for any dimension more than 8 inches.
  2. Out-of-Square Tolerance: Plus or minus 1/16 inch.
  3. Warpage Tolerance: Plus 0 inch or minus 1/16 inch.
  4. Variation of Shape from Specified Angle: Plus or minus one degree.
  5. Modulus of Rupture: Not less than 250 psi when tested according to ASTM C 67.
  6. Tensile Bond Strength: Not less than 150 psi when tested before and after freeze-thaw test according to ASTM E 488 as modified. Adhere a steel plate with a welded rod on a single thin-brick face with epoxy for each test.
  7. 24-Hour Cold-Water Absorption: Not more than 6 percent when tested according to ASTM C 67.
  8. Freeze-Thaw Resistance: No detectable disintegration or separation after 300 freezing-and-thawing cycles when tested according to ASTM C 666/C 666M, Method B.
  9. Chemical Resistance: Tested according to ASTM C 650 and rated "not affected."
  10. Efflorescence: Tested according to ASTM C 67 and rated "not effloresced."
  11. Surface Coating: Thin brick with colors or textures applied as coatings shall withstand 50 cycles of freezing and thawing; ASTM C 67 with no observable difference in applied finish when viewed from 10 feet.
  12. Back Surface Texture: Scored, combed, wire roughened, ribbed, keybacked, or dovetailed.
- C. Special Shapes: Include corners, edge corners, and end edge corners.
- D. Face Size: Custom "Queen" size unless noted otherwise on Drawings.
- E. Face Color and Texture: Match Architect's samples

## 2.2 CEMENT BACKER BOARD

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, with glass-fiber-reinforced fronts, backs, and long edges, and approved by mortar manufacturer.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. National Gypsum Company; PermaBase Brand Cement Board.
  2. Thickness: 1/2 inch.

## 2.3 MORTAR AND WATERPROOFING MATERIALS

- A. Source Limitations for Mortar and Waterproofing Materials: Obtain mortar and waterproofing system components from a single manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Laticrete International, Inc.
  2. MAPEI Corporation.
  3. Parex USA, Inc.; Merkrete SBVS Systems.
- C. Fluid-Applied Waterproof Membrane: Liquid-latex rubber or elastomeric polymer, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated.

- D. Veneer Mortar: Polymer-modified portland cement mortar recommended by the mortar manufacturer for the application indicated.
  - 1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
  - 2. Provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
- E. Pointing Mortar: Provide mortar manufacturer's recommended masonry pointing mortar in color selected by Architect from manufacturer's standard.
- F. Water: Potable.

## 2.4 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
  - 1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.
  - 2. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
- B. Solder and Sealants for Sheet Metal Flashings:
  - 1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
  - 2. Elastomeric Sealant: ASTM C 920, chemically curing sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

## 2.5 MISCELLANEOUS MASONRY ACCESSORIES

- A. Expanded Metal Lath: 3.4 lb/sq. yd. self-furring, diamond-mesh lath complying with ASTM C 847. Fabricate from structural-quality, zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G60
- B. Lath Attachment Devices: Material and type required by ASTM C 1063 for installations indicated.

## 2.6 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
  - 1. Do not use calcium chloride.
  - 2. Use portland cement-lime mortar unless otherwise indicated.
  - 3. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches required consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.
- B. Latex-Modified Portland Cement Setting Mortar: Proportion and mix portland cement, aggregate, and latex additive to comply with latex-additive manufacturer's written instructions.
- C. Pigmented Mortar: Use colored cement product.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine surfaces indicated to receive adhered veneer, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of adhered veneer.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 WATERPROOFING INSTALLATION**

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
- B. Do not install veneer units or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

**3.3 INSTALLATION OF ADHERED MASONRY VENEER**

- A. Comply with mortar manufacturer's written instructions, for adhered veneer system specified.
- B. Coat backs of units and face of scratch coat with cement-paste bond coat, then butter both surfaces with setting mortar. Use sufficient setting mortar so a slight excess will be forced out the edges of units as they are set. Tap units into place, completely filling space between units and scratch coat.
- C. Rake out joints for pointing with mortar to depth of not less than 3/4 inch before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

**3.4 POINTING**

- A. Prepare joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch deep until a uniform depth is formed.
- B. Point joints by placing and compacting pointing mortar in layers of not more than 3/8 inch deep. Compact each layer thoroughly and allow to it become thumbprint hard before applying next layer.
- C. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint profile:
  - 1. Joint Profile: Concave.

**3.5 ADJUSTING AND CLEANING**

- A. Remove and replace veneer units of the following description:
  - 1. Broken, chipped, stained, or otherwise damaged units. Units may be repaired if methods and results are approved by Architect.
  - 2. Defective joints.
  - 3. Units not matching approved samples and mockups.
  - 4. Units not complying with other requirements indicated.
- B. Replace in a manner that results in assembly matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean veneer as work progresses. Remove mortar fins and smears before tooling joints.

- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  3. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

### **3.6 MASONRY WASTE DISPOSAL**

- A. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION



**SECTION 05 12 00 – STRUCTURAL STEEL FRAMING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

**1.2 SUMMARY**

- A. Section includes labor, materials, services, equipment, and appliances required in conjunction with or related to the furnishing, fabrication, delivery, and erection of all structural steel, as defined below. Include all supplementary parts, members, and connections necessary to complete the structural steel work, regardless of whether all such items specifically are shown or specified on the drawings. Miscellaneous metal fabrications, architecturally exposed structural steel, metal stairs and ladders, steel joists and joist girders, cold-formed metal framing, and steel deck are specified in other Division 05 sections.
- B. Related Requirements:
1. Specification **014000 “Quality Requirements”** for requirements of material testing and inspection.
  2. Specification **014529 “Structural Testing and Inspections”** for testing and inspection requirements associated with structural steel.
  3. Section 051213 “Architecturally Exposed Structural Steel Framing” for additional requirements for architecturally exposed structural steel.
  4. Specification **099600 “High-Performance Coatings”** for surface preparation and priming requirements.

**1.3 REFERENCES**

- A. Definitions:
1. Erection Drawings: Field installation or member-placement drawings that are prepared by the Fabricator to show the location and attachment of the individual shipping pieces.
  2. Erection-Bracing Drawings: Drawings that are prepared by the Erector to illustrate the sequence of erection, any requirements for temporary supports, and the requirements for raising, bolting, and or/welding. These drawings are in addition to and separate from the Erection Drawings.
  3. Heavy Trusses: A steel truss composed of wide flange members with a span greater than 150'-0”.
  4. Heavy Shapes and Plates:
    - a. Heavy Shapes:
      - 1) ASTM A6 structural shapes with a flange thickness greater than 2 inches.
    - b. Heavy Plates: Plates with thickness equal to or greater than 2 inches.
  5. Long-span Steel: Custom-fabricated steel with spans that are greater than 100 feet.
  6. Professional Engineer: A professional engineer who is licensed to practice engineering in the state where the project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Project in material.
  7. Shop Drawings: Drawings of the individual structural steel shipping pieces that are to be produced in the fabrication shop.
  8. Structural Steel: Structural steel shall be defined as that work prescribed in Section 2.1 of AISC 303 and all steel support for elevator guide rails and catwalks (including support

members and attached structural steel shapes and plates such as hangers, toe plates, and the grating or checkered plate walking surface).

B. Reference Standards:

1. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified.
  - a. All federal (OSHA), state, and local laws that govern safety requirements for steel erection and other requirements if more stringent than the codes and standards enumerated below. OSHA requirements include regulation 29 CFR 1926, Part R, "Safety Standard for Steel Erection".
  - b. AISC, "Steel Construction Manual."
  - c. AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," except as noted herein.
    - 1) Certain sections in this specification contain requirements that are more restrictive and/or different than contained in this standard. In such cases, the requirements of this specification shall control.
  - d. ANSI/AISC 360, "Specification for Structural Steel Buildings."
  - e. ANSI/AWS D1.1, "Structural Welding Code – Steel."
  - f. ANSI/AWS D1.3, "Structural Welding Code – Sheet Steel."
  - g. ANSI/AWS D1.4, "Structural Welding Code – Reinforcing Steel."
  - h. Research Council on Structural Connections (RCSC), "Specification for Structural Joints using High-Strength Bolts."
  - i. The Society of Protective Coatings, "SSPC Painting Manual", Volumes 1 and 2.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Quality Control:
  - a. The Contractor is responsible for quality control, including workmanship and materials furnished by their subcontractors and suppliers.
  - b. The Contractor shall coordinate the fabrication and erection of all structural steel work with the work of other trades.
  - c. The Fabricator alone shall be responsible for all errors of detailing, fabrication, and for the correct fitting of the structural members.
  - d. The Fabricator shall coordinate connection details, joint fit-up procedures, and field adjustment requirements with Erector. The Contractor shall coordinate provision of all erection bolts, lifting lugs, or other devices required for erection with the Fabricator and the Erector and for interference with architectural finishes and constraints.
2. Document Conflict and Precedence:
  - a. In case of conflict among documents, including architectural and structural drawings and specifications, notify Architect/Engineer prior to submitting proposal. In case of conflict between and/or among the structural drawings and specifications, the strictest interpretation shall govern, unless specified otherwise in writing by the Architect/Engineer.
  - b. Questions about Contract Documents: The Contractor shall notify promptly the Architect/Engineer whenever design of members and connections for any portion of the structure are not indicated clearly or when other questions exist about the Contract Documents. Such questions shall be resolved prior to the submission of shop drawings.
3. Materials and installed work may require testing and retesting, as directed by the governing building code or the Architect/Engineer, at any time during progress of work.
  - a. The Contractor shall provide adequate notification to the Owner's Testing Agency of construction operation including the project schedule to allow the Testing Agency to schedule inspections. Failure to notify sufficiently may result in additional costs

incurred by the Testing Laboratory that may be back-charge to the Contractor by the Owner.

- b. The Contractor shall cooperate with laboratory personnel, provide access to the work, and provide access to manufacturer's operations.
- c. The Contractor shall cooperate with the Owner's Testing Laboratory when Arbitration Testing and Inspection is called for due to a disagreement regarding the tension in installed bolts that have been inspected according to the **Structural Testing and Inspections specification**.
- d. The Contractor shall make adequate arrangement with the Owner's Testing Agency for inspection of material stockpiles and facilities.
- e. The Contractor shall provide to the laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.
- f. The Contractor shall furnish labor, equipment, and facilities as required for sampling and testing by the laboratory and other facilitates the required inspections and test.
- g. Inspection or testing by the Owner does not relieve the Contractor of their responsibility to perform the Work in accordance with the Contract Documents. Test not specifically indicated to be done at the Owner's expense, including retesting of rejected materials and installed work, shall be done at the Contractor's expense. See the **Structural Testing and Inspections Specification**.

B. Preinstallation Meetings:

1. At least 14 days prior to beginning structural steel erection, the Contractor shall hold a meeting to review the detailed quality control and construction requirements and to determine the procedures for producing proper structural steel construction. Also, review requirements for submittals, status of coordinated work, and availability of materials. Establish work progress schedule and procedures for materials inspection, testing, and certification.
2. The Contractor shall require responsible representatives of every party who is concerned with the structural steel work to attend the conference, including, but not limited to, the following:
  - a. Contractor's Superintendent.
  - b. Laboratory responsible for field quality control.
  - c. Special Inspector or Laboratory responsible for shop inspection or testing.
  - d. Structural steel detailer.
  - e. Structural steel fabricator.
  - f. Structural steel erector.
  - g. Owner's **<and Architect's/Engineer's>** Representative.
  - h. Engineer.
3. Minutes of the meeting shall be record, typed, and printed by the contractor and distributed to all parties concerned within five days of the meeting. One copy of the minutes shall be transmitted to the following for information purposes:
  - a. Owner's Representative.
  - b. Architect.
  - c. Engineer.
4. The Engineer shall be present at the conference. The Contractor shall notify the Engineer at least seven days prior to the scheduled date of the conference.

C. Alternates: Substitutions for the member sizes, type(s) of steel connection details, or any other modifications proposed will be considered by the Architect/Engineer only under the following conditions:

1. The request has been made and accepted prior to the submission of shop drawings. All substitutions shall be marked clearly and indicated on the shop drawings as a substitute.
2. There is a substantial cost advantage or time advantage to the Owner or that the proposed revision is necessary to obtain the required materials or methods at the proper times to accomplish the work in the time scheduled.

3. Sufficient sketches, engineering calculations, and other data have been submitted to facilitate checking by the Architect/Engineer, including cost reductions or savings in time to complete the work.
4. In no case shall such substitutions result in additional cost to the Owner.

## 1.5 SUBMITTALS

- A. Product Data: Submit producer's or manufacturer's specifications and installation instructions for following products to show compliance with specifications, including the specified standards):
  1. Shrinkage-Resistant Grout.
  2. Welding Electrodes.
  3. Structural Steel Primer Paint.
  4. Inorganic or Other Protective Paint.
  5. Shear Studs.
  6. Direct Tension Indicators.
  7. Bearing pads.
- B. Shop Drawings:
  1. Preliminary Connection Review: Submit preliminary details of proposed connections not less than 14 days in advance of the start of preparation of detailed shop drawings. Proposed variations from the details shown on the drawings will be considered and such variations must have preliminary approval from the Engineer prior to the preparation of detailed shop drawings. Failure to adhere to the requirements of this paragraph obligates the Contractor to take responsibility for any and all resulting delays in the detailing and fabrication of structural steel.
  2. Detailed Shop Drawings: Submit drawings showing complete details and schedules for fabrication and assembly of structural steel members. Drawings shall include the following minimum information:
    - a. Details of cuts, connections, camber, holes, and other pertinent data.
    - b. Indication of welds by standard AWS symbols, and show size, length, and type of each weld.
    - c. Indication of type, size, and length of bolts, distinguishing between shop and field bolts. Identify the type of high-strength bolted connection (slip-critical, direct-tension, or bearing connections). Indicate locations of pretensioned bolts.
    - d. Connection material specification and sizes.
    - e. Joints or groups of joints in which a specific assembly order, welding sequence, welding technique, or other special precautions are required.
    - f. Holes, flange cuts, slots, and openings shall be made as required by the structural drawings, all of which shall be properly located by means of templates.
    - g. Setting drawings, templates, and directions for installation of anchor rods and other anchorages to be installed by others.
    - h. Non-Destructive Testing (NDT) to be performed by the Fabricator, if any.
    - i. A letter sealed by the Fabricator's Professional Engineer responsible for the design of any of the connections shown on the shop drawings attesting that the engineer has reviewed the shop drawings and that the connections detailed and shown on the shop drawings conform to the engineer's design.
    - j. Fabrication Model: For each submittal, the steel detailer shall provide the associated fabrication model to be used internally by the SEOR as an aid for shop drawing review; the fabrication model will not be returned with electronic markups. If the model is not created using Tekla Structures, a .CSV formatted table containing structural steel framing information, noting the model origin and orientation with respect to a project grid intersection, shall also be provided. The .CSV formatted table and fabrication model shall contain the following information for every structural steel member:
      - 1) Piece mark
      - 2) Section profile

- 3) Material grade
  - 4) Start coordinates (x, y, z) in decimal format
  - 5) End coordinates (x, y, z) in decimal format
  - 6) Stud Count
  - 7) Camber in decimal format
3. Erection Drawings: Submit complete erection drawings showing field installation and member-placing instructions for locating and attaching the individual shipping pieces.
  4. Erection-Bracing Drawings: Submit, for record purposes only, complete erection-bracing drawings.
  5. Shear Connector Placement Drawings: Provide drawings showing proper placement (longitudinal and transverse spacing) of shear connectors on each composite beam requiring such connectors. The drawings shall show the proper relationship of the shear connectors to the flutes in the steel deck and the arrangement of shear connectors along the span of the composite beam. Show the method of attachment of shear connectors and the proposed brand and model of equipment to be used.
  6. All drawings submitted for review shall have blank space for a 2" high and 3.5" wide shop drawing stamp of the Engineer as part of the title block
- C. Certificates:
1. Structural Steel: Submit for each type.
  2. High-Strength Bolts: Submit for each type, including nuts and washers.
  3. Unfinished Bolts and Nuts.
  4. Bearing Pads.
- D. Delegated Design Submittals:
1. Connection Design Submittals: The Fabricator's licensed professional engineer shall submit complete design calculations show all information as specified in the "Connections" section under Part 2. The Engineer reserves the right to reject all shop drawings submitted without complete design calculations.
  2. Connection Design Validation Letter: The Fabricator's licensed professional engineer responsible for the design of any of the connections shown on the shop drawings shall submit a letter that is sealed attesting that the connection design engineer has reviewed the shop drawings and that the connections detailed and shown on the shop drawings conform to the engineer's design.
  3. Long-Span Steel Erection Design Submittals: Submit calculations and drawings, prepared under the supervision of the Erector's licensed professional engineer, for the final erection procedure.
- E. Test and Evaluations Reports: Submit certified reports of tests required by this Specification. Include data on type(s) of tests conducted and test results.
1. For structural steel where is it unclear if the steel conforms to the ASTM requirements, submit certified test reports that verify conformity to ASTM standards.
- F. Field Quality Control Submittals:
1. Surveys: Submit for each survey required.
- G. Environmental Product Declarations:
1. To encourage the use of building products that are working to minimize their environmental and health impacts, consideration will be given to products with publicly available Environmental Product Declarations. For all structural steel submit one of the following that applies to the product:
    - a. Product-specific Type III EPD with internal or external review that conform to ISO 14025, and EN 15804 or ISO 21930 and has at least a cradle to gate scope.
    - b. Industry Wide Type III EPD in which the manufacturer is explicitly recognized as a participant by the program operator. EPD shall conform to ISO 14025, and EN 15804 or ISO 21930 and has at least a cradle to gate scope.

- c. A letter from the product manufacturer, on manufacturer's letterhead, stating that the product does not have a product specific EPD nor was a participant in an industry wide EPD.
- H. Special Procedure Submittals:
  - 1. Long-Span Steel Erection Procedure: Submit a written, detailed erection procedure for the long-span steel system that has been reviewed and approved by the General Contractor, Fabricator, Steel Erector, and the Erector's licensed professional engineer. Procedure shall be sealed by the Erector's engineer.
- I. Qualification Statements:
  - 1. Submit qualification data, including required certifications, for firms and persons specified in the "Qualifications" section under Part 1, to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
  - 2. Submit a resume from the structural steel detailer showing a minimum of two years of experience selecting or completing structural steel connection details using information found in tables in the AISC "Steel Construction Manual".
  - 3. Submit Welding Procedure Specifications (WPS) in accordance with ANSI/AWS D1.1 for all welded joints. Submit test reports showing successful passage of qualification tests for all non-prequalified WPSs.
  - 4. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests as specified in the "Qualifications" section under Part 1. If recertification of welders is required, retesting will be at Contractor's responsibility.
  - 5. A fabricator that is registered with the local building official and is approved to perform fabrication without special inspection shall submit a certificate of compliance stating that the work was performed in accordance with the approved construction documents.
- J. Record Documentation:
- K. Minutes of Preinstallation Meeting: Submit for review.

## 1.6 QUALITY ASSURANCE

- A. Scope of Work:
  - 1. Contract Obligations:
    - a. Owner Responsibility: The Owner shall pay for initial shop and field inspections and tests as required during the fabrication and erection of the structural steel.
    - b. Testing Laboratory Responsibility: The inspection by the Testing Laboratory of the Fabricator's work shall be in sequence, timely, and performed in such a manner so that corrections can be made without delaying the progress of the work. Inspections shall be performed by qualified technicians with a minimum of two years of experience in structural steel testing and inspection. Refer to "Qualifications of Welding Inspectors" Paragraph below. The Testing Laboratory shall provide test reports of inspections. All test reports shall indicate types and locations of defects found during inspection, the measures required and performed to correct such defects, statements of final approval of welding and bolting of shop and field connections, and other fabrication and erection data pertinent to the safe and proper welding and bolting of shop and field connections. Weld inspection reports shall be signed by an inspector with current certification as an AWS Certified Welding Inspector (CWI). In addition to the parties listed in this Specification the Fabricator and Erector shall receive copies of the test reports.
    - c. Rejection of Material or Workmanship: The Owner, Architect, Engineer, and Testing Laboratory reserve the right to reject any material or workmanship not in conformance with the Contract Documents at any time during the progress of the work. However, this provision does not allow waiving the obligation for timely, in sequence inspections.

- B. Testing Laboratory Requirements: The Owner's Testing Laboratory shall:
1. Verify the fabrication shop's certification from AISC.
  2. Verify that the fabricator's fabrication and quality control procedures provide a sound basis for inspection control of workmanship and of the ability to conform to construction documents and industry standards. Review the procedures for completeness and adequacy relative to code requirements for the fabricator's finished product.
  3. Review field welder qualifications by certification or verify by retesting. Obtain welder certificates.
- C. Qualifications:
1. Fabricator:
    - a. The structural steel fabricator shall have not less than 10 years of experience in the successful fabrication of structural steel including not less than three projects using heavy trusses.
    - b. The structural steel fabricator shall have not less than **10** years of experience in the successful fabrication of structural steel similar to this project.
    - c. The structural steel fabricator must participate in the AISC Quality Certification Program and be designated an AISC Certified Plant in Category STD, Standard for Steel Building Structures.
    - d. The structural steel fabricator must be registered and approved by the local building official to perform fabrication work without special inspection. Should the fabricator not be so approved, the fabricator shall reimburse the Owner for the cost of the special inspections required by the local building official.
  2. Detailer:
    - a. The structural steel detailer shall have not less than **five** years of experience in the successful detailing of structural steel similar to this project including experience in selecting or completing structural steel connection details using information found in tables in the AISC "Steel Construction Manual".
    - b. The structural steel detailer firm shall be certified under the Quality Procedures Program of the National Institute of Steel Detailing. The project shall be detailed by qualified structural steel detailers who are either personally certified under the National Institute of Steel Detailing as a Class I or Class II Detailer in the Structural/Miscellaneous discipline or are supervised by a detailer certified as a Class I Senior Detailer in the Structural/Miscellaneous discipline.
  3. Erector:
    - a. The structural steel erector shall have not less than **five** years of successful experience in the erection of structural steel of a similar nature to this project.
    - b. The structural steel erector must participate in the AISC Erector Certification Program and be designated an AISC **Advanced Certified Steel Erector**.
    - c. The structural steel erector shall have not less than five years of successful experience in the erection of structural steel including not less than three projects using heavy trusses.
  4. Welding Qualifications: Qualify welding processes and welding operators in accordance with AWS "Structural Welding Code – Steel".
  5. Professional Engineer:
    - a. The Professional Engineer employed by the Fabricator for connection design shall be experienced in the specific area of structural steel connection design with demonstrated experience of not less than three projects of similar scope and complexity.
    - b. The Professional Engineer employed by the Erector for preparation of Erection Bracing Drawings shall be experienced in the specific area of structural frame bracing during erection design with demonstrated experience of not less than three projects of similar scope and complexity.
  6. Independent Testing Laboratory:
    - a. Any testing laboratory retained to perform tests that are required by this specification shall meet the basic requirements of ASTM E 329 and shall submit to the Owner,

Architect, and Engineer evidence of current accreditation from the American Association for Laboratory Accreditation, the AASTHO Accreditation Program or the "NIST" National Voluntary Laboratory Accreditation Program.

- b. The Testing Laboratory shall be an Approved Agency by the Building Official to perform Special Inspections and other tests and inspections as outlined in the applicable building code.
- c. Tests and inspections shall be conducted in accordance with specified requirements, and if not specified, in accordance with the applicable standards of the American Society for Testing and Materials or other recognized and accepted authorities in the field.
- d. Qualification of Welding Inspectors:
  - 1) Inspectors performing visual weld inspection shall meet the requirements of AWS D1.1 Section 6.1.4. Inspectors shall have current certification as an AWS Certified Welding Inspector (CWI). Assistant inspectors, if any, shall be supervised by an Inspector and shall be qualified by training and experience to perform the specific functions to which they are assigned.
  - 2) Inspectors performing nondestructive examinations of welds other than visual inspection (MT, PT, UT, and RT) shall meet the requirements of AWS D1.1, Section 6.14.6.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.
- B. Deliver anchor rods and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time so as not to delay work.
- C. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration. Do not store materials on structure in a manner that might exceed allowable loads on or cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed by Architect/Engineer.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Structural Steel:
  1. All hot rolled steel plates, shapes, sheet piling, and bars shall be new steel conforming to ASTM A 6.
  2. Comply with the provisions of the following ASTM Specifications as appropriate for the grades and types, and at the locations as specified on the drawings:
    - a. Structural Steel Wide Flange and WT Shapes: High Strength Steel, ASTM A 992.
    - b. M-Shapes, S-Shapes, and Channels: High Strength Steel, ASTM A 572, Grade 50.
    - c. Angle Shapes: Carbon Steel, ASTM A 36.
    - d. Structural Steel Plates and Bars: High Strength Steel, ASTM A 572, Grade 50.
    - e. Structural Shapes, Plates and Bars: Weathering Steel, ASTM A 588 or ASTM A 242.
    - f. Steel Pipe: ASTM A 53 (Type E or S) Grade B (Fy = 35 ksi).
    - g. Round HSS: ASTM A 500, Grade C (Fy = 46 ksi).
    - h. Square and Rectangular HSS: ASTM A 500, Grade C (Fy = 50 ksi).
    - i. Round, Square, and Rectangular HSS: Weathering Steel, ASTM A 847.
  3. Requirements for Heavy Shapes and Heavy Plates in Welded Connections. Heavy Shapes and Heavy Plates shall have a Charpy V-Notch toughness of 20 ft-lb or greater at 70 F, established by testing. The impact test shall comply with ASTM A 673, Frequency P.



- a. Heavy Shapes shall be supplied with Charpy V-Notch impact test results in accordance with ASTM A 6, Supplementary Requirement S30, "Charpy V-Notch Impact Test for Structural Shapes: Alternate Core Location."
- b. Heavy Plates shall be supplied with Charpy V-Notch impact test results in accordance with ASTM A 6, Supplementary Requirement S5, "Charpy V-Notch Impact Test".

Exception: This requirement does not apply to columns that are not part of the Seismic Force Resisting System and are not part of a braced frame or a moment frame.

4. Connection Material: Unless noted otherwise on the drawings, column stiffener plates and doubler plates at moment connections shall be the same grade of steel as the beam connecting the column (highest grade if more than one grade is used). All other connection material except as noted otherwise on the drawings including bearing plates, gusset plates, stiffener plates, filler plates, angles, etc. shall be A36 steel unless a higher or matching grade of steel with the members connected is required by strength or stiffness calculations and provided the resulting sizes are compatible with the members connected.
  5. Structural Steel Surfaces: For fabrication of work which will be exposed to view in the completed structure, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.
  6. Potential Non-conforming Material: For structural steel for which evidence exists that the steel may not conform to ASTM requirements, the Contractor, where permitted by the Engineer, shall engage the services of an independent testing laboratory to test the material according to ASTM A 6 and submit certified test reports that verify conformity to ASTM standards. Tests shall be made for each 10 tons of affected material unless otherwise directed by the Engineer.
- B. Structural Bolts and Threaded Fasteners: Structural bolts and threaded fasteners shall comply with the following ASTM Specifications as appropriate for the types and at the locations as specified on the drawings:
1. ASTM F 3125 Grade A325 Type 1.
  2. ASTM F 3125 Grade A490 Type 1.
  3. ASTM A 449 Type 1 to be used only for bearing type connections with a bolt diameter greater than 1 1/2".
  4. Twist-Off-Type Tension-Control Bolt Assemblies:
    - a. Bolts that are manufactured to conform to ASTM F 3125 Grade F1852.
    - b. Bolts that are manufactured to conform to ASTM F 3125 Grade F2280.
    - c. Subject to conformance with specified requirements, acceptable manufacturers include but are not limited to:
      - 1) Nucor Fastener, A Division of Nucor Corporation.
      - 2) Lake Erie Screw Corp.
      - 3) Vermont Fasteners Manufacturing.
      - 4) Lohr Structural Fasteners.
  5. Bolts and Nuts, High Strength Bolts: Bolts and nuts for all high strength bolts shall be heavy hex head conforming to ANSI Standards B18.2.1 and B18.2.2 respectively. Nuts shall conform to ASTM A 563.
  6. Washers: All washers shall be circular, flat and smooth and shall conform to the requirements of Type A washers in ANSI Standard B23.1. Washers for high strength bolts shall be hardened and conform to ASTM F 436. Beveled washers for American Standard Beams and channels shall be square or rectangular, shall taper in thickness (16 2/3% slope) with an average thickness of 5/16". When an outer face of a bolted part has a slope greater than 1:20 with respect to a plane normal to the bolt axis, a beveled washer shall be used. Washers to be used with A490 bolts larger than 1 inch in diameter and installed over oversized or short-slotted holes and other similar situations shall conform to ASTM F 436 except with 5/16 inch minimum thickness.

7. Zinc-Coated Bolts: ASTM F 3125 Grade A325 bolts, with their nuts and washers, that are used to connect steel called for on the drawings or in the specifications as hot-dip galvanized after fabrication shall be zinc-coated either by the hot-dip process in accordance with ASTM A 153, Class C or by the mechanical deposition process in accordance with ASTM B 695, Class 50, Type 1. The bolts, nuts, and washers shall all be zinc-coated using the same process and they shall be considered together as an assembly and shall be tested and shipped together as such. Comply with all the requirements of ASTM F 3125 Grade A325 and ASTM A 563 as they relate to zinc-coated materials. ASTM F 1852 bolts with their nuts, and washers shall be zinc-coated only by the mechanical deposition process in accordance with ASTM B 695, Class 50, Type 1. Do not zinc-coat ASTM F 3125 Grade A490 bolts.
  8. Atmospheric Corrosion Resistant Bolts: High strength bolts, nuts and washers connecting steel specified as ASTM A 588 or A242 weathering steel shall be weather resistant Type 3 bolts and similarly treated nuts and washers.
  9. Direct Tension Indicators: Compressible washer-type direct-tension indicators conforming to ASTM F 959.
    - a. Subject to conformance with specified requirements, acceptable manufacturers include but are not limited to:
      - 1) Applied Bolting Technology.
      - 2) Turnasure, LLC.
  10. Bolt Lubrication: All bolts shall be well lubricated at time of installation. Dry, rusty bolts will not be allowed.
  11. New Bolts: All bolts shall be new and shall not be reused.
- C. Electrodes for Welding:
1. Provide electrodes that comply with AWS D1.1, "Structural Welding Code - Steel" and that can produce welds that have a minimum Charpy V-notch toughness of 20 ft-lbs at 40° F, unless noted otherwise in these specifications or on the drawings.
  2. Electrodes for various welding processes shall be as specified below:
    - a. SMAW:
      - 1) E70XX low hydrogen.
      - 2) E80XX for Grade 60 and 65 steel with complete joint penetration (CJP) welds or as indicated on the drawings.
    - b. SAW:
      - 1) F7X-EXXX.
      - 2) E8X-EXX-XX for Grade 60 and 65 steel with complete joint penetration (CJP) welds or as indicated on the drawings.
    - c. GMAW:
      - 1) ER70S-X.
      - 2) ER80S-X for Grade 60 and 65 steel with complete joint penetration (CJP) welds or as indicated on the drawings.
    - d. FCAW:
      - 1) E7XT-X.
      - 2) E8XT-X for Grade 60 and 65 steel with complete joint penetration (CJP) welds or as indicated on the drawings.
  3. Weathering Steel Electrodes shall conform to Table 3.3 of the ANSI/AWS D1.1 Manual.
  4. Electrodes shall be compatible with parent metal joined.
- D. Headed Studs used as Anchors for Structural Steel Plates and Members connecting to Concrete: AWS Type A studs manufactured in conformance with ASTM A 29 with a minimum tensile strength of 61,000 psi of sizes as specified on the drawings.
- E. Headed Studs used as Composite Member Shear Connectors: AWS type B studs manufactured in conformance with ASTM A 29 with a minimum tensile strength of 65,000 psi of sizes as specified on the drawings.
- F. Deformed Bar Anchors: 3/8" to 5/8" diameter AWS Type C studs manufactured in conformance with ASTM A 1064 with a minimum yield strength of 70,000 psi and a tensile strength of 80,000

PSI. 3/4" or larger diameter, ASTM A 706 bars of equal size with welds to steel substrate that develop the full strength of the anchor. ASTM A 615 reinforcing bars may not be substituted for deformed bar anchors. Reinforcement shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Service Report submitted for Engineer review. The following are acceptable products, provided that their Evaluation Service Reports are still valid at the time of intended use on the project:

- a. Nelson Stud Welding, Inc.; Nelson D2L Deformed Bar Anchor Studs (ESR-2907).
- b. Tru-Weld Division, TFP Corporation; Deformed Bar Anchors (ESR-2823).

G. Anchor Rods:

1. All anchor rods shall conform to ASTM F 1554. unless noted otherwise on the drawings and shall be of the yield strength as specified below as appropriate for the types and at the locations as specified on the drawings:
  - a. Grade 55 (1/4 inch to 4 inches in diameter), complying with Supplementary Requirement S1 of ASTM F 1554.
  - b. Grade 105 (1/4 inch to 3 inches in diameter).
2. Anchor rods used with ASTM A 588 base plates shall be threaded round stock conforming to ASTM A 588, Grade 50.
3. Anchor rods used with galvanized baseplates shall be galvanized.
4. Nuts: All nuts with anchor rods shall be heavy hex head conforming to ASTM A 563.
5. Washers: Unless indicated otherwise, washers for all base plates shall be in accordance with the AISC "Steel Construction Manual", Table 14-2 with holes 1/16" larger than the anchor rod diameter. Washers shall conform to ASTM A 36 steel.

H. Structural Steel Primer Paint:

1. Unless noted otherwise, at interior, conditioned spaces, primer paint shall be one of the following types with the indicated surface preparation:
  - a. Zinc oxide, raw linseed oil and alkyd primer, surface prepared according to SSPC-SP-2 (Hand Tool Cleaning) unless noted otherwise in this specification.
  - b. SSPC-Paint 23 acrylic primer, surface prepared according to SSPC-SP-6 (Commercial Blast Cleaning).
  - c. Fast-curing, lead- and chromate-free, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements of FS TT-P-664, surface prepared according to SSPC-SP-2 (Hand Tool Cleaning) unless noted otherwise in this specification. The contractor is responsible for supplying a paint that complies with the VOC requirements of all local governing agencies.
2. At exterior and/or unconditioned spaces, primer paint shall be one of the following types with the indicated surface preparation:
  - a. Organic zinc-rich primer utilizing either an epoxy or urethane binder with a minimum volume solids ratio of 50 percent with a minimum zinc content of 80 percent by weight in the dry film. Apply primer at a rate to achieve a dry film thickness of 3.0 to 4.0 mils. The primer shall comply with the AISC Class B slip critical requirement. (SSPC-SP6 Commercial Blast Cleaning).
  - b. Ethyl Silicate Inorganic zinc-rich primer with a minimum volume solids ratio of 60 percent and with a minimum zinc content of 75 percent by weight in the dry film. The primer shall comply with the AISC Class B slip critical requirement. (SSPC-SP6 Commercial Blast Cleaning).
  - c. Hydrophobic Acrylic Polymer with dry film thickness of not less than 2.0 mils: Tnemec Series 30, Spra-Saf EN or Sherwin Williams, Spraylastic Exterior Waterborn Dryfall (SSPC-SP6 Commercial Blast Cleaning).
3. Primer paint shall produce a Class A or B coating on all painted faying surfaces that are a part of a slip-critical connection as noted on the drawings; surface prepared according to SSPC-SP-6 (Commercial Blast Cleaning) and shall be of the following types.
  - a. Class A

- 1) Polyamide Epoxy with a minimum volume solids ratio of 65 percent. The primer shall comply with the AISC Class A slip critical requirement. (SSPC-SP6 Commercial Blast Cleaning).
  - b. Class B
  - c. Organic zinc-rich primer utilizing either an epoxy or urethane binder with a minimum volume solids ratio of 50 percent with a minimum zinc content of 80 percent by weight in the dry film. Apply primer at a rate to achieve a dry film thickness of 3.0 to 4.0 mils. The primer shall comply with the AISC Class B slip critical requirement. (SSPC-SP6 Commercial Blast Cleaning).
  - d. Ethyl Silicate Inorganic zinc-rich primer with a minimum volume solids ratio of 60 percent and with a minimum zinc content of 75 percent by weight in the dry film. The primer shall comply with the AISC Class B slip critical requirement. (SSPC-SP6 Commercial Blast Cleaning).
4. Refer to Architect's drawings and specifications for final paint finish requirements of structural steel. Primer paint shall be compatible with final paint requirements.
- I. Non-Shrink Grout: Provide grout type(s) as specified on the drawings:
1. Non-Metallic Non-Shrink Grout: Premixed, non-corrosive, non-staining product containing Portland cement, silica sands, shrinkage compensating agents, and fluidity improving compounds. Conform to ASTM C 1107. Provide the minimum strength as shown below as determined by grout cube test at 28 days:
    - a. Unless noted otherwise on the drawings, grout strength for supporting concrete shall be **6,000 PSI**.

Subject to conformance with specified requirements, acceptable non-shrink grouts include:

    - a. L&M Construction Chemicals, Inc.; Crystex and Duragrout.
    - b. Dayton-Superior Corporation; Sure Grip High Performance Grout and 1107 Advantage Grout.
    - c. BASF Construction Chemicals; Masterflow 555 and Set Grout.
    - d. U.S. Grout Corp.; Five Star Grout.
    - e. The Euclid Chemical Company; NS Grout.
    - f. Hilti, Inc.; CG 200 PC.
  2. High Flow, Non-Metallic Grout: Use high-flow grout where high fluidity and/or increased placing time is required and for base plates that are larger than 10 square feet. The factory pre-mixed grout shall conform to ASTM C 1107, "Standard Specification for Packages Dry, Hydraulic-Cement Grout (Non-Shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95% bearing under an 18" x 36" base plate. Provide one of the following:
    - a. The Euclid Chemical Co.; Hi-Flow Grout.
    - b. BASF Construction Chemicals; Masterflow 928.
  3. Metallic Non-Shrink Grout: Premixed, factory packaged, ferrous aggregate grout conforming to Corps of Engineers CRD-C621. Provide minimum strength of 8,000 psi at 28 days as determined by grout cube tests.
    - a. Subject to conformance with specified requirements acceptable products include:
      - 1) BASF Construction Chemicals; Embeco 636 and Embeco 885.
      - 2) The Euclid Chemical Company; NS Metallic Grout and Hi-Flow Metallic Grout.
  4. Epoxy Grout: A three-part grout system consisting of a blend of epoxy resin, curing agent and specialty aggregates conforming to Corps of Engineers CRD-590.
    - a. Subject to conformance with specified requirements, acceptable products include:
      - 1) L&M Construction Chemicals, Inc.; Epogrout 758.
      - 2) The Euclid Chemical Company; E<sup>3</sup>-G, E<sup>3</sup>-F and E<sup>3</sup>-HP.
      - 3) Dayton-Superior Corporation; Sure-Grip High-Flow Epoxy Grout.
      - 4) BASF Construction Chemicals; Masterflow 648 CP and Masterflow MP.
- J. Grating: Welded steel bar grating of the type, depth, and finish noted on the drawings capable of carrying not less than the stated live load and deflecting not more than span/360 under that load.

- K. Checkered Plate: **ASTM A 786**.
- L. Hot-Dip Galvanizing:
1. Scope: All structural steel items and their connections permanently exposed to exterior conditions or that are within areas of unconditioned airspace, whether specified on the drawings or not, shall be hot-dip galvanized after fabrication unless indicated on the drawings or in Specification <099100> to receive a primer and/or finish coat. Such items include, but are not limited to:
    - a. Base plates and anchor rods supporting galvanized members.
    - b. Shelf angles.
    - c. Parapet wall supporting members.
    - d. Screen wall supporting members.
    - e. Window washing support members.
    - f. Exterior covered walkways.
    - g. Embedded plates in concrete exposed to unconditioned airspace.
    - h. Cooling tower support steel.
    - i. Building skin support steel exposed to moisture outside the exterior waterproofing surface.
    - j. Examine the architectural and structural drawings for other items required to be hot-dip galvanized.
  2. Zinc-coat all ASTM F 3125 Grade A325 bolts nuts, and washers used in the connection of such steel. Field welded connections shall have welds protected and the exposed portions of ASTM F3125 Grade A490 bolts, nuts, and washers shall be protected with galvanizing repair paint.
  3. Surface Preparation: All steel to be hot-dip galvanized shall undergo the following surface preparation as specified by the Society for Protective Coatings (SSPC), Volume 2.
    - a. Remove all grease, oil, grime and foreign contaminants by thorough cleaning with an alkaline or organic solvent followed by thorough rinsing in cold water.
    - b. Remove scale by pickling in diluted sulfuric or hydrochloric acid. Pickling shall be followed by a rinse in warm water and a second rinse in cold water. As an alternative to pickling, the steel may be white metal blast cleaned according to SSPC-SP-5.
    - c. Dip in a flux solution of zinc ammonia chloride followed by drying at room temperature.
  4. Zinc Coating: The zinc coating for steel shapes and plates shall conform to ASTM A 123. Weight of zinc coating per square foot of surface for 1/8 inch and 3/16 inch thick steels shall average not less than 3.0 mils with no individual thickness less than 2.6 mils. The coating weight shall average not less than 3.9 mils for 1/4" thick and heavier steel with no individual thickness less than 3.3 mils.
- M. Galvanizing Repair Paint: Galvanizing repair paint shall be "ZRC Cold Galvanizing Compound" as manufactured by ZRC Chemical Products or a paint complying with SSPC-Paint 20, Level 1.

## 2.2 FABRICATION

- A. Structural steel members for which shop drawings have not been reviewed shall not be fabricated. Any steel detailed or fabricated prior to the Initial Survey from Part 3 below is at contractor's risk.
- B. All fabricated material and connections shall fit within architectural constraints.
- C. The omission from the shop drawings of any materials required by the Contract Documents shall not relieve the Contractor of the responsibility of furnishing and installing such materials, even though the shop drawings may have been reviewed.
- D. Shop Fabrication and Assembly:
1. Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specification and as indicated on approved final shop drawings. Provide camber in structural members where indicated.

2. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
  3. Milled surfaces of built-up sections shall be completely assembled or welded before milling.
  4. Fitted stiffeners shall be fabricated neatly between flanges, and the ends of stiffeners shall be milled or ground to secure an even bearing against abutting surfaces. All milled or ground joints shall bear throughout their contact length.
  5. with the requirements of Section D2.4 of ANSI/AISC 341 and clause 4.1 of AWS D1.8.
- E. Dimensional Tolerances: Dimensional tolerances of fabricated structural steel shall conform to Section 6.4 of the AISC Code of Standard Practice.
- F. Camber:
1. Camber of structural steel members **and trusses** is indicated on the drawings. Camber shall be measured in the Fabricator's shop in the unstressed condition, prior to erection. The Fabricator shall provide camber measurements of all beams and a report to the Testing Laboratory confirming this has been done.
  2. Where possible, camber of beams shall be applied by a cold bend process.
  3. The local application of heat may be used to introduce or correct camber, curvature, or straightness provided the temperature of the heated area, as measured by temperature crayons or other approved means, does not exceed 1,200°F.
  4. Where indicated on the drawings in a camber diagram, cantilever or double cantilever beams shall be cambered for the main span and cantilever end separately, either by a staged cold bending process or by the application of heat.
  5. Beams **and trusses** detailed without specified camber shall be fabricated so that after erection any natural camber due to rolling or shop fabrication is upward.
  6. Truss Camber Tolerances: Unless noted otherwise, the tolerance for any specified camber point shall be plus or minus 1/1600 (three-quarter inch per 100 feet) of the distance from the nearest specified support point.
- G. Splices in Structural Steel: Splicing of structural steel members in the shop or the field is prohibited without prior approval of the Engineer. Any member having a splice not shown and detailed on approved shop drawings will be rejected.
- H. Compression Joints: Ends of columns, except as otherwise noted, and other compression joints at splices and other connections as noted on the drawings which depend on contact bearing as part of the splice strength shall be finished to bear in accordance with AISC Specification M2.6 so as to provide complete true bearing in accordance with AISC Specification M4.4.
- I. Cutting: Manual oxygen cutting shall be done only with a mechanically guided torch. An unguided torch may be used provided the cut is not within 1/8 inch of the finished dimension and final removal is completed by means such as chipping or grinding to produce a smooth surface quality free of notches or jagged edges. All corners shall be smooth and rounded to a minimum 1/2" radius.
- J. Anchor Rods: Furnish anchor rods and other connectors required for securing structural steel to foundations and other in-place work. Furnish 1/8" minimum steel templates for presetting bolts and other anchors to accurate locations.
- K. Large Plates to be Embedded in Concrete: For steel plates that are larger than 24"x24" and are to be embedded horizontally in and at the top surface of concrete, provide one-inch diameter holes to prevent trapped air underneath plates and to achieve full consolidation. The location of holes shall be shown on the shop drawings and shall not impair the strength of the plate.
- L. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members as shown on the contract documents, and/or the final shop drawings.
1. Provide specialty items as indicated to receive other work.
  2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

- M. Lifting and Erection Devices: The Fabricator shall be responsible for designing, detailing, and furnishing all lifting devices and erection aids required for erection. Such devices shall be removed after erection if they interfere with architectural finish requirements.
- N. Special Fabrication Requirements for Welded Splices and Moment Connections Using Groove Welds in Heavy Shapes or Heavy Plates:
1. Scope: Requirements specified herein shall apply to Heavy Shapes or Heavy Plates with groove welds.
  2. Material Verification: The Fabricator shall verify that all special material requirements in Part 2 of this specification are met.
  3. Weld Sequencing:
    - a. Perform flange welds prior to web welds, unless otherwise noted.
    - b. Sequence individual passes of multipass welds to minimize the restraint produced against the contraction of subsequent passes. For wide flange shape members with double bevel flanges, weld the inside flanges first, then the outside flanges, and lastly the web.
- O. Drainage Holes: Provide 1 inch diameter drainage (weep) holes in all members (trusses, girders, beams, etc.) exposed to weather where rain water could collect (at low points and/or behind dams caused by connections, stiffener plates, etc.). Show all holes on shop drawings for review by the Engineer.
- P. Requirements for Heavy Shapes and Heavy Plates: Heavy Shapes and Heavy Plates shall meet the following requirements:
1. Cutting: Preheating is required. Preheat temperature shall be sufficient to prevent cracking. The minimum preheat temperature is 150 degrees F through the entire thickness; higher preheat shall be provided if necessary to prevent cracking.
  2. All cut edges shall be free of gouges and notches.
  3. Edge preparations: Copes, cuts, weld access holes, and other flame-cut edges within 12" of a groove weld, hole, or discontinuity in that section shall be ground to bright metal with a surface roughness not exceeding 1000 micro-inches and tested for cracks using the dye penetrant method.

### 2.3 WELDING

- A. Welder certifications never expire unless the welder has not welded for more than 6 months or there is a specific reason to question a welder's ability. For complicated welding jobs, consider requiring requalification if certification is over two years old. Requalification testing should be at contractor's expense.
- B. Welder Certification: All shop and field welders shall be certified according to all the applicable AWS procedures for the welding process and welding position used. Each welder shall be assigned an identifying symbol or mark and all shop and field welded connections containing complete or partial joint penetration welds, multi-pass fillet welds, and fillet welds greater than 5/16" shall be identified by the symbol or mark of the welder responsible for the connection.
- C. Minimum Size and Strength:
1. Fillet Welds: Minimum size of fillet welds shall be as specified in Table J2.4 in AISC Specification, Chapter J.
  2. Partial-Penetration Groove Welds: The minimum effective throat thickness of partial-penetration groove welds shall be as specified in Table J2.1 in AISC Specification, Chapter J.
  3. Minimum Strength of Welded Connections: Except as specified below in "Connections" or noted otherwise on the drawings, all shop and field welds shall develop the full tensile strength of the member or element joined. All members with moment connections as indicated on the drawings shall be welded to develop the full flexural capacity of the member, unless noted otherwise on the drawings.

- D. Filler Metal Requirements: Weld metal shall be as specified in Table J2.5 in AISC Specification, Chapter J and other requirements of this specification.
- E. Specialty Welding Consultant: The Fabricator shall hire a specialty welding consultant that is a professional engineer and shall have a minimum of 5 years of experience in weld engineering. The specialty welding consultant shall review the heavy weldments that are shown on the drawings for any stress relieving requirements there may be and to specify the welding sequence that will be required. The specialty welding consultant shall also write the Welding Procedure Specifications for the welds in those details.
- F. Welding Procedure Specification:
1. All welding shall be performed in accordance with a Welding Procedure Specification (WPS) as required in AWS D1.1 and reviewed by the Owner's Testing Laboratory and by the Architect/Engineer. The WPS variables shall be within the parameters established by the filler-metal manufacturer. Engage the services of an independent Testing Laboratory to provide the qualification testing required by AWS D 1.1, Chapter 4, part B to qualify any non-prequalified WPS needed for the project. The independent Testing Laboratory shall prepare Welding Procedure Qualification Records (WPQR) documenting the successful qualification of each Welding Procedure Specification.
- G. Welding Procedures:
1. All welding processes shall comply with the requirements of ANSI/AWS D1.1 unless noted otherwise.
  2. Built-up sections assembled by welding shall be free of warpage and all axes shall have true alignment.
  3. Welds not specified shall, if possible, be continuous fillet welds developing the minimum strength, as specified above, using not less than the minimum fillet welds as specified by AISC.
  4. The toughness and notch sensitivity of the steel shall be considered in the formation of all welding procedures to prevent brittle and premature fracture during fabrication and erection.
  5. The Welding Procedure Specification shall be followed without deviation unless specific approval for change is obtained from the Owner's Testing Laboratory and the Architect/Engineer.
  6. Before welding, particular attention shall be paid to surface preparation, fit up, and cleanliness of surfaces to be welded.
  7. Minimum preheat and interpass temperatures for structural steel welding shall be as specified in ANSI/AWS D1.1, except that no welding shall be performed when the ambient temperature is lower than 0 degrees F. The temperature shall be measured from the side opposite that upon which the preheat is applied.
  8. The heat, input, length of weld, and sequence of weld shall be controlled to prevent distortions. The surfaces to be welded and the filler metals to be used shall be subject to inspection before any welding is performed.
  9. Welds shall be sound throughout. There shall be no crack in any weld or weld pass. Welds shall be considered sound if they conform to AWS requirements, as confirmed by non-destructive testing.
  10. Welds shall be free from overlap.
  11. Craters shall be filled to the full cross section of the welds.
  12. For high-strength low-alloy steels, follow welding procedures as recommended by steel producer for exposed and concealed connections.
  13. Fabricator and Erector shall coordinate welding responsibility at all welded joints.
- H. Stress Relieving: All welding sequences shall be such as to reduce the residual stresses due to welding to a minimum value. If high residual stresses are present, stress relieving of joints shall be required. Welded connections shall be detailed and designed to minimize the accumulation and concentration of through-thickness strains due to weld shrinkage.



## 2.4 BOLTING

- A. Bolt Diameter: Minimum bolt diameter shall be 3/4 inch. The difference in diameter between bolts of differing sizes used on the project shall be not less than 1/4".
- B. Connection Type: Unless noted otherwise on the drawings, all bolted connections shall be snug-tightened using high-strength bolts in standard holes (hole diameter nominally 1/16 inch greater than the nominal bolt diameter) with threads included in the shear planes. Notwithstanding, the contractor shall be responsible to adhere to provisions of ANSI/AISC 360 Section J1.10, which lists circumstances under which certain connections require pretensioned high strength bolts.
- C. Oversize, Short-Slotted and Long-Slotted Holes: The dimensions and washer requirements of oversize, short-slotted, and long-slotted holes shall conform to ANSI/AISC 360 Table J3.3.
- D. Fastener Tension:
  - 1. High strength bolts in snug-tightened joints shall be tightened to a snug tight condition only. Do not pretension bolts in snug-tightened joints the same as if they were in slip-critical joints. The snug-tightened condition is defined as the tightness that exists when all plies are in firm contact. This may usually be attained by a few impacts of an impact wrench or the full effort of an ironworker using an ordinary spud wrench. If Twist-Off-Type Tension-Control Bolt Assemblies are used in snug-tightened joints, do not fully tension bolts and leave the splines intact.
  - 2. High-strength Bolts in **<Slip-critical and>** Pretensioned Joints:
    - a. High-strength bolts in **<slip-critical and>** pretensioned joints shall be tightened to achieve the minimum bolt tension as specified in the RCSC's "Specification for Structural Joints using High-Strength Bolts" when all the fasteners of a joint are tight.
    - b. Any of the four methods to tighten bolts specified in the RCSC Specification may be used to achieve the minimum bolt tension. The tightening procedure that uses direct tension indicator washers shall conform to the requirements of ASTM F 959. Conform to the requirements of ASTM F 1852 for a Twist-Off-Type Tension-Control bolt pretensioning.
- E. Washers: Washers under the bolt head and/or nut shall be used as required by the RCSC Specification.
- F. Bolt Lubrication: All bolts shall be well lubricated at time of installation. Dry, rusty bolts are not be allowed.
- G. Impact Wrenches: Properly sized and lubricated air impact wrenches with adequate air pressure shall be utilized for all bolt installation.
- H. New Bolts: All bolts shall be new and shall not be reused.

## 2.5 CONNECTIONS

- A. Conceptual connection details with the required member design forces are shown on the drawings for bidding purposes and are applicable to all connections not designed and completely detailed on the drawings. The conceptual details are provided only to indicate the connection type required and may not fully represent the complexity of the connection as required by the final connection design for the forces they must resist. Except as noted below, the Fabricator is responsible for engaging the services of a professional engineer to prepare a final connection design for submission that meets the requirements of the conceptual connection details and resists the indicated design forces. Refer to the drawings and specifications for complete requirements.
- B. Typical connection details are indicated on the drawings.
- C. Design and Detailing Procedure:
  - 1. Unless noted otherwise or specifically detailed on the drawings, end connections of beams, girders, and trusses shall be designed as flexible and the connection shall accommodate

- end rotations of the unrestrained beams. Restrained end connections, as indicated on the drawings, shall be designed for the combined effect of bending moment and shears induced by the rigidity of the connection. Forces to be used in the design are described below.
2. The Fabricator's licensed professional engineer shall design and submit sealed calculations documenting the design and showing details of the assembled joint with the bolts and welds required for the conditions noted below:
    - a. For each connection not otherwise completely detailed on the drawings.
    - b. Where connections are encountered on the project that do not match those assumed in the AISC Manual.
  3. Where connections are of the type that can be selected or completed using information found in tables in the AISC "Steel Construction Manual", sealed calculations need not be submitted provided the project design conditions precisely match those assumed in the referenced publications. For conditions encountered on the project that do not conform to the AISC Manual, a complete design shall be prepared and submitted for Engineer's review.
  4. The Fabricator's licensed professional engineer shall seal all design calculations.
  5. The Engineer reserves the right to reject all shop drawings submitted without complete design calculations if required. Failure to adhere to the requirements of this section obligates the Contractor to take responsibility for any and all resulting delays in the detailing and fabrication of structural steel.
  6. The Fabricator's detailer shall complete connection detailing using predesigned connections taken directly from the AISC "Steel Construction Manual". The Fabricator's Professional Engineer shall submit a sealed letter attesting that the engineer has reviewed the shop drawings and the connections detailed and shown on the shop drawings conform to the requirements of AISC and meet the required capacities.
  7. Where connections are of the type that would normally be selected or completed using information found in tables in the AISC "Steel Construction Manual" but where conditions are encountered on the project that do not match those assumed in the AISC Manual publication, the Fabricator shall retain a Professional Engineer to design and submit sealed calculations documenting the design and showing details of the assembled joint with the bolts and welds required.
  8. The Fabricator, their detailer, and professional engineer shall coordinate all connection requirements with the Erector. The Fabricator is responsible to detail connections that contain the adjustability and all other requirements that allow the Erector to erect the structural steel in conformance to all specified tolerances. The Fabricator shall be responsible for providing adjustability in all connections between exterior-cladding systems, skylights, and other architectural features and the supporting structural steel as required in achieving the specified tolerances for the architectural feature as specified in the contract documents or per the manufacturer's requirements.
- D. Design Intent: It is the intention of the plans and specifications that shop connections be welded or bolted and that field connections be bolted, unless detailed otherwise on the drawings.
- E. Preliminary Connection Review: Proposed variations from the details shown on the drawings will be considered and such variations must obtain preliminary approval from the Engineer prior to preparation of detailed shop drawings.
- F. Flexible (Simple) Beam Connections:
1. All typical beam simple connections shall conform to requirements of the AISC specifications. Refer to the drawings for typical connection types.
  2. Beam and girder connections shall have a minimum nominal axial tensile strength equal to two-thirds of the required vertical shear strength for load and resistance factor design (LRFD) but not less than 10 kips, which may be assumed to act independently from the specified vertical force. Where an axial force is specified on plan, the specified axial force must be assumed to act concurrently with the specified vertical shear force. In such cases,

- the connections shall also be designed for the integrity force noted above acting independently of the specified forces.
3. Seated beam connections and stiffened seated beam connections shall not be used unless indicated on the drawings or unless Engineer approval is obtained to verify capacity of supporting member for the resulting eccentricity. The Fabricator must verify and bear responsibility that the use of such connections does not interfere with architectural or MEP requirements.
  4. Simple Beam Connection Capacity: Support a factored load reaction R equal to the reaction shown on the plans. Contact the Engineer if no reaction for a beam is shown on the plan. Each connection shall contain not less than the minimum number of bolts shown in the AISC connection tables for each beam size.
- G. Restrained (Moment) Connections:
1. Refer to the drawings for moment connection details.
  2. Moment connections shall conform to the "Structural Integrity" requirements of the governing Building Code.
  3. Design Reactions for Moment Connected Beams: Shear connections for moment-connected beams shall be designed for the factored reactions shown on the drawings.
  4. Design and Furnishing of Reinforcement in Moment Connected Joints: As part of the design responsibility outlined above, the fabricator shall design and furnish all additional reinforcement in moment connected joints to resist the specified design forces unless otherwise specifically detailed on the drawings. Column sections shall be investigated for web shear, web yielding, web buckling, and tension. Stiffeners and/or doubler plates shall be furnished as required by the AISC Specification Section J10.
- H. Tightening of Bolts in Welded Moment Connections: At moment connections where beams are complete-joint penetration welded directly to columns or girders in the field, welds shall be made after installation of erection bolts to draw the pieces together and before the final shear connection bolts are tightened. Where loose moment plates are used, such plates shall be groove welded to columns prior to connecting these plates to the beams.
- I. Column Splices:
1. Compression Splice: Unless indicated otherwise on the drawings, all column splices shall be either a bolted compression splice using high strength snug-tightened bolts or a welded compression splice. Splice and filler plate sizes, thicknesses, and number of fasteners or weld information shall be as shown in Table 14-3 of AISC "Steel Construction Manual". It shall be the Fabricator's responsibility to examine the architectural drawings to verify that splice plates and fasteners do not violate architectural finish requirements.
  2. Column splices shall conform to the "Structural Integrity" requirements of the governing Building Code.
  3. Bearing and Fit-Up of Column Compression Joints: All column splices, except those that are direct welded with complete-joint penetration welds, shall be considered as a compression joint as defined herein unless noted otherwise on the drawings.
- J. Base Plates and Bearing Plates:
1. Finish: All baseplates and bearing plates shall be finished in accordance with AISC Specification M2.8.
  2. Anchor Rod Holes in Baseplates: Hole sizes in baseplates for anchor rods shall be per the AISC "Steel Construction Manual", Table 14-2.
- K. Trusses:
1. Truss Geometry: Chord and web lines shown on truss elevations represent the centroid of the truss member unless detailed otherwise.
  2. Member End Supplement Plates: Tension members in bolted trusses have been proportioned based on yielding in the gross section. Therefore, connections removing more than  $(1 - (.9F_y / .75F_u))$  of the gross member area at any cross section shall have steel plates welded to the member cross section and extended along the member length to develop the tensile strength of the plate in order to replace material removed so that the

member does not fail by fracture of the net section. The responsibility for the design and furnishing of these plates shall rest with the Fabricator.

3. Preassembly of Trusses: Trusses shall be preassembled in the shop to verify proper fit-up of connections.
- L. Hangers and Braces:
  1. Connections for all hangers and braces shall have connections designed to develop the factored axial force shown on the drawings. Contact the Engineer if no force for a member is shown on the drawings.
  2. Compression members composed of two or more rolled shapes separated from one another by intermittent fillers shall be connected to one another at such fillers at intervals (not to exceed 48") so that the slenderness ratio  $l/r$  of either shape, between the fasteners, does not exceed 75% of the governing slenderness ratio of the built-up member. The least radius of gyration,  $r$ , shall be used in computing the slenderness ratio of each component part.
- M. Stiffeners: Provide stiffeners finished to bear under load concentrations where shown on the drawings.
- N. Steel Shelf Angles: Shelf angles supporting veneer shown on the drawings to be continuous shall be furnished to a maximum length of 20'-0". Provide a 1/4" gap at each joint. The gap shall not be welded. The distance from the joint to the first supporting bolt shall not exceed 40% of the bolt spacing (12" maximum). Shelf angles shall be continuous around corners with corner joint complete-joint penetration welded. The distance to the first supporting bolt from the corner shall not exceed 12".
- O. Limitations on Use of A307 Bolts: ASTM A 307 bolts shall not be used in any permanent steel-to-steel or concrete-to-steel connection.
- P. Bolts in Combination with Welds: Bolts shall not be considered as sharing the load in combination with welds, except as allowed in AISC Specification Section J1.8.

## 2.6 SURFACE PREPARATION AND SHOP PRIME PAINTING

- A. Specification: Surface preparation, paint, and painting practices shall conform to the "SSPC Painting Manual", Volumes 1 and 2.
- B. Scope: All steel shall remain unpainted, except the following:
  1. Shop paint surfaces that are to remain exposed to view in the final construction.
  2. Shop paint any steel other than weathering steel that, in the final construction, will not be in a controlled environment and is therefore subject to moisture or high humidity infiltration and that has not been specified to be galvanized.
  3. Shop paint any steel that is shown on the drawings to receive a finished paint system as defined in Specification **099100**.
  4. Coordinate all shop painting of structural steel with Architect's painting requirements as specified on the architectural drawings and in the specifications. The Fabricator shall be responsible for determining all painting requirements (which surfaces are to be painted or left unpainted) on the project prior to fabrication.
- C. Additional Painting Requirements:
  1. Extend shop paint to 2" from location of welds on surfaces that are to be field welded.
  2. All unpainted mating surfaces of all elements that are welded together into an assembly that is permanently exposed to the exterior shall be seal welded in addition to structural welding requirements.
  3. If individual elements (including the mating surfaces) of an assembly that is required to be painted are painted prior to welding into an assembly, then all painted surfaces affected by welding shall be touched-up and repaired (according to manufacturer's instructions, if any) to prevent corrosion bleeding.

4. The fabricator shall be responsible to ensure that all elements of all assemblies that are to be painted are fabricated so that no exposed surface shall be subject to stains due to corrosion bleeding during the warranty period of the paint.
  5. Structural steel elements that are bolted with slip-critical joints and are required on the drawings to be painted shall have all faying surfaces (including all surfaces of filler plates, member end supplement plates, and welds) painted to comply with the specified slip-critical coating requirement.
- D. Surface Preparation – Unpainted Steel: All structural steel that is not specified to receive a shop coat of primer paint shall be prepared in accordance with Society for Protective Coatings specifications as follows:
1. SSPC-SP 2, “Hand Tool Cleaning” or SSPC-SP 3, “Power Tool Cleaning” unless otherwise specified.
  2. SSPC-SP 6, “Commercial Blast Cleaning” shall be applied to the faying surfaces of connections that are noted on the drawings as slip-critical connections requiring a Class B surface. Apply this surface preparation to the area surrounding all bolt holes including the area up to 2” outside the outer-most holes.
- E. Surface Preparation and Primer Paint – Shop Painted Steel:
1. Surface Preparation: Prepare the surface of all structural steel specified to be shop painted as required by the paint manufacturer or the Society for Protective Coatings specifications, but not less than the following:
    - a. SSPC-SP 2, “Hand Tool Cleaning” or SSPC-SP 3, “Power Tool Cleaning” unless otherwise specified.
    - b. SSPC-SP 6, “Commercial Blast Cleaning” shall be applied to the faying surfaces (including filler and member-end supplement plates, if any) of connections that are noted on the drawings as requiring a slip-critical coating. At a minimum, apply this surface preparation to the area between and surrounding all bolt holes including the area up to 2” outside the outer-most holes.
  2. Priming: Immediately after surface preparation, apply primer to all structural steel specified to be shop primed in strict accordance with manufacturer’s instructions and the Society for Protective Coatings specifications. Apply paint at a rate to conform to the manufacturer’s written instructions and to provide a dry film thickness of not less the 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, welds, and all exposed surfaces. Apply two coats to surfaces that are inaccessible after assembly or erection. Change the color of the second coat to distinguish it from the first coat.
  3. Finish Coat: Coordinate shop primer paint requirements with architectural drawings and specifications. The primer selected must be compatible with any specified finish coat.
- F. Shop Touch-Up Painting: The Fabricator shall provide for cleaning and touch-up painting of welds, bolted connections (including nuts, bolts, washers, filler plates, member end supplement plates and welds, if any), and abraded areas. Prior to shipment, apply paint to exposed areas using same materials and surface preparation as used for shop painting. Paint shall be applied by brush or spray with minimum dry film thickness of 1.5 mils.

## 2.7 SOURCE QUALITY CONTROL

- A. Source Testing and Inspection: Refer to Specification 014529 “Structural Testing and Inspections” for testing and inspection requirements associated with structural steel.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 05 31 00 – STEEL DECKING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

**1.2 SUMMARY**

- A. Supplier: The steel deck supplier shall furnish all steel deck materials and accessories indicated on the Architectural, Structural, and Mechanical Drawings required to produce a complete job including but not necessarily limited to deck units, cover plates, steel deck edge closures, cell closures, cant strips, sump pans, and all related accessories.
- B. Erector: The Subcontractor responsible for erecting the steel deck shall provide all labor and equipment as required to place all steel deck components and accessories as described above.
- C. Related Requirements:
1. Specification **014000** "Quality Requirements" for requirements of material testing and inspection.
  2. Specification **014529** "Structural Testing and Inspections" for inspection requirements associated with cast-in-place concrete.
  3. Specification **032000** "Concrete Reinforcing" for reinforcement in steel deck slabs.
  4. Specification **033000** "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.

**1.3 REFERENCES**

- A. Definitions:
1. Professional Engineer: A professional engineer who is licensed to practice engineering in the state where the project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with steel decking that are similar to that indicated for this Project in material.
- B. Reference Standards:
1. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified.
    - a. AISI, "Specification for the Design of Cold Formed Steel Structural Members."
    - b. AWS D1.3, "Structural Welding Code - Sheet Steel."
    - c. SDI, "Design Manual for Composite Decks, Form Decks, and Roof Decks."

**1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
1. Quality Control: The Contractor is responsible for quality control, including workmanship and materials furnished by subcontractors and suppliers.
  2. Document Conflict and Precedence: In case of conflict among documents, including architectural and structural drawings and specifications, notify the Architect/Engineer prior to submitting proposal. In case of conflict between and/or among the structural drawings and specifications, the strictest interpretation shall govern, unless specified otherwise in writing by the Architect/Engineer.

3. Materials and installed work may require testing and retesting, as directed by the governing building code or the Architect/Engineer, at any time during progress of work.
  - a. The Contractor shall provide adequate notification to the Owner's Testing Agency of construction operations including the project schedule to allow the Testing Agency to schedule inspections. Failure to notify sufficiently may result in additional costs incurred by the Testing Laboratory that may be back-charged to the Contractor by the Owner.
  - b. The Contractor shall cooperate with laboratory personnel, provide access to the work, and provide access to manufacturer's operations.
  - c. The Contractor shall make adequate arrangement with the Owner's Testing Agency for inspection of material stockpiles and facilities.
  - d. The Contractor shall provide to the laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.
  - e. The Contractor shall furnish casual labor, equipment, and facilities as required for sampling and testing by the laboratory and otherwise facilitate the required inspections and tests.
  - f. Inspection or testing by the Owner does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents. Tests not specifically indicated to be done at the Owner's expense, including retesting of rejected materials and installed work, shall be done at the Contractor's expense. See **014529** Structural Testing and Inspections section of the Specifications.

## 1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications and installation instructions for each type of deck specified.
- B. Shop Drawings: Submit detailed shop drawings showing type of deck, complete layout, attachment details, closures, edge strips, pans, deck openings, special jointing, supplementary framing, and all other accessories.
- C. Certificates: Submit a certificate of product compliance with SDI standards as specified.
- D. Delegated Design Submittals: If the submitted deck does not comply with the minimum properties shown on the drawings, the steel deck manufacturer shall submit design calculations sealed by a Professional Engineer verifying compliance with the specifications for all load and span conditions shown on the drawings.
- E. Qualification Statements:
  1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests as specified in the "Qualifications" section under Part 1. If recertification of welders is required, retesting will be at Contractor's responsibility.
- F. Insurance Certification: Assist Architect and Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire, windstorm, and extended coverage insurance.
- G. Minutes of Preinstallation Meeting: Submit for review.

## 1.6 QUALITY ASSURANCE

- A. Qualifications:
  1. Supplier: The steel deck supplier shall be a manufacturer with a minimum of two years of successful experience and with a minimum of two successful projects of a comparable size and scope to this project.



2. Erector: The steel deck erector shall have a minimum of two years of successful experience and with a minimum of two successful projects of a comparable size and scope to this project.
  3. Welding Qualifications: Qualify welding processes and welding operators in accordance with AWS D1.3 procedures.
  4. Professional Engineer: The professional engineer employed by the Deck Supplier for deck design shall be experienced in the specific area of steel deck design with demonstrated experience of not less than three projects of similar scope and complexity.
- B. Underwriters Laboratories Classifications:
1. Provide steel deck units which are listed and conform to Underwriters Laboratories "Fire Resistance Directory", with each deck unit bearing the UL label and marking for specific fire-resistant system detailed.

## **PART 2 - PRODUCTS**

### **2.1 COMPOSITE FLOOR DECK**

- A. General Requirements
1. See the drawings for location of steel deck types and for depth of deck, design deck properties, design deck yield strength, concrete type, total slab thickness, slab reinforcing, and design superimposed loads. The average rib width to depth of deck ratio shall be greater than or equal to 2.0. The deck properties specified are the values used for the design of the deck shown on the drawings. Provide deck with the depth as noted and other properties equal to or greater than the values stated on the drawings except that a deck with properties less than those stated, other than depth, may be used provided that the deck manufacturer take responsibility for the design of the deck. The design shall include the ability to carry the construction dead loads and design superimposed loads indicated for all the spans shown on the drawings and to meet all performance criteria as specified by the SDI. Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck".
  2. Acceptable manufacturers include the following:
    - a. ASC Steel Deck.
    - b. Canam Steel Corp.
    - c. New Millennium Building Systems, Inc
    - d. Cordeck.
    - e. DACS, Inc.
    - f. Marlyn Steel Decks, Inc.
    - g. New Millennium Building Systems, Inc.
    - h. Roof Deck, Inc.
    - i. United Steel Deck, Inc.
    - j. Valley Joist, Inc.
    - k. Verco Manufacturing Co.
    - l. Vulcraft/Div. Nucor Corp.
    - m. Other manufacturers may be used only with Architect/Engineer approval.
- B. Grade of Steel:
1. Composite steel deck shall be cold formed from steel sheets conforming to ASTM A1008 or ASTM A653, Structural Steel Grade, with a minimum yield strength as stated on the drawings. The delivered thickness of the uncoated steel shall not be less than 95% of design thickness. Sheet metal accessories shall conform to the same material specification as the deck product.

- C. Finish:
1. Galvanized: Composite steel deck shall be galvanized with a protective zinc coating conforming to **ASTM A653 G90**.
  2. Galvanizing Repair Paint: High zinc-dust content paint for repair of damaged galvanized surfaces complying with Department of Defense Specifications DOD-P-21035.
- D. Fabrication:
1. Steel Deck Spans: The deck properties shown on the drawings are selected so that the spans do not exceed the maximum clear spans with unshored construction as required by SDI criteria unless indicated otherwise on the drawings. The deck manufacturer shall be responsible for supplying a deck that meets that criterion. Where possible, all steel deck shall extend over three or more spans. Simple span deck will not be permitted unless it is shored at midspan or approved by EOR. Any additional concrete topping specified over the composite slab shall be placed after the slab has reached 75% of its design strength.

## 2.2 ROOF DECK

- A. General Requirements:
1. See General Notes on the drawings for the location, depth of deck, design thickness, and type of deck required.
  2. Acoustic Steel Roof Deck Units:
    - a. Single-Pan Units: Single-pan fluted units with vertical webs perforated sufficiently to meet the following minimum sound absorption criteria in the table below. The steel thickness, depth and width shall be as indicated on the drawings. Provide mineral fiber acoustical insulation strips, encapsulated in clear PVC plastic that is between 0.5 and 3.0 mil thick for moisture protection, with profile to fit void space between vertical ribs.
      - 1) Deck Type = 1 1/2" Deep, Wide Rib:
        - a) 125 Hz Frequency: 0.44.
        - b) 250 Hz Frequency: 0.93.
        - c) 500 Hz Frequency: 1.06.
        - d) 1,000 Hz Frequency: 0.94.
        - e) 2,000 Hz Frequency: 0.54.
        - f) 4,000 Hz Frequency: 0.23.
      - 2) Deck Type = 3" Deep, Deep Rib:
        - a) 125 Hz Frequency: 0.53.
        - b) 250 Hz Frequency: 1.00.
        - c) 500 Hz Frequency: 1.01.
        - d) 1,000 Hz Frequency: 0.87.
        - e) 2,000 Hz Frequency: 0.44.
  3. Acceptable manufacturers include:
    - a. ASC Steel Deck.
    - b. Canam Group.
    - c. New Millennium Building Systems, Inc
    - d. Cordeck.
    - e. Epic Metals Corp.
    - f. Loadmasters Systems, Inc.
    - g. Marlyn Steel Decks, Inc.
    - h. New Millennium Building Systems, Inc.
    - i. United Steel Deck, Inc.
    - j. Valley Joist, Inc.
    - k. Verco Manufacturing Co.
    - l. Vulcraft/Div. Nucor Corp.
    - m. Other manufacturers may be used only with Architect/Engineer approval.

- B. Grades of Steel:
  - 1. Steel deck shall be manufactured from steel conforming to ASTM A1008 Grades C, D, or E for painted deck or A653, Structural Steel Grade for galvanized deck or Engineer approved equal, having a minimum yield strength as stated on the drawings.
- C. Finish:
  - 1. Galvanizing: Steel deck shall be galvanized with a protective zinc coating conforming to ASTM A653 G90.
  - 2. Galvanizing Repair Paint: High zinc-dust content paint for repair of damaged galvanized surfaces complying with Department of Defense Specifications DOD-P-21035.
- D. Fabrication:
  - 1. General: Fabricate deck panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck", in SDI Publication No. 29, and the following.
  - 2. Steel Deck Spans: Where possible, all steel deck shall extend over three or more supports. Single span deck is prohibited.

### 2.3 ACCESSORIES

- A. Mechanical Fasteners:
  - 1. Powder-Actuated or Pneumatically Driven Pins: Provide corrosion-resistant, powder-actuated or pneumatically driven fasteners manufactured from steel conforming to AISI 1070 steel, austempered to a core hardness of 52 to 58 Rockwell C. Fasteners shall have a knurled shank and shall be zinc-plated in accordance with ASTM B633, Sc. I, Type III.
    - a. Subject to compliance with requirements, provide products of one of the following manufacturers:
      - 1) Hilti, Inc.
      - 2) ITWBuildex.
      - 3) Pneutek, Inc.
  - 2. Self-Drilling Screw Fasteners: *Provide corrosion-resistant, hexagonal head, steel self-drilling screws conforming to ASTM C1513[, with a surface hardness of not less than Rockwell C50 and a core hardness not less than Rockwell C32].*
    - a. Subject to compliance with requirements, provide products of one of the following manufacturers:
      - 1) Hilti, Inc.
      - 2) ITWBuildex.
      - 3) Grabber Construction Products.
      - 4) SFS Intec Fastening Systems, Inc.
      - 5) Textron Fastening Systems.
- B. Side-Lap Fasteners:
  - 1. Provide corrosion-resistant, hexagonal washer head undercut with reverse serrations, self-drilling, carbon-steel screws, No. 10 minimum diameter.
    - a. Subject to compliance with requirements, provide products of one of the following manufacturers:
      - 1) Hilti, Inc.
      - 2) Other approved alternative.
- C. Roof Deck Accessories:
  - 1. Provide minimum 20 gauge ridge and valley plates, minimum 20 gauge cant strips, minimum 14 gauge sump pans, minimum 20 gauge inside or outside closure channels angles or plates, minimum 20 gauge butt strips at change of deck directions, and minimum 20 gauge filler sheets.

2. Provide a 20 gage galvanized flat plate to reinforce openings in roof deck that are greater than 6" and less than 10" in any one direction.
- D. Composite/Form Deck Accessories:
1. Flexible Closure Strips: Provide manufacturers standard vulcanized closed cell, synthetic rubber.
  2. Acoustic Sound Barrier Closures: Provide manufacturers standard mineral fiber closures.
  3. Metal Cover Plates – Cellular Deck: Fabricate metal cover plates for end abutting floor deck units of not less than same thickness as decking, formed to match contour of deck units.
  4. Cell Closure at Ends of Steel deck Flutes: Fabricate metal closure strips of not less than 0.0358" minimum (20 gage) cold formed sheet steel. Form to provide tight fitting cell closures at open ends of cells or flutes to prevent wet concrete from leaking through open cells.
  5. Pour Stop Closures at Slab Edges: Provide sheet metal pour stop closures at all slab edges, columns, walls, and openings unless steel angles or bent plates are specified in details on the drawings. The closures shall be fabricated from light gage steel not less than the thickness shown below when the slab edge is parallel to the deck span. Provide a return lip on the vertical leg in accordance with the SDI Design Manual. The overhang dimension is measured from the edge of the flange to the edge of the slab.
    - a. Slab Thickness = 2.5" to 4":
      - 1) Overhang between 0" and 2": 20 gage.
      - 2) Overhang between 2" and 4": 18 gage.
      - 3) Overhang between 4" and 6": 16 gage.
      - 4) Overhang between 6" and 8": 12 gage.
      - 5) Overhang between 8" and 10": 12 gage.
      - 6) Overhang between 10" and 12": 10 gage.
      - 7) Overhang greater than 10": Not acceptable as light gage.
    - b. Slab thickness = 6.5"
      - 1) Overhang between 0" and 2": 16 gage.
      - 2) Overhang between 2" and 4": 14 gage.
      - 3) Overhang between 4" and 8": 12 gage.
      - 4) Overhang greater than 8": Not acceptable as light gage.
- E. Openings on Concrete Floor:
1. For unframed openings, provide blockout in slab for opening with deck uncut. Cut deck at opening after concrete has been poured and obtained 75% of its design strength. See Section **033000**, "Cast-In-Place Concrete", **032000**, "Concrete Reinforcing", for reinforcing in the slab around all unframed openings in steel deck that are greater than 10" width in either direction.
- F. Extra Concrete Required for Deck Deflection
1. The General Contractor shall include in his bid additional concrete required for steel deck slabs to account for deck deflection.

## 2.4 CONCRETE SLAB REINFORCEMENT

- A. See drawings for reinforcement in composite and non-composite concrete slabs. See Section **033000**, "Cast-in-Place Concrete", for minimum reinforcement requirements.

## 2.5 CHLORIDE ADMIXTURES

- A. The use of admixtures in concrete containing chloride salts shall not be permitted for steel deck concrete.

## 2.6 ROOF OPENINGS

- A. Provide a 20 gage galvanized flat plate to reinforce openings in roof deck that are greater than 6" and less than 10" in any one direction.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install deck units as accessories in accordance with manufacturers recommendations and approved shop drawings, and as specified herein:
1. Place deck units on supporting framework and adjust to final position with ends accurately aligned and minimum bearing on supporting members indicated below before being permanently fastened. Do not stretch or contract side lap interlocks. Place the end joint over a chord angle for deck bearing on steel joists.
  2. Place deck units in straight alignment for entire length of run of cells and with close alignment between cells at ends of abutting units.
  3. Place deck units flat and square, secured to adjacent framing without warp or excessive deflection.
  4. Do not place deck units on concrete supporting structure until concrete has cured and is dry.
  5. Do not use floor or roof deck units for storage or working platforms until permanently secured.
  6. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.
  7. The Contractor is responsible for temporary deck fastening to meet OSHA requirements to use the floor deck unit as a storage or working platform before final attachment is installed.
- B. Deck Attachments: The deck shall be fastened to the structural support members using one of the following methods:
1. Powder-Actuated Driven Pins:
    - a. An operator licensed by the manufacturer shall install all pins.
    - b. Comply with the manufacturer's requirements to install the pins through all layers of the deck material and the manufacturer's required embedment into the supporting member.
  2. Welding: Welds shall be puddle welds with diameters as indicated below. Where two deck units abut each other, each unit shall be so welded. Puddle welds may be replaced with welded shear connectors when applicable.
    - a. All welding shall be performed by AWS qualified welders unless otherwise approved by the building official.
    - b. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.
    - c. Weld metal shall penetrate all layers of deck material at end laps and side joints and shall have good fusion to the supporting member.
    - d. Welding washers shall be used only when welding steel deck less than 0.028" thickness. Welding washers shall be a minimum thickness of 0.0568 inches and have a nominal 3/8" diameter hole.
  3. Self-Drilling Fasteners: Comply with the manufacturer's requirements to install the screws through all layers of the deck material and the manufacturer's required embedment into the supporting member.
  4. Attachment of Composite Deck:
    - a. Powder-Actuated Driven Pins: Refer to the drawings for type of pin used and number and spacing of attachments.

- b. Welding: Steel deck units shall be welded to the structural support members with 5/8" diameter puddle welds at each end of sheet and each intermediate support at each low flute, unless more frequent attachment is specified on the drawings.
    - 1) Welding Washers: Welding washers shall be used when welding steel deck units less than 0.028" thickness.
  - c. Self-Drilling Fasteners may not be used for attachment of composite deck.
  - d. Attachment to Girders: Steel deck units shall be attached to girders (steel framing that is parallel to span of deck) using one of the specified fastening methods at a spacing of 12" center to center.
  - e. Side Laps: Unless noted otherwise on the drawings, side laps of adjacent units shall be fastened by welding (1-1/2 inch long), sheet metal screws (No. 10 or larger) or button punching at maximum intervals not exceeding the lesser of half of the span or 36".
  - f. Welding of Composite Deck used on Roof: In addition to the minimum attachment specified above, typical areas of the roof deck shall be welded to resist the net uplift pressures as specified in the General Notes on the drawings
  - g. Minimum Bearing: Provide a minimum deck bearing of 1 1/2" over all supports with butted end joints.
5. Attachment of Roof Deck:
- a. The method of attachment, attachment pattern, and side lap fastener type and spacing, shall be as shown on the drawings and comply with the requirements noted below.
  - b. Powder-Actuated or Pneumatically Driven Pins.
  - c. Welding: Use 5/8" diameter puddle welds.
  - d. Self-Drilling Fasteners.
  - e. Side Lap Fastening: Unless required otherwise by this specification, side laps of adjacent units shall be fastened by welding (on 20 gauge or heavier deck only) or #10 (minimum) TEK screws so that spacing between supports and fasteners does not exceed the value prescribed on the drawings. Nest side laps one-half corrugation for form deck. Button punching is not allowable as a side-lap fastener.
  - f. End Bearing: Provide a minimum end bearing of 2" over supports.
  - g. End Joints: End joints of sheets shall be lapped 2" minimum over supports unless a more stringent requirement is specified by Factory Mutual or Underwriters Laboratory. Decks that slope 1/4 inch or more in 12 inches in the long direction shall be erected beginning at the low side to insure that end laps are shingle fashion.
  - h. Underwriters Laboratories Wind Uplift Classification Requirements: Unless a more stringent attachment requirement is specified elsewhere in this specification or on the drawings, roof deck units shall be attached to the supporting structure as required by the Construction Number specified elsewhere in this section.
  - i. Attachment to Girders: At locations noted in the drawings, attach the deck to steel members that are parallel to the deck flutes in accordance with the requirements noted in the drawings.
  - j. Definition of Perimeter and Corner
    - 1) Definition of Roof Height: Roof height shall be defined as eave height for roofs that slope less than 10% and mean roof height for roofs with a greater slope.
    - 2) Buildings with roof heights greater than 60 feet
      - a) Perimeter: The width of the perimeter strip shall be one-tenth the least dimension of the building but not less than four feet.
      - b) Corner: On an exterior (not re-entrant) corner, a strip the width of a perimeter strip defined above and extending for a length equal to the dimension of two perimeter strips each direction from the exterior corner.

- k. Underwriters Laboratories Wind Uplift Classification Requirements: Unless a more stringent attachment requirement is specified elsewhere in this specification or on the drawings, roof deck units shall be attached to the supporting structure as required by Construction Number specified elsewhere in this section.
  - l. Attachment to Girders: At locations where the deck flutes are parallel to the span of the steel framing and the top of the framing is at the bottom of the deck elevation, the deck shall be attached to the girder using one of the specified fastening methods at 18 inches on center.
- C. Welding Requirements: Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Cutting and Fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking.
- E. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking, and support of other work.
- 1. Roof Openings: Roof openings less than 6" square or diameter require no reinforcement. Opening 6" to 10" inclusive shall be reinforced with a 20 gauge galvanized plate welded to the deck at each corner and 6" maximum centers with a 5/8" diameter puddle weld or sheet metal screws. For openings greater than 10" in diameter or width, refer to the drawings and structural steel specifications for additional framing to support the deck around the opening.
- F. Hanger Slab or Clips: Provide UL approved punched hanger slots between cells or flutes of lower element where floor deck units are to receive hangers for support of ceiling construction, air ducts, diffusers or lighting fixtures.
- 1. Hanger clips designed to clip over male side lap joints of floor deck units may be used instead of hanger slots.
  - 2. Locate slots or clips at not more than 14" o.c. in both directions, not over 9" from walls at ends, and not more than 12" from walls at sides, unless otherwise shown.
  - 3. Provide manufacturer's standard hanger attachment devices.
  - 4. Loads hanging from steel deck slabs shall not exceed 100 pounds unless specifically detailed otherwise on the drawings.
- G. Joint Covers and Cell Closures: Weld steel sheet joint covers at abutting ends and at changes in direction of deck units, except where taped joints are specified. Weld steel sheet column closures, cell closures and Z-closures to deck with 1" long weld at 12" maximum centers to provide tight-fitting closures at open ends of ribs, unless shown otherwise on the drawings.
- H. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated. Provide minimum 2" bearing over steel support.
- I. Roof Sump Pans and Sump Plates: Install over openings provided in roof decking and weld flanges to top of deck. Space welds not more than 12 inches apart with at least 1 weld in each corner.
- J. Miscellaneous Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

### 3.2 TOUCH-UP PAINTING

- A. After deck installation, wire brush, clean and paint scarred areas, welds and rust spots on top and bottom surfaces of decking units and supporting steel members.

- B. Touch-up galvanized surfaces with galvanizing repair paint applied in accordance with manufacturer's instructions.
- C. In areas where shop-painted surfaces are to be exposed, apply touch-up paint to blend into adjacent surfaces.

**3.3 FIELD QUALITY CONTROL**

- A. Field Testing and Inspection: Refer to Specification 014529 "Structural Testing and Inspections" for testing and inspection requirements associated with steel decking.

END OF SECTION



THIS IS INTENTIONALLY LEFT BLANK

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 05 40 00 - COLD-FORMED METAL FRAMING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Exterior non-load-bearing wall framing.
  - 2. Interior non-load-bearing wall framing.
  - 3. Ceiling joist framing.
  - 4. Soffit framing.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
  - 2. Section 09 21 16.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies, with height limitations.
  - 3. Section 09 22 16 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
- B. Meet with Owner, Architect, testing and inspecting agency representative, metal framing Installer, Metal Framing Engineer, exterior sheathing Installer, and installers whose work interfaces with or affects cold-formed metal framing.
- C. Review methods and procedures related to cold-formed metal framing installation, including those contained in metal framing engineer's delegated design submittal.
- D. Review design loads imposed on building structure.
  - 1. Review and clearly identify locations of interior and corner wind load zones of building façade.
  - 2. Review design wind speeds and resulting positive and negative loads imposed on metal framing and exterior sheathing at interior zones and corner zones of building façade.
  - 3. Review securement of system components required to withstand design wind loads, including the following:
    - a. Attachment of bottom track to floor structure, and type and spacing of fasteners.
    - b. Attachment of top track to overhead structure, and type and spacing of fasteners.
    - c. Attachment of studs to top and bottom tracks.
    - d. Attachment of vertical deflection clips to overhead structure.
    - e. Attachment of studs to vertical deflection clips.
    - f. Review required minimum edge clearance from edge of slab, and size, spacing, and required penetration of fasteners.
- E. Review size and location of exterior wall framing mockup.
- F. Review requirements and understanding of Field Quality Control article.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of cold-formed steel framing product and accessory.

- B. Shop Drawings:
  - 1. Provide Shop Drawings prepared by cold-formed steel framing manufacturer.
    - a. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
    - b. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- C. Delegated Design Submittal: For cold-formed steel framing indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Product Certificates: For each type of code-compliance certification for studs and tracks.
- D. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
  - 1. Steel sheet.
  - 2. Expansion anchors.
  - 3. Power-actuated anchors.
  - 4. Mechanical fasteners.
  - 5. Vertical deflection clips.
  - 6. Miscellaneous structural clips and accessories.
- E. Research Reports:
  - 1. For nonstandard cold-formed steel framing from ICC-ES, or other qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Steel framing manufacturer to have a third-party evaluation report for its products that are reviewed to the local building code or its model code (IBC **2021** and AISI S100).
  - 3. For sill sealer gasket/termite barrier, showing compliance with ICC-ES AC380.
- F. Field Quality Control:
  - 1. Photographic documentation of approved exterior wall framing mockup, in digital form. Include pan and close-up photos of the following:
    - a. Attachment of bottom track to floor structure.
    - b. Attachment of top track to overhead structure.
    - c. Attachment of studs to bottom track and top track/clips.
    - d. Attachment of vertical deflection clips to overhead structure.
    - e. Attachment of studs to vertical deflection clips.
    - f. Attachment of sheathing to studs.
  - 2. Pre-Inspection Notification: Submit written report that work has been reviewed for compliance by Contractor, Installer, and Metal Framing Engineer, and is ready for inspection by Testing Agency.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Member in good standing of the Steel Framing Industry Association (SFIA).
  - 1. Products to be certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 IAS Accreditation Criteria for Inspection Agencies.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the state where Project is located and who is experienced in providing engineering

services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed steel framing that are similar to those indicated for this Project in material, design, and extent.

- C. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- D. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- E. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified in accordance with the product-certification program of the Steel Framing Industry Association (SFIA).
- F. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- G. Comply with the following AISI specifications and standards:
  - 1. AISI S240, "North American Standard for Cold-Formed Steel Structural Framing."
- H. Mockups: Build mockups to verify quality standards for materials and execution, and to demonstrate compliance with structural performance criteria and delegated design submittals.
  - 1. Unless otherwise requested by Owner or Architect, build mockup of typical exterior non-load-bearing wall, one structural bay wide by one story high, at an outside corner.
  - 2. Include studs, top track, bottom track, sealer gasket, deflection clips and bridging.
  - 3. Cover approximately 25 percent of wall framing with specified sheathing. Include sheathing at outside corner.
  - 4. Mockup shall be reviewed by Metal Framing Engineer.
  - 5. Mockup will be inspected by testing and inspection agency.
  - 6. Provide photographic documentation of approved mockup.
  - 7. Subject to compliance with requirements, approved mockup may become part of the completed Work.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or a comparable product approved by Architect:
  - 1. AllSteel & Gypsum Products, Inc.
  - 2. CEMCO; California Expanded Metal Products Company.
  - 3. ClarkDietrich Building Systems, Inc.
  - 4. Consolidated Fabricators Corp.; Building Products Division.
  - 5. MarinoWARE.
  - 6. MBA Metal Framing.
  - 7. SCAFCO Corporation.
  - 8. Steel Network, Inc. (The).
  - 9. Steeler, Inc.
  - 10. Telling Industries, LLC.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer (Metal Framing Engineer), as defined in Section 01 40 00 "Quality Requirements," to design cold-formed steel framing, including fasteners and connections to building structure.
- B. Structural Performance: Provide cold-formed steel framing and connections capable of withstanding design loads within limits and under conditions indicated.
  - 1. Design Loads: As indicated on Structural Drawings.
  - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
    - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height.
    - b. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 20 lbf/sq. ft.
    - c. Ceiling Joist Framing: Vertical deflection of 1/240 of the span for live loads and 1/240 for total loads of the span.
  - 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
  - 4. Wind Design: Refer to the Structural Drawings.
  - 5. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
    - a. Upward and downward movement of 3/4 inch or as indicated on Structural Drawings.
  - 6. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Standards:
  - 1. AISI S240.
- D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S240.

### 2.3 COLD-FORMED STEEL FRAMING MATERIALS

- A. Framing Members, General: Comply with AISI 240 for conditions indicated.
- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
  - 1. Grade: As required by structural performance.
  - 2. Coating: G60 or G90 when exposed to moisture.
- C. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
  - 1. Grade: As required by structural performance.
  - 2. Coating: G60 or G90 when exposed to moisture.

### 2.4 EXTERIOR AND INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Steel Thickness: 0.0329 inch.
  - 2. Flange Width: 1-5/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Steel Thickness: Matching steel studs.
  2. Flange Width: 1-3/8 inches.
- C. Vertical Deflection Clips, Exterior: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch.
  2. Flange Width: As noted on Structural Drawings or 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
    - a. Minimum Base-Metal Thickness: 0.0428 inch.
    - b. Flange Width: As noted on Structural Drawings or 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
  2. Inner Track: Of web depth indicated, and as follows:
    - a. Minimum Base-Metal Thickness: 0.0428 inch
    - b. Flange Width: Outer deflection track flange width plus 1 inch.

## 2.5 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch.
  2. Flange Width: 1-5/8 inches, minimum.

## 2.6 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch. Flange Width: 1-5/8 inches, minimum.
  2. Flange Width: , minimum.

## 2.7 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Supplementary framing.
  2. Bracing, bridging, and solid blocking.
  3. Web stiffeners.
  4. Anchor clips.
  5. End clips.
  6. Foundation clips.
  7. Gusset plates.
  8. Stud kickers and knee braces.
  9. Joist hangers and end closures.
  10. Hole-reinforcing plates.

11. Backer plates.

## 2.8 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade 36 threaded carbon-steel hex-headed bolts, and carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- D. Power-Actuated Anchors: Fastener systems of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES A70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by qualified testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
  1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

## 2.9 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20, Type II-Organic, and the following:
  1. Zinc Content: 95 percent, minimum.
  2. Solids: 52 percent by volume, minimum.
  3. Dry film thickness not less than 1.5 mils per coat.
  4. Color: Flat grey finish matching original hot-dipped galvanizing.
  5. Available Product: ZRC Cold Galvanizing Compound; ZRC Worldwide.
- B. Cement Grout: Portland cement, ASTM C 150/C 150M, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout, containing selected silica sands, Portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, and with a fluid consistency and 30-minute working time.
- D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- E. Sealer Gasket: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

## 2.10 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
  1. Fabricate framing assemblies using jigs or templates.
  2. Cut framing members by sawing or shearing; do not torch cut.



3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
  4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
  2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.
- C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.
- E. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

#### **3.3 INSTALLATION, GENERAL**

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and manufacturer's written instructions unless more stringent requirements are indicated.

- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
  - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 07 21 00 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
  - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### **3.4 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING**

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
  - 1. Stud Spacing: 16 inches unless otherwise indicated.
  - 2. Decrease spacing between studs (or increase minimum base-metal thickness) where required to ensure cold-formed metal framing system installation will withstand positive and negative wind pressures imposed by design wind speeds, as indicated in Shop Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  - 1. Install single deep-leg deflection tracks and anchor to building structure.

2. Connect vertical deflection clips to bypassing or infill studs and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
  1. Install solid blocking at centers indicated.
  2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### **3.5 INSTALLATION OF INTERIOR NONLOADBEARING WALL FRAMING**

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
  1. Stud Spacing: 16 inches.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  1. Install single deep-leg deflection tracks and anchor to building structure.
  2. Connect vertical deflection clips to studs and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
  1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
  2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
  3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
  1. Install solid blocking at centers indicated.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### **3.6 INSTALLATION OF JOIST FRAMING**

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
  2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.
- C. Space joists not more than 2 inches from abutting walls, and as follows:
1. Joist Spacing: As indicated on Drawings.
- D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.
1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
  2. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

### 3.7 INSTALLATION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.8 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

### 3.9 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Submit written report that work has been reviewed for compliance by Contractor, Installer, and Metal Framing Engineer, and is ready for inspection by Testing Agency.
- D. Testing agency will report test results promptly and in writing to Contractor and Architect, and Metal Framing Engineer.

- E. Inspection Frequency:
1. Owner and Architect will select approximately 20 random locations, roughly 12 to 15 feet wide by one story high, to be inspected by Testing Agency. Testing Agency will inspect the following at each location:
    - a. Top and Bottom Track:
      - 1) Each lineal foot of bottom track to structure.
      - 2) Each lineal foot of outer track (of double deflection track) to structure.
    - b. Studs:
      - 1) Attachment of each stud to bottom track.
      - 2) Attachment of each stud to inner track of double deflection track.
      - 3) Attachment of each vertical deflection clip to structure.
      - 4) Attachment of each stud to vertical deflection clip.
  2. If inspections reveal repeat deficiencies or a pattern of noncompliance with requirements, as determined by the Owner, Architect, and Testing Agency, work of this Section for the entire balance of the project will be inspected by the Testing Agency at the Contractor's expense.
- F. Remove and replace work where inspections indicate that it does not comply with specified requirements. Do not cover or conceal corrected work until it has been reinspected for compliance with requirements.
- G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### **3.10 PROTECTION**

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 05 45 00 – METAL SUPPORT ASSEMBLIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Light Grid of Aluminum tube.
- B. Related Requirements:

**1.2 COORDINATION**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Manufacturer's product lines of mechanically connected railings.
  - 2. Railing brackets.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
  - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
  - 2. Fittings and brackets.
- D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- C. Evaluation Reports: For post-installed anchors, from ICC-ES.

**1.5 QUALITY ASSURANCE****1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

**1.7 FIELD CONDITIONS**

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

**PART 2 - PRODUCTS****2.1 LIGHT GRID MANUFACTURERS**

- A. Aluminum Pipe and Tube Railings:
  - 1. Basis of Design supplier: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. <http://www.stagelightingstore.com/>
    - b. Approved Equal.
- B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Uniform load of 50 lbf/ ft. applied in any direction.
  - 2. Concentrated load of 200 lbf applied in any direction.
  - 3. Uniform and concentrated loads need not be assumed to act concurrently.

**2.3 METALS, GENERAL**

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
  - 1. Provide type of bracket with predrilled hole for exposed bolt anchorage.

**2.4 ALUMINUM**

- A. Extruded Straight Tubing: 6061-T6 Aluminum alloy, minimum yield strength of 35,000 pounds, minimum ultimate tensile strength of 38,000 pounds per square inch. Basis of Design:
  - 1. Clear anodized aluminum tubing: Light Source 6061-PI-1.5-S40-240
  - 2. Black anodized aluminum tubing: Light Source 6061-PI-1.5-S40-240B
- B. Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- C. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.
- D. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

**2.5 TUBE FASTENERS**

- A. General: Provide the following:
  - 1. Aluminum Railings: Aluminum or Type 304 stainless-steel fasteners.
  - 2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.



- B. Basis of Design Cast Aluminum Fittings for aluminum tube or steel pipe:
1. Key Safety Klamp
  2. Hollaender Speed Rail
- |                      |                             |                       |                     |
|----------------------|-----------------------------|-----------------------|---------------------|
| <u>Tube to wall</u>  | <u>Tube to tube bracket</u> | <u>Tube crossover</u> | <u>Tube corner</u>  |
| Keel Safety - LC58-8 | Keel Safety - L25-8:        | Keel Safety - L45-8   | Keel Safety - L15-8 |
| Hollaender #41 adj   | Hollaender #5sr Tee         | Hollaender #30A       | Hollaender #3 elbow |
- C. Basis of Design fittings for mill finish aluminum tube:
- |                          |                             |                               |
|--------------------------|-----------------------------|-------------------------------|
| <u>tube to structure</u> | <u>tube to tube bracket</u> | <u>tube to suspension bar</u> |
| Light Source WM1.5PM:    | Light Source MGM:           | Light Source MBATM:           |
- D. Basis of Design fittings for black anodized aluminum tube:
- |                          |                             |                               |
|--------------------------|-----------------------------|-------------------------------|
| <u>tube to structure</u> | <u>tube to tube bracket</u> | <u>tube to suspension bar</u> |
| Light Source WM1.5PB:    | Light Source MGB:           | Light Source MBATB:           |
- E. Splices are allowed only in lengths exceeding 20 feet using prefabricated fittings:
1. Basis of Design Tube Splice, Color to match tube:
 

Light Source MQSM80	Light Source MQSB80
---------------------	---------------------
- F. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
  2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

## 2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Bending 6061-T6 Aluminum alloy is not allowed.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- F. Connections: Fabricate railings with prefabricated bracket connections unless otherwise indicated.
- G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

## 2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41.
- B. Black Color Anodic Finish: AAMA 611, AA-M12C22A42/A44.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### **3.2 INSTALLATION, GENERAL**

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
  - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### **3.3 RAILING CONNECTIONS**

- A. Nonwelded Connections: Use prefabricated mechanical joints for permanently connecting railing components.

### **3.4 ATTACHING RAILINGS**

- A. Where indicated, anchor rail with flanges anchored to wall or structural steel and connected to railing ends using nonwelded connections.

### **3.5 ADJUSTING AND CLEANING**

- A. Clean aluminum or stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Immediately after erection clean bolted connections and abraded areas and paint exposed areas with the compatible material.
  - 1. Apply by spray to provide a minimum 2.0-mil dry film thickness.

### **3.6 PROTECTION**

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

**SECTION 05 50 00 - METAL FABRICATIONS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes the following and as indicated in the Drawings:
1. Steel framing and supports for overhead doors.
  2. Steel framing and supports for countertops.
  3. Steel tube reinforcement for low partitions.
  4. Steel framing and supports for mechanical and electrical equipment.
  5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  6. Miscellaneous framing and supports.
  7. Elevator machine beams and hoist beams.
  8. Steel shapes for supporting elevator door sills.
  9. Permanent ladders for elevator pits.
  10. Permanent ladders for access to roof areas.
  11. Miscellaneous loose steel lintels.
  12. Shelf angles.
  13. Metal ladders.
  14. Ladder safety system.
  15. Metal ships' ladders and pipe crossovers.
  16. Elevator pit sump covers.
  17. Miscellaneous steel trim.
  18. Pipe bollards – steel, concrete filled, painted.
  19. Loose bearing and leveling plates for applications where they are not specified in other Sections .
- B. Products furnished, but not installed, under this Section include the following:
1. Loose steel lintels.
  2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
  3. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
- C. Related Requirements:
1. Section 03 30 00 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, inserts, and other items cast into concrete.
  2. Section 04 20 00 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
  3. Section 05 12 00 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.

**1.2 COORDINATION**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

**1.3 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
  - 2. Paint products.
  - 3. Grout.
  - 4. Manufactured metal ladders.
  - 5. Metal ships' ladders and pipe crossovers.
  - 6. Metal bollards.
  - 7. Metal downspout boots.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
  - 1. Miscellaneous/Steel framing and supports for applications where framing and supports are not specified in other Sections.
  - 2. Elevator machine beams, hoist beams, and divider beams.
  - 3. Steel tube reinforcement for low partitions.
  - 4. Steel framing and supports for mechanical and electrical equipment.
  - 5. Steel shapes for supporting elevator door sills.
  - 6. Permanent ladders for elevator pits.
  - 7. Permanent ladders for access to roof areas.
  - 8. Ladder safety system.
  - 9. Shelf angles.
  - 10. Metal ladders.
  - 11. Metal ships' ladders and pipe crossovers.
  - 12. Elevator pit sump covers.
  - 13. Miscellaneous steel trim including steel angle corner guards and steel edgings.
  - 14. Miscellaneous loose steel lintels.
  - 15. Metal bollards.
  - 16. Pipe bollards – steel, concrete filled, painted.
  - 17. Other miscellaneous metal fabrications.
- C. Delegated Design Submittals: For the items listed under the Performance Requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.
- E. Delegated design engineer qualifications.

**1.5 QUALITY ASSURANCE**

- A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the state where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed steel framing that are similar to those indicated for this Project in material, design, and extent.

- B. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

## 1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design.
1. Steel framing and supports for overhead doors.
  2. Steel framing and supports for countertops.
  3. Steel tube reinforcement for low partitions.
  4. Steel framing and supports for mechanical and electrical equipment.
  5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  6. Elevator machine beams and hoist beams.
  7. Steel shapes for supporting elevator door sills.
  8. Permanent ladders for elevator pits.
  9. Permanent ladders for access to roof areas.
  10. Ladder safety system.
  11. Elevator pit sump covers.
  12. Miscellaneous steel trim including steel angle corner guards and steel edgings.
  13. Metal bollards.
  14. Pipe bollards – steel, concrete filled, painted.
  15. Miscellaneous loose steel lintels.
  16. Miscellaneous metal edgings.
  17. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  18. Other miscellaneous metal fabrications.
  19. Loose bearing and leveling plates for applications where they are not specified in other Sections.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections and other detrimental effect.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A283/A283M, Grade C or D.
- D. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

- E. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- F. Aluminum Plate and Sheet: ASTM B209, Alloy 6061-T6.
- G. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
- H. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
- I. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

### 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 or Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941/F 1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1 or Group 2.
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
  - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E 488/E 488M, conducted by a qualified independent testing agency.
- F. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329/F 2329M.
- G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941/F 1941M, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 or Group 2 stainless steel bolts, ASTM F 593, and nuts, ASTM F 594.
- H. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

### 2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting." and Section 09 91 23 "Interior Painting."
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20, Type II-Organic and compatible with paints specified to be used over it.
- C. Galvanizing Repair Paint for Unpainted Fabrications: High-zinc-dust-content paint complying with SSPC-Paint 20, Type II-Organic, and the following:
  - 1. Zinc Content: 95 percent, minimum.
  - 2. Solids: 52 percent by volume, minimum.

3. Dry film thickness not less than 1.5 mils per coat.
  4. Color: Flat grey finish matching original hot-dipped galvanizing.
  5. Available Product: ZRC Cold Galvanizing Compound; ZRC Worldwide
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Concrete: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

## 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
  - 1. Fabricate units from slotted channel framing where indicated.
  - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
  - 1. Provide bearing plates welded to beams where indicated.
  - 2. Drill or punch girders and plates for field-bolted connections where indicated.
  - 3. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches o.c.
- D. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.
  - 1. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
  - 2. Unless otherwise indicated, provide 1/2-inch baseplates with four 5/8-inch anchor bolts and 1/4-inch top plates.
- E. Galvanize miscellaneous framing and supports where indicated.

## 2.7 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
  - 1. Provide mitered and welded units at corners.
  - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize shelf angles.
- D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

## 2.8 METAL LADDERS

- A. General:
  - 1. Comply with ANSI A 14.3, except for elevator pit ladders.
  - 2. For elevator pit ladders, comply with ASME A 17.1/CSA B44.
- B. Steel Ladders:
  - 1. Space siderails 16 inches apart unless otherwise indicated.
  - 2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
  - 3. Rungs: 3/4-inch-diameter, steel bars.
  - 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
  - 5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
  - 6. Nonslip Surfaces for Steel Ladders: Provide nonslip surfaces on top of each rung by coating with abrasive material metallurgically bonded to rung.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Harsco Industrial IKG, a division of Harsco Corporation; Mebac.



- 2) SlipNOT Metal Safety Flooring, a division of W. S. Molnar Company; SlipNOT.
- 7. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch in least dimension.
- 8. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
- 9. Galvanize ladders, including brackets.
- C. Provide metal pipe crossovers where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.
  - 1. Treads are not to be less than 5 inches exclusive of nosing or less than 8-1/2 inches including the nosing, and riser height is not to be more than 9-1/2 inches.
  - 2. Fabricate pipe crossovers, **including railings from steel.**
  - 3. Fabricate treads and platforms from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 1/2 inch in least dimension.
  - 4. Comply with applicable railing requirements in Section 05 52 13 "Pipe and Tube Railings."
- D. Galvanize exterior steel pipe crossovers, including treads, railings, brackets, and fasteners.

## 2.9 LADDER SAFETY SYSTEM

- A. Ladder Safety System: Two-user, galvanized steel vertical system (vertical lifeline) comply with ANSI Z359.16 standard, along with OSHA 1910.130 and 1926.502 with top and bottom brackets and 20 ft. galvanized steel cable.
  - 1. Basis of Design: 3M DBI SALA, Lad-Saf Cable Vertical Safety, Two-user System or comparable product approved by the Architect.

## 2.10 ELEVATOR PIT SUMP COVERS

- A. Fabricate from 3/16-inch rolled-steel floor plate with four 1-inch-diameter holes for water drainage and for lifting.
- B. Provide steel angle supports unless otherwise indicated.

## 2.11 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
  - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize miscellaneous steel trim.

## 2.12 METAL BOLLARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or a comparable product approved by Architect:
  - 1. Gibraltar Perimeter Security.
- B. Fabricate metal bollards from Schedule 40 steel pipe.
- C. Galvanize bollards.

- D. Concrete fill or provide cap. As indicated.

### **2.13 METAL DOWNSPOUT BOOTS**

- A. Source Limitations: Obtain downspout boots from single source from single manufacturer.
- B. Provide downspout boots made from cast [iron] [aluminum] in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
  - 1. Outlet: Vertical, to discharge into pipe.
- C. Prime cast-iron downspout boots with primer specified in Section 09 96 00 "High-Performance Coatings."

### **2.14 LOOSE BEARING AND LEVELING PLATES**

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.

### **2.15 LOOSE STEEL LINTELS**

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches unless otherwise indicated.
- C. Galvanize loose steel lintels.

### **2.16 STEEL WELD PLATES AND ANGLES**

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

### **2.17 GENERAL FINISH REQUIREMENTS**

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

### **2.18 STEEL AND IRON FINISHES**

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items indicated to be painted unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting".
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
1. Cast Aluminum: Heavy coat of bituminous paint.
  2. Extruded Aluminum: Two coats of clear lacquer.

#### **3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS**

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for overhead doors and overhead grilles securely to, and rigidly brace from, building structure.
- C. Anchor shelf angles securely to existing construction with [expansion anchors], [anchor bolts], or [through bolts].
- D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

**3.3 INSTALLATION OF SHELF ANGLES**

- A. Install shelf angles as required to keep masonry level, at correct elevation, and flush with vertical plane.

**3.4 INSTALLATION OF METAL LADDERS**

- A. Secure ladders to adjacent construction with the clip angles attached to the stringer.
- B. Install brackets as required for securing of ladders welded or bolted to structural steel or built into masonry or concrete.

**3.5 INSTALLATION OF METAL SHIPS' LADDERS AND PIPE CROSSOVERS**

- A. Secure top and bottom of ships' ladders to construction to comply with manufacturer's written instructions.
- B. Secure pipe crossovers to construction to comply with manufacturer's written instructions.

**3.6 INSTALLATION OF ELEVATOR PIT SUMP COVERS**

- A. Install tops of elevator sump pit cover plates and frames flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.

**3.7 INSTALLATION OF MISCELLANEOUS STEEL TRIM**

- A. Anchor to concrete construction to comply with manufacturer's written instructions.

**3.8 INSTALLATION OF METAL BOLLARDS**

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
  - 1. Do not fill removable bollards with concrete.
- B. Anchor bollards to existing construction with expansion anchors. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.
  - 1. Embed anchor bolts at least 4 inches in concrete.
- C. Anchor bollards in concrete in formed or core-drilled holes not less than 42 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- D. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- E. Anchor internal sleeves for removable bollards in concrete by inserting in pipe sleeves preset into concrete. Fill annular space around internal sleeves solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward internal sleeve.
- F. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.
- G. Place removable bollards over internal sleeves and secure with 3/4-inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.

- H. Fill bollards solidly with concrete, mounding top surface to shed water.
  - 1. Do not fill removable bollards with concrete.

### **3.9 INSTALLATION OF METAL DOWNSPOUT BOOTS**

- A. Anchor metal downspout boots to concrete or masonry construction to comply with manufacturer's written instructions.
- B. Secure downspouts terminations to downspouts and substrate per manufacturer's instructions.

### **3.10 INSTALLATION OF BEARING AND LEVELING PLATES**

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### **3.11 REPAIRS**

- A. Touchup Painting:
  - 1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting." and Section 09 91 23 "Interior Painting."
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780, and galvanizing repair paint manufacturer's written instructions.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 05 51 13 - METAL PAN STAIRS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Preassembled steel stairs with concrete-filled treads.
  - 2. Steel tube railings attached to metal stairs.
  - 3. Steel tube handrails attached to walls adjacent to metal stairs.
  - 4. Railing gates at the level of exit discharge.
- B. Related Requirements:
  - 1. Sustainability Requirements: Comply with additional requirements indicated in Division 01 for Construction Waste Management and Disposal requirements; Sustainable Design requirements; Indoor Air Quality requirements; Sustainable Design Submittals; and Performance Requirements for LEEDv4 BD+C.
  - 2. Section 03 30 00 "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
  - 3. Section 05 52 13 "Pipe and Tube Railings" for pipe and tube railings.

**1.2 COORDINATION**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs.
  - 1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
  - 2. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For metal pan stairs and the following:
  - 1. Prefilled metal-pan-stair treads.
  - 2. Abrasive nosings.
  - 3. Shop primer products.
  - 4. Nonslip-aggregate concrete finish.
  - 5. Handrail wall brackets.
  - 6. Grout.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Verification: For each type and finish of nosing and tread.
- D. Delegated Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which Project is located.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Fabricator of products.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store materials to permit easy access for inspection and identification.
  - 1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
  - 2. Protect steel members and packaged materials from corrosion and deterioration.
  - 3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
    - a. Repair or replace damaged materials or structures as directed.

**PART 2 - PRODUCTS****2.1 MANUFACTURES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Stair, Inc.
  - 2. Lapeyre Stair Inc.
  - 3. Pacific Stair Corporation.
  - 4. Duvinage (Sharon Stairs).
- B. Other fabricators as may be approved by the Architect prior to Bid. Fabricators shall have 10-year demonstrable history of successfully completing projects of similar size, scope, and stair types as required by this Project.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design stairs and railings.
- B. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Uniform Load: 100 lbf/sq. ft..
  - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
  - 3. Uniform and concentrated loads need not be assumed to act concurrently.
  - 4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
  - 5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.



- C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
    - b. Infill load and other loads need not be assumed to act concurrently.
- D. Seismic Performance of Stairs: Metal stairs withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. Component Importance Factor: 1.0.

### 2.3 METALS

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A 36M.
- C. Steel Tubing: ASTM A 500/A 500M (cold formed).
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 coating, either commercial steel, Type B, or structural steel, Grade 33, unless another grade is required by design loads.
- E. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

### 2.4 ABRASIVE NOSINGS

- A. Extruded Units: Aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Safety Tread Co., Inc.
    - b. Amstep Products.
    - c. Armstrong Products, Inc.
    - d. Balco, Inc.
    - e. Nystrom, Inc.
    - f. Wooster Products, Inc.
  - 2. Provide solid-abrasive units without ribs.
  - 3. Nosings, Square-Back Units: 1-7/8 inches wide, without lip.
- B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- C. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

### 2.5 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941/F 1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls.
  - 1. Select fasteners for type, grade, and class required.

- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
  - 1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts.
- D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
  - 1. Material: Alloy Group 1 or Group 2 stainless steel bolts, ASTM F 593, and nuts, ASTM F 594.

## 2.6 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 Type II-Organic, and the following:
  - 1. Zinc Content: 95 percent, minimum.
  - 2. Solids: 52 percent by volume, minimum.
  - 3. Dry film thickness not less than 1.5 mils per coat.
  - 4. Color: Flat grey finish matching original hot-dipped galvanizing.
  - 5. Available Product: ZRC Cold Galvanizing Compound; ZRC Worldwide.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- D. Prefilled Concrete Treads:
  - 1. Concrete Materials and Properties: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
- E. Galvanized, Welded Wire Reinforcement: 2 by 2 inches by 0.062-inch-diameter wire; comply with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size
- F. Geotextile: Woven geotextile fabric made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
  - 1. Survivability: Class 2; AASHTO M 288.
  - 2. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
  - 3. Permittivity: 0.02 per second, minimum; ASTM D 4491.

## 2.7 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
  - 1. Join components by welding unless otherwise indicated.
  - 2. Use connections that maintain structural value of joined pieces.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible.
  - 1. Disassemble units only as necessary for shipping and handling limitations.
  - 2. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately.
  - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.

2. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Weld exposed corners and seams continuously unless otherwise indicated.
  5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: Finish # 3 - Partially dressed weld with spatter removed.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
  1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
  2. Locate joints where least conspicuous.
  3. Fabricate stairs exposed to weather in a manner to exclude water.
  4. Provide weep holes where water may accumulate.

## 2.8 STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for Commercial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
  1. Stringers: Fabricate of steel plates or steel channels.
    - a. Provide closures for exposed ends of channel stringers.
  2. Platforms: Construct of steel channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
  3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.
  1. Galvanized Steel Sheet: Galvanized steel sheet.
  2. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
  3. Provide 1/8-inch diameter weep holes at quarter points in center of long dimension of each subtread.
  4. Shape metal pans to include nosing integral with riser.
  5. Attach abrasive nosings to risers.
  6. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Attach subplatforms to platform framing with brackets made of steel angles or bars.
    - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

**2.9 STAIR RAILINGS**

- A. Comply with applicable requirements in Section 05 52 13 "Pipe and Tube Railings."
  - 1. Connect posts to stair framing by direct welding unless otherwise indicated.
- B. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.
  - 1. Rails and Posts: As indicated.
  - 2. Intermediate Rails Infill: Intermediate rails spaced as indicated.
- C. Welded Connections: Fabricate railings with welded connections.
  - 1. Cope components at connections to provide close fit, or use fittings designed for this purpose.
  - 2. Weld all around at connections, including at fittings unless noted otherwise.
  - 3. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: Finish #2 - Completely sanded joint, some undercutting and pinholes are okay as shown in NAAMM AMP 521.
  - 4. Weld pickets at two sides only.
- D. Form changes in direction of railings as follows:
  - 1. Mitered.
- E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- F. Close exposed ends of railing members with prefabricated end fittings.
- G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
  - 1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- H. Connect posts to stair framing by direct welding unless otherwise indicated.
- I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
  - 1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
  - 2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
  - 3. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.
- J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.
  - 1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

**2.10 FINISHES**

- A. Finish metal stairs after assembly.
- B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
  - 1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
  - 2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

- C. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- D. Apply shop primer to surfaces of metal stair components, except those to be embedded in concrete or masonry unless otherwise indicated. Comply with manufacturer's requirement for priming for High Performance Coatings. Refer to Section 09 96 00 "High Performance Coatings" for painting.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
  - 1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION OF METAL PAN STAIRS**

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
  - 1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints.
  - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
  - 2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
  - 3. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.
- F. Place and finish concrete fill for treads and platforms to comply with Section 03 30 00 "Cast-in-Place Concrete."
  - 1. Do not place wire welded reinforcing in stair pans until just before placement of concrete.
  - 2. Prevent leakage of concrete mix through weep holes and construction gaps by placing woven geotextile fabric in bottom of stair pan.
  - 3. Screed concrete on treads and platforms of exterior stairs to slope toward nosing for positive drainage.
  - 4. Broom Finish: Apply a broom finish to exterior stairs, and elsewhere as indicated.
    - a. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
  - 5. Coordinate depth of concrete with the Finish Legend to allow for the thickness of the finish material to be flush with the steel stair nosing.
  - 6. Install abrasive nosings with anchors fully embedded in concrete.
  - 7. Center nosings on tread width.

**3.3 INSTALLATION OF RAILINGS**

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints.
  - 1. Space posts at spacing indicated or, if not indicated, as required by design loads.
  - 2. Plumb posts in each direction.
  - 3. Secure posts, rail ends to building construction as follows:
    - a. Anchor posts to steel by welding to steel supporting members.
    - b. Anchor handrail to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.
- B. Attach handrails to wall with wall brackets.
  - 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
  - 2. Secure wall brackets to building construction as required to comply with performance requirements.
    - a. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
    - b. For hollow masonry anchorage, use toggle bolts.
    - c. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

**3.4 REPAIR**

- A. Touchup Painting:
  - 1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M, and galvanizing repair paint manufacturer's written instructions.

END OF SECTION

**SECTION 05 51 16 - METAL FLOOR PLATE STAIRS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Industrial-type, straight-run stairs with steel floor plate treads.
  - 2. Steel railings attached to metal floor plate stairs.

**1.2 COORDINATION**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs.
  - 1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts and items with integral anchors, that are to be embedded in concrete or masonry.
  - 2. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.
- D. Schedule installation of railings and guards so wall attachments are made only to completed walls.
  - 1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For metal floor plate stairs and the following:
  - 1. Metal floor plate treads.
  - 2. Paint products.
  - 3. Grout.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated Design Submittal: For stairs including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which Project is located.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Fabricator of products.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store materials to permit easy access for inspection and identification.
  - 1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
  - 2. Protect steel members and packaged materials from corrosion and deterioration.
  - 3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
    - a. Repair or replace damaged materials or structures as directed.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design stairs.
- B. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Uniform Load: 100 lbf/sq. ft..
  - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
  - 3. Uniform and concentrated loads need not be assumed to act concurrently.
  - 4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
  - 5. Limit deflection of treads, platforms, and framing members to L/360.

**2.2 METALS**

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- D. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallurgically bonded to steel.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Balco, Inc.
    - b. GCP Applied Technologies.
    - c. IKG Industries, a division of Harsco Corporation.
    - d. SlipNOT Metal Safety Flooring; W.S. Molnar Company.

**2.3 FASTENERS**

- A. General: Provide [zinc-plated fasteners with coating complying with ASTM B 633 and Class Fe/Zn 5 where built into exterior walls.
  - 1. Select fasteners for type, grade, and class required.



- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
  - 1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for stairs indicated to be shop primed with zinc-rich primer.
- D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941/F 1941M, Class Fe/Zn 5, unless otherwise indicated.

## 2.4 MISCELLANEOUS MATERIALS

- A. Welding Electrodes: Comply with AWS requirements.
- B. Shop Primers: Provide primers that comply with Section 09 91 23 "Interior Painting."
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20: and compatible with paints specified to be used over it.
- D. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

## 2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, railings, guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
  - 1. Join components by welding unless otherwise indicated.
  - 2. Use connections that maintain structural value of joined pieces.
- B. Assemble stairs in shop to greatest extent possible.
  - 1. Disassemble units only as necessary for shipping and handling limitations.
  - 2. Clearly mark units for reassembly and coordinated installation.
- C. Form exposed work with accurate angles and surfaces and straight edges.
- D. Weld connections to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Weld exposed corners and seams continuously unless otherwise indicated.
  - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #4 - Good quality, uniform undressed weld with minimal splatter.
- E. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
  - 1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
  - 2. Locate joints where least conspicuous.

**2.6 FABRICATION OF STEEL-FRAMED STAIRS**

- A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for Industrial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
  - 1. Stringers: Fabricate of steel plates or steel channels.
    - a. Stringer Size: As required to comply with "Performance Requirements" Article.
    - b. Provide closures for exposed ends of channel stringers.
    - c. Finish: Shop primed.
  - 2. Platforms and Tread Supports: Construct of steel plate or steel channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
    - a. Provide closures for exposed ends of channel framing.
    - b. Finish: Shop primed.
  - 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers.
  - 4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below.
    - a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.
  - 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Floor Plate Stairs: Form treads and platforms to configurations shown from abrasive-surface floor plate of thickness needed to comply with performance requirements, but not less than 3/16 inch.
  - 1. Form treads with integral nosing and back edge stiffener. Form risers of same material as treads.
  - 2. Form treads with integral nosing and back edge stiffener. Form risers from steel sheet not less than 0.097 inch thick, welded to tread nosings and stiffeners and to platforms.
  - 3. Form treads with integral nosing and back edge stiffener and with open risers.
  - 4. Weld steel supporting brackets to stringers and weld treads to brackets.
  - 5. Fabricate platforms with integral nosings matching treads and weld to platform framing.
- D. Risers: Solid.
- E. Toe Plates: Provide toe plates around openings and at edge of open-sided floors and platforms, and at open ends and open back edges of treads.
  - 1. Material and Finish: Match treads and platforms.
  - 2. Fabricate to dimensions and details indicated.

**2.7 FABRICATION OF STAIR RAILINGS**

- A. Comply with applicable requirements in Section 05 52 13 "Pipe and Tube Railings."
  - 1. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
- B. Connect posts to stair framing by direct welding unless otherwise indicated.

**2.8 FINISHES**

- A. Finish metal stairs after assembly.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:

1. Interior Stairs:
  - a. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - b. SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
  1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION OF METAL STAIRS WITH GROUTED BASEPLATES**

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
  1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
  1. Grouted Baseplates: Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces.
    - a. Clean bottom surface of baseplates.
    - b. Set steel stair baseplates on wedges, shims, or leveling nuts.
    - c. After stairs have been positioned and aligned, tighten anchor bolts.
    - d. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
    - e. Promptly pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
      - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
      - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints.
  1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
  2. Comply with requirements for welding in "Fabrication, General" Article.

### **3.3 REPAIR**

- A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

END OF SECTION

**SECTION 05 51 19 - METAL GRATING STAIRS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes industrial-type, straight-run stairs with steel-grating treads and railings attached to metal grating stairs.

**1.2 COORDINATION**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs.
  - 1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
  - 2. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.
- D. Schedule installation of railings and guards so wall attachments are made only to completed walls.
  - 1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For metal grating stairs and the following:
  - 1. Paint products.
  - 2. Grout.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, details, and attachment to other work.
- C. Delegated Design Submittal: For stairs including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which Project is located.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Fabricator of products.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store materials to permit easy access for inspection and identification.
  - 1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
  - 2. Protect steel members and packaged materials from corrosion and deterioration.
  - 3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
    - a. Repair or replace damaged materials or structures as directed.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design stairs including attachment to building construction.
- B. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Uniform Load: 100 lbf/sq. ft..
  - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
  - 3. Uniform and concentrated loads need not be assumed to act concurrently.
  - 4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
  - 5. Limit deflection of treads, platforms, and framing members to L/360.
- C. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

**2.2 METALS**

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- D. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- E. Steel Wire Rod for Grating Crossbars: ASTM A 510.
- F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- G. Cast-Abrasive Nosings: Cast iron, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both.

**2.3 FASTENERS**

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941/F 1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls.
  - 1. Select fasteners for type, grade, and class required.

- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
  - 1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for stairs indicated to be galvanized.
- D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941/F 1941M, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 or Group 2 stainless steel bolts, ASTM F 593, and nuts, ASTM F 594.

## 2.4 MISCELLANEOUS MATERIALS

- A. Welding Electrodes: Comply with AWS requirements.
- B. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior and exterior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

## 2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, railings, guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
  - 1. Join components by welding unless otherwise indicated.
  - 2. Use connections that maintain structural value of joined pieces.
- B. Assemble stairs in shop to greatest extent possible.
  - 1. Disassemble units only as necessary for shipping and handling limitations.
  - 2. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately.
  - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
  - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Weld exposed corners and seams continuously unless otherwise indicated.

5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #4 - Good quality, uniform undressed weld with minimal splatter.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
  2. Locate joints where least conspicuous.
  3. Fabricate joints that are exposed to weather in a manner to exclude water.
  4. Provide weep holes where water may accumulate internally.

## 2.6 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Industrial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
1. Fabricate stringers of steel plates or channels.
    - a. Stringer Size: As required to comply with "Performance Requirements" Article.
    - b. Provide closures for exposed ends of channel stringers.
    - c. Finish: Galvanized.
  2. Construct platforms and tread supports of steel plate or channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
    - a. Provide closures for exposed ends of channel framing.
    - b. Finish: Galvanized.
  3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers.
  4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below.
    - a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.
  5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."
1. Fabricate treads and platforms from welded steel or pressure-locked steel grating with 1-1/4-by-3/16-inch bearing bars at 15/16 inch o.c. and crossbars at 4 inches o.c.
  2. Fabricate treads and platforms from welded steel or pressure-locked steel grating with openings in gratings no more than 1/2 inch in least dimension.
    - a. Surface: Serrated.
    - b. Finish: Galvanized.
  3. Fabricate grating treads with cast-abrasive nosing and with steel angle or steel plate carrier at each end for stringer connections.
    - a. Secure treads to stringers with bolts.
  4. Fabricate grating platforms with nosing matching that on grating treads.
    - a. Secure grating to platform framing by welding.
- D. Risers: Open.
- E. Toe Plates: Provide toe plates around openings and at edge of open-sided floors and platforms, and at open ends and open back edges of treads.
1. Material and Finish: Steel plate to match finish of other steel items.
  2. Fabricate to dimensions and details indicated.

## 2.7 FABRICATION OF STAIR RAILINGS



- A. Comply with applicable requirements in Section 05 52 13 "Pipe and Tube Railings."
  - 1. Fabricate newels of square steel tubing and provide newel caps of pressed steel, as shown.
  - 2. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
  - 3. Connect posts to stair framing by direct welding unless otherwise indicated.

## 2.8 FINISHES

- A. Finish metal stairs after assembly.
- B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
  - 1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
  - 2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:
  - 1. Exterior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Interior Stairs:
    - a. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
    - b. SSPC-SP 3, "Power Tool Cleaning."
- D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
  - 1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF METAL STAIRS WITH GROUTED BASEPLATES

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
  - 1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces.
  - a. Clean bottom surface of baseplates.
  - b. Set steel-stair baseplates on wedges, shims, or leveling nuts.
  - c. After stairs have been positioned and aligned, tighten anchor bolts.
  - d. Do not remove wedges or shims, but if protruding, cut off flush with edge of bearing plate before packing with grout.
  - e. Promptly pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
    - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
    - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints.
  1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
  2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
  3. Comply with requirements for welding in "Fabrication, General" Article.

### 3.3 REPAIR

- A. Touchup Painting:
  1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
  2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M, and galvanizing repair paint manufacturer's written instructions.

END OF SECTION

**SECTION 05 52 13 - PIPE AND TUBE RAILINGS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Steel pipe and tube railings.
  - 2. Aluminum pipe and tube railings.
- B. Related Requirements:
  - 1. Section 05 51 13 "Metal Pan Stairs" for steel tube railings associated with metal pan stairs.
  - 2. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood blocking for anchoring railings.
  - 3. Section 09 91 23 "Exterior Painting" for painting of interior and exterior rails.
  - 4. Section 09 22 16 "Non-Structural Metal Framing" for metal backing for anchoring railings.
  - 5. Section 09 69 00 "Access Flooring" for railings included with access flooring.

**1.2 COORDINATION**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Manufacturer's product lines of mechanically connected railings.
  - 2. Railing brackets.
  - 3. Grout, anchoring cement, and paint products.
  - 4. Metal finishes.
  - 5. Paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
  - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters, including finish.
  - 2. Fittings and brackets.
  - 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
    - a. Show method of connecting and finishing members at intersections.
- D. Delegated Design Submittal: For railings, , indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Mill Certificates: Signed by manufacturers of stainless-steel products, certifying that products furnished comply with requirements.
- D. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E 894 and ASTM E 935.
- E. Reports: For post-installed anchors, from ICC-ES.

**1.5 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
- B. Mockups: Build mockups for each rail type to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockups for each form and finish of railing (every rail type) consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 72 inches in length.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the state where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of pipe and tube railings that are similar to those indicated for this Project in material, design, and extent.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

**1.7 PRECONSTRUCTION TESTING**

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on laboratory mockups. Payment for these services will be made by Owner. Retesting of products that fail to meet specified requirements shall be done at Contractor's expense.
  - 1. Test railings according to ASTM E 894 and ASTM E 935.
  - 2. Notify Architect seven days in advance of the dates and times when laboratory mockups will be tested.

**1.8 FIELD CONDITIONS**

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
    - d. Deflection limited to H/90 or 1/2 inch whichever is less.
  2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
    - b. Infill load and other loads need not be assumed to act concurrently.
    - c. Deflection limited to H/90 or 1/2 inch whichever is less.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

**2.3 METALS, GENERAL**

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 2-1/4" inch clearance from inside face of handrail to finished wall surface.

**2.4 STEEL AND IRON RAILINGS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Julius Blum & Co, Inc.
  2. Wagner, R & B, Inc.
- B. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- C. Tubing: ASTM A 500/A 500M (cold formed).
- D. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
1. Provide galvanized finish for exterior installations and where indicated.
- E. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- F. Cast Iron: Malleable iron, ASTM A 47/A 47M, Grade 32510, galvanized.

## 2.5 FASTENERS

- A. Fastener Materials:
  - 1. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329/F 2329M for zinc coating.
  - 2. Finish exposed fasteners to match appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
  - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
  - 2. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated. Finish fasteners to match adjacent materials.
- D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
  - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941/ F1941M, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F 593, and nuts, ASTM F 594.

## 2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint, complying with SSPC-Paint 20, Type II-Organic, and the following:
  - 1. Zinc Content: 95 percent, minimum.
  - 2. Solids: 52 percent by volume, minimum.
  - 3. Dry film thickness not less than 1.5 mils per coat.
  - 4. Color: Flat grey finish matching original hot-dipped galvanizing.
  - 5. Available Product: ZRC Cold Galvanizing Compound; ZRC Worldwide.
- C. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- D. Bituminous Paint: Cold-applied asphalt emulsion, complying with ASTM D 1187/D 1187M.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
  - 1. Clearly mark units for reassembly and coordinated installation.

2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
  1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
  2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water.
  1. Provide weep holes where water may accumulate.
  2. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove flux immediately.
  4. At exposed connections, finish exposed surfaces at top of rail or handrail smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint. All other weld finishes shall be NOMMA's; Finish #3 welds; utilitarian appearance not subject to view, partially dressed weld with spatter removed.
- I. Form changes in direction as follows:
  1. As Mitered.
- J. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
  1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
  2. Coordinate anchorage devices with supporting structure.
- O. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- P. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height.
  1. Provide socket covers designed and fabricated to resist being dislodged.

2. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- Q. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

## 2.8 STEEL AND IRON FINISHES

- A. Galvanized Railings:
1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
  2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
  3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
  4. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
  5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
1. Comply with SSPC-SP 16.
- D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blasting Cleaning".
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 "Shop, Field, and Maintenance Painting of Steel", for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
1. Shop prime uncoated railings with primers specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting".

## 2.9 ALUMINUM FINISHES

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Mill Finish: AA-M12, nonspecular as fabricated.
- C. Clear Anodic Finish: AAMA 611, AA-M12C22A41.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.



### 3.2 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
  - 1. Fit exposed connections together to form tight, hairline joints.
  - 2. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
  - 3. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 4. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 5. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
  - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches of post.

### 3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Leave anchorage joint exposed with 1/8-inch reveal in anchoring material. Seal with silicone joint sealant specified in Section 07 92 00 "Joint Sealant."
- C. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members as follows:
  - 1. For steel railings, weld flanges to post and bolt to metal supporting surfaces.
- D. Install removable railing sections, where indicated, in slip-fit stainless steel sockets cast in concrete.

### 3.5 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and connected to railing ends, using nonwelded connections.

- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and connected to railing ends, using nonwelded connections.
- C. Attach railings to walls with wall brackets..
  - 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
  - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  - 2. For hollow masonry anchorage, use toggle bolts.
  - 3. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements, using self-tapping screws.

### **3.6 REPAIR**

- A. Touchup Painting:
  - 1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

### **3.7 CLEANING**

- A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M and galvanizing repair paint manufacturer's written instructions.

### **3.8 PROTECTION**

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

**SECTION 05 53 13 - BAR GRATINGS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: includes metal bar gratings and metal frames and supports for gratings.
- B. Related Requirements:
  - 1. Section 05 12 00 "Structural Steel Framing" for structural-steel framing system components.
  - 2. Section 05 51 00 "Metal Stairs" for grating treads and landings of steel-framed stairs.
  - 3. Section 05 51 19 "Metal Grating Stairs" for grating treads and landings of steel-framed stairs.
  - 4. Section 05 52 13 "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

**1.2 COORDINATION**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Clips and anchorage devices for gratings.
  - 2. Paint products.
- B. Shop Drawings:
  - 1. Include plans, sections, and attachment details to other work.
- C. Delegated Design Submittals: For gratings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- C. Welding certificates.

**1.5 QUALITY ASSURANCE**

- A. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## 1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Borden Metal Products (Canada) Limited.
  2. Grating Pacific, Inc.
  3. Harsco Industrial IKG, a division of Harsco Corporation.
  4. McNichols.
  5. Ohio Gratings, Inc.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design gratings.
- B. Structural Performance: Gratings to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  1. Floors for Light Manufacturing: Uniform load of 125 lbf/sq. ft. or concentrated load of 2000 lbf, whichever produces the greater stress.
  2. Floors for Heavy Manufacturing: Uniform load of 250 lbf/sq. ft. or concentrated load of 3000 lbf, whichever produces the greater stress.
  3. Walkways and Elevated Platforms Other Than Exits: Uniform load of 60 lbf/sq. ft..
  4. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft..
  5. Sidewalks and Vehicular Driveways, Subject to Trucking: Uniform load of 250 lbf/sq. ft. or concentrated load of 8000 lbf, whichever produces the greater stress.
  6. Limit deflection to L/360 or 1/4 inch, whichever is less.
- C. Seismic Performance: Gratings to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
  1. Component Importance Factor: 1.5.

### 2.3 METAL BAR GRATINGS

- A. Metal Bar Grating Standards: Comply with [NAAMM MBG 531], "Metal Bar Grating Manual" [and] [NAAMM MBG 532, "Heavy-Duty Bar Grating Manual"].
- B. Pressure-Locked Steel Grating: Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars.
  1. Bearing Bar Spacing: 11/16 inch o.c.
  2. Bearing Bar Depth: As required to comply with structural performance requirements.
  3. Bearing Bar Thickness: 3/16 inch.
  4. Crossbar Spacing: 4 inches o.c.
  5. Traffic Surface: Plain.
  6. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface.

- C. Pressure-Locked, Rectangular-Bar Aluminum Grating:[ MBG-#.] Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars.
1. Bearing Bar Spacing: 11/16 incho.c.
  2. Bearing Bar Depth: As required to comply with structural performance requirements.
  3. Bearing Bar Thickness: 3/16 inch.
  4. Crossbar Spacing: 4 inches o.c.
  5. Traffic Surface: Plain.
  6. Aluminum Finish: Mill finish.

## 2.4 GRATING FRAMES AND SUPPORTS

- A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
1. Unless otherwise indicated, fabricate from same basic metal as gratings.
  2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.
- B. Galvanize steel frames and supports in the following locations:
1. Exterior.
  2. Interior, where indicated.

## 2.5 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 **or** Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941/F 1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
1. Provide stainless steel fasteners for fastening aluminum.
  2. Provide hot-dip galvanized steel fasteners for fastening galvanized steel.
- B. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, nuts, and where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1or Group 2.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563, and, where indicated, flat washers.
1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E4 88/E 488M, conducted by a qualified independent testing agency.
1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

## 2.6 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

**2.7 FERROUS METALS**

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

**2.8 ALUMINUM**

- A. General: Provide alloy and temper recommended by aluminum producer for type of use indicated, with not less than the strength and durability properties of alloy, and temper designated below for each aluminum form required.
- B. Extruded Bars and Shapes: ASTM B221, alloys as follows:
  - 1. Alloy 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.
  - 2. Alloy 6061-T1, for grating crossbars.

**2.9 FABRICATION**

- A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Welding: Comply with AWS recommendations and the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
- F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
  - 1. Fabricate toeplates for attaching in the field.
  - 2. Toeplate Height: 4 inches unless otherwise indicated.
- G. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.
  - 1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.
  - 2. Furnish threaded bolts with nuts and washers for securing grating to supports.
  - 3. Furnish self-drilling fasteners with washers for securing grating to supports.
- H. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
  - 1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
- I. Do not notch bearing bars at supports to maintain elevation.

**2.10 ALUMINUM FINISHES**

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I.

**2.11 STEEL FINISHES**

- A. Finish gratings, frames, and supports after assembly.
- B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

**PART 3 - EXECUTION****3.1 INSTALLATION, GENERAL**

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- D. Fit exposed connections accurately together to form hairline joints.
  - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Attach toeplates to gratings by welding at locations indicated.
- F. Field Welding: Comply with AWS recommendations and the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.

**3.2 CONSTRUCTION WASTE MANAGEMENT**

- A. Construction Waste shall be managed in accordance with provisions of Section 01 74 19 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that section.

**3.3 INSTALLATION OF METAL BAR GRATINGS**

- A. Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

- C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

**3.4 REPAIR**

- A. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION



**SECTION 05 70 00 - DECORATIVE METAL****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Metal reveals.
  - 2. Decorative metal panels on vertical surfaces.
- B. Related Requirements:
  - 1. Section 05 75 00 "Decorative Formed Metal" for decorative metal items made from sheet metal.

**1.2 COORDINATION**

- A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for decorative metal.
  - 1. Include plans, elevations, component details, and attachment details.
  - 2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design including mechanical finishes.
- D. Samples for Verification: For each type of exposed finish.
  - 1. Sections of linear shapes.
  - 2. Samples of welded joints showing quality of workmanship and color matching of materials.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For fabricator.
- B. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.
- C. Welding certificates.

**1.6 QUALITY ASSURANCE**

- A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- B. Installer Qualifications: Fabricator of products.
- C. Organic-Coating Applicator Qualifications: A firm experienced in successfully applying organic coatings, of type indicated, to aluminum extrusions and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

## 1.7 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.
- B. Deliver and store cast-metal products in wooden crates surrounded by enough packing material to ensure that products are not cracked or otherwise damaged.

## 1.9 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

## PART 2 - PRODUCTS

### 2.1 METALS, GENERAL

- A. Metal Surfaces, General: Use materials with smooth, flat surfaces unless otherwise indicated. Use materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

### 2.2 ALUMINUM

- A. Fabricate products from alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Bars and Shapes: ASTM B221, Alloy 6063-T5/T52.
- C. Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6.
- D. Tubing: ASTM B210, Alloy 6063-T832.
- E. Plate and Sheet: ASTM B209, Alloy 3003-H14.
- F. Forgings: ASTM B247, Alloy 6061-T6.
- G. Castings: ASTM B26/B26M, Alloy A356.0-T6.

**2.3 STEEL AND IRON**

- A. Tubing: ASTM A 500/A 500M (cold formed).
- B. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M unless otherwise indicated.
- E. Steel Sheet, Cold Rolled: ASTM A 1008/A 1008M, either commercial steel or structural steel, exposed.
- F. Fasteners: Unless otherwise indicated, provide Type 304 or Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls.
  - 1. Select fasteners for type, grade, and class required.
  - 2. Use concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated.

**2.4 DECORATIVE METAL PANELS FOR VERTICAL SURFACES**

- A. Basis of Design Product: Subject to compliance with requirements, provide products indicated on Finish Legend or comparable product by an alternate manufacturer approved by the Architect prior to Bid.
  - 1. Material: Refer to Finish Legend
  - 2. Finish: Refer to Finish Legend

**2.5 FASTENERS**

- A. Fastener Materials: Unless otherwise indicated, provide the following:
  - 1. Aluminum Items: Type 304 stainless steel fasteners.
  - 2. Uncoated-Steel Items: Plated steel fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed, Type 304 stainless steel fasteners where exposed.
  - 3. Dissimilar Metals: Type 304 stainless steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.
- C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless exposed fasteners are unavoidable.
  - 1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F 593, and nuts, ASTM F 594.

**2.6 MISCELLANEOUS MATERIALS**

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

## 2.7 FABRICATION, GENERAL

- A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly.
  1. Disassemble units only as necessary for shipping and handling limitations.
  2. Clearly mark units for reassembly and coordinated installation.
  3. Use connections that maintain structural value of joined pieces.
- B. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
- D. Form simple and compound curves in bars, pipe, tubing, and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.
- E. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- F. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.
- G. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- H. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.
- I. Comply with AWS for recommended practices in shop welding. Weld behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded joints of flux, and dress exposed and contact surfaces.
  1. Where welding cannot be concealed behind finished surfaces, finish joints to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 Welds: completely sanded joint, some undercutting and pinholes okay.

## 2.8 FABRICATION OF METAL REVEALS

- A. Fabricate metal reveals for gypsum board, metal panels, and wood paneling from extruded aluminum channels or size noted otherwise on Drawings.
  1. Drill for mounting screws 6 inches from ends of channels and not more than 24 inches o.c.
  2. Locate mounting screws at same heights for all channels.
  3. Provide hex-socket, wafer-head screws for mounting reveals.
    - a. Basis of Design: Fry Reglet profiles, as indicated on Drawings.
    - b. Finish and color of reveals and fasteners, as selected by Architect.

## 2.9 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## 2.10 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Clear Anodic Finish: AAMA 611, [AA-M12C22A41, Class I, 0.018 mm] [AA-M12C22A31, Class II, 0.010 mm] or thicker.
- C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
  - 1. Color: As selected by Architect from full range of industry colors and color densities .
- D. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.
- E. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

## 2.11 STEEL AND IRON FINISHES

- A. Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
  - 1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Interiors (SSPC Zone 1A): SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- B. Primer Application: Apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
  - 1. Shop prime uncoated ferrous-metal surfaces with primers specified in Section 09 91 13 "Exterior Painting" and primers specified in Section 09 91 23 "Interior Painting."
  - 2. Do not apply primer to galvanized surfaces.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.
- B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide

temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.

- C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.
- D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- E. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.
- F. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
  - 1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.
- G. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding and requirements for welding and for finishing welded connections in "Fabrication, General" Article. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
- H. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
  - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

### **3.3 INSTALLATION OF METAL REVEALS AT WOOD PANELING**

- A. Install metal reveals between wood panels as paneling is installed. Secure to wood grounds with specified screws.

### **3.4 CLEANING AND PROTECTION**

- A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.
- B. Touchup Painting:
  - 1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- C. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.
- D. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

**SECTION 05 70 10 - VISION BARRIERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Furnish screenwall/vision barrier, structural supports and attachment brackets as shown on the drawings, as specified, and as needed for a complete and proper installation.
- B. The screenwall/vision barrier to be furnished include the following:
  - 1. Fixed extruded screenwall/vision barrier.

**1.2 REFERENCES**

- A. The Aluminum Association Incorporated
  - 1. Aluminum Standards and Data
  - 2. Specifications and Guidelines for Aluminum Structures
- B. American Society of Civil Engineers
  - 1. Minimum Design Loads for Buildings and Other Structures
- C. American Society for Testing and Materials
  - 1. ASTM B209
  - 2. ASTM B211
  - 3. ASTM B221
  - 4. ASTM E90-90
- D. Architectural Aluminum Manufacturers Association
  - 1. AAMA 800 Voluntary Specifications and Test Methods for Sealants
  - 2. AAMA 605.2 Voluntary Specification for High Performance Organic Coatings on Aluminum Extrusions and Panels.
  - 3. AAMA TIR Metal Curtain Wall Fasteners
  - 4. AAMA 2605-98 Superior Performing Organic Coatings on Aluminum Extrusions and Panels
- E. Canadian Standards Association
  - 1. CAN3-S157-M83 Strength Design in Aluminum
  - 2. S136 94 Cold Formed Steel Structural Members

**1.3 SUBMITTALS**

- A. Product Data
  - 1. Material types and thickness.
- B. Shop Drawings
  - 1. Include elevations, sections, and specific details for each louver.
  - 2. Show anchorage details and connections for all component parts.
  - 3. Include signed and sealed structural calculations.
- C. Samples
- D. Submit color chips for approval.

**1.4 QUALITY ASSURANCE**

- A. Single subcontract responsibility: Subcontract the work to a single firm that has had not less than six years' experience in the design and manufacturing of work similar to that shown and required.

- B. Structural Requirements: Design all materials to withstand wind and snow loads as required by the applicable building code. Maximum allowable deflection for the louver structural members to be  $l/180$  or 0.75 inch, whichever is less. Maximum allowable deflection for the louver blades to be  $l/120$  or 0.50 inch across the weak axis, whichever is less.
- C. Professional Engineer Requirements: Drawings and structural calculations to be signed and sealed by a professional engineer licensed to practice in the state where the project is located.
- D. Warranty: Provide written warranty to the owner that all products will be free of defective materials or workmanship for a period of one year from date of installation.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Delivery: At the time of delivery all materials shall be visually inspected for damage. Any damaged boxes, crates, louver sections, etc. shall be noted on the receiving ticket and immediately reported to the shipping company and the material manufacturer.
- B. Storage:
  - 1. Material may be stored flat on end or on its side.
  - 2. Material may be stored either indoors or outdoors.
  - 3. If stored outdoors the material must be raised sufficiently off the ground to prevent it being flooded.
  - 4. If stored outdoors the material must be covered with a weatherproof flame-resistant sheeting or tarpaulin.
- C. Handling:
  - 1. Material shall be handled in accordance with sound material handling practices and in such a way as to minimize racking.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Basis of Design: As manufactured by Construction Specialties subject to compliance with requirements listed. The grilles and related materials herein specified and indicated on the drawings shall be manufactured by: Construction Specialties, 3 Werner Way, Lebanon, NJ 08833. Tel: 800.233.8493. Email: cet@c-sgroup.com., or pre-approved equivalent.
- B. Drawings and specifications are based on manufacturer's literature from Construction Specialties, Inc. drawings and specifications unless otherwise indicated. Other manufacturers must be approved equal by Architect/Owner.

### **2.2 MATERIALS**

- A. Aluminum Extrusions: ASTM B211, Alloy 6063-T5, 6063-T6 or 6061-T6.
- B. Aluminum Sheet: ASTM B3209, Alloy 1100, 3003 or 5005.

### **2.3 FABRICATION, GENERAL**

- A. Provide screenwall models, structural supports and accessories as specified and/or shown on the drawings. Materials, sizes, depths, arrangements, and material thickness to be as indicated or as required for optimal performance with respect to strength; durability; and uniform appearance.
- B. Screenwall to be mechanically assembled using stainless steel or aluminum fasteners.
- C. Include supports, anchorage, and accessories required for complete assembly.



**2.4 SCREENWALL/VISION BARRIER MODELS (VBS)**

- A. Manufacturer/Model: CS Aluminum Screen, Vert-A-Cade 308 as manufactured by Construction Specialties, Inc. Blades to be fabricated from extruded aluminum sections in 6063-T52 alloy and spaced approximately 5" on center. Blades to be nominal 4.625" deep and mechanically secured to continuous extruded aluminum supports. Aluminum supports fixed directly to horizontal steel supports (not by CS) or to spandrel beams with extruded aluminum clip angles. All fasteners to be stainless steel or aluminum. Material shipped knocked down for field assembly by the installer. Support braces and mounting clips to painted standard Kynar to coat black.

**2.5 FINISHES**

- A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process. Provide color as indicated or, if not otherwise indicated, as selected by architect.
- B. 100% Fluoropolymer Resin Powder Coat System complying with AAMA-2605-5 standards for gloss and color retention. Finish thickness to be 1.5 to 3.0 mils.
  - 1. Finish to allow zero VOCs to be emitted into facility of application or at job site.
  - 2. Finish to adhere to a 4H Hardness rating.
  - 3. Furnish manufacturer's twenty (20) year warranty for finish for gloss and color retention.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine openings to receive the work. Do not proceed until any unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of the work.
- B. Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designed, fabricated, and fitted to the structure.
- C. Anchor sunshades to the building substructure as indicated on architectural drawings.
- D. Erection Tolerances:
  - 1. Maximum variation from plane or location shown on the approved shop drawings: 1/8" per 12 feet of length, but not exceeding 1/2" in any total building length or portion thereof (non-cumulative).
  - 2. Maximum offset from true alignment between two members abutting end to end, edge-to-edge in line or separated by less than 3": 1/16" (shop or field joints). This limiting condition shall prevail under both load and no-load conditions.
- E. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.
- F. Do not erect warped, bowed, deformed, or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.
- G. Set units level, plumb and true to line, with uniform joints.

**3.3 PROTECTION**

- A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

**3.4 ADJUSTING AND CLEANING**

- A. Immediately clean exposed surfaces of the louvers to remove fingerprints and dirt accumulation during the installation process. Do not let soiling remain until the final cleaning.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to the material finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers and accessory components damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the Architect, remove damaged materials, and replace with new materials.
  - 1. Touch up minor abrasions in finishes with a compatible air-dried coating that matches the color and gloss of the factory applied coating.

END OF SECTION

**SECTION 05 73 13 - GLAZED DECORATIVE METAL RAILINGS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Glass-supported railings.
- B. Related Requirements:
  - 1. Section 03 30 00 "Cast-in-Place Concrete" for coordination of cast-in accessories.
  - 2. Section 05 12 00 "Structural Steel Framing" for steel embeds for anchoring railings.
  - 3. Section 08 80 00 "Glazing" for glass specifications installed in this Section.
  - 4. Section 09 22 16 "Non-Structural Metal Framing" for metal backing for anchoring railings.

**1.2 DEFINITIONS**

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor and for pedestrian guidance and support, visual separation, or wall protection.

**1.3 COORDINATION AND SCHEDULING**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

**1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.5 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Manufacturer's product lines of railings assembled from standard components.
  - 2. Glazing accessories.
  - 3. Grout and paint products.
  - 4. Glass products.
  - 5. Glazing cement and accessories for structural glass railings.
  - 6. Sealant and accessories for structural glass railings.
  - 7. Fasteners.
  - 8. Shop primer.
  - 9. Bituminous paint.
  - 10. Nonshrink, nonmetallic grout.
  - 11. Anchoring cement.
- B. Shop Drawings: Include plans, elevations, sections, and attachment details.
- C. Samples for Verification: For each type of exposed finish required.
  - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
  - 2. Base channel.
  - 3. Each type of glass and glass edge required.

4. Fittings and brackets.
  5. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, structural glass balusters,. Show method of finishing members at intersections. Samples need not be full height.
- D. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### **1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For professional engineer and testing agency.
- B. Mill Certificates: Signed by manufacturers of stainless-steel products, certifying that products furnished comply with requirements.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, in accordance with ASTM E 894, and ASTM E 935.
- D. Preconstruction test reports.
- E. Evaluation Reports: From ICC-ES, for post-installed anchors.

#### **1.7 MAINTENANCE MATERIAL SUBMITTALS**

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's maintenance, and removal and replacement of glass panels.

#### **1.8 QUALITY ASSURANCE**

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
1. Build mockups for each form and finish of railing consisting of two glazed sections and one corner section, posts, top rail, handrail, glass-infill panel, and anchorage system components that are full height and are not less than 24 inches in length.
  2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### **1.9 PRECONSTRUCTION TESTING**

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on laboratory mockups. Payment for these services will be made by Owner. Retesting of products that fail to meet specified requirements is to be done at Contractor's expense.
1. Test railings in accordance with ASTM E 894 and ASTM E 935.
  2. Notify Architect seven (7) days in advance of the dates and times when laboratory mockups will be tested.
- B. Provide manufacturer's testing results.

#### **1.10 FIELD CONDITIONS**

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

#### **1.11 WARRANTY**

- A. Manufacturer's Special Warranty for Laminated Glass: Glazed decorative metal railing manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
1. Warranty Period: Ten (10) years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or a comparable product approved by Architect:
1. Architectural Railings & Grilles, Inc.
  2. ARTACO Railing Systems, a Division of TACO Metals Inc.
  3. Julius Blum & Co., Inc.
  4. CraneVeyor Corp.
  5. CRL / C. R. Laurence Co., Inc.
  6. Livers Bronze Co.
  7. VIEWRAIL
  8. Tri Tech, Inc.
  9. Tuttle Railing Systems.
  10. The Wagner Companies.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazed decorative metal railings, including attachment to building construction.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
1. Aluminum: The lesser of minimum yield strength divided by 1.65, or minimum ultimate tensile strength divided by 1.95.
  2. Stainless Steel: 60 percent of minimum yield strength.
  3. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA Aluminum Curtain Walls CW-12, "Structural Properties of Glass."
- C. Structural Performance: Railings, including attachment to building construction, are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
    - d. Deflection limited to H/90 or 1/2 inch whichever is less.
  2. Structural Glass Railings and Glass-Infill Panels:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
    - b. Infill load and other loads need not be assumed to act concurrently.
    - c. Deflection limited to H/90 or 1/2 inch whichever is less.
- D. Wind Loads: For exterior glazed decorative metal railings, capable of withstanding the following wind loads in accordance with the IBC and ASTM E1300:

1. Wind Load: per code required within the location of the project.
- E. Windborne-Debris-Impact Resistance: Exterior glazed decorative metal railings passing ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for project's Wind Zone classification for basic protection.
  1. Large-Missile Test: For exterior glazing located within 30 feet (9.1m) above grade.
  2. Small-Missile Test: For exterior glazing located between 30 feet (9.1 m) above grade.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### **2.3 GLAZED DECORATIVE METAL RAILINGS**

- A. Source Limitations for Decorative Metal Railing Components: Obtain from single manufacturer for each component and installation method.
- B. Product Options: Information on Drawings and in the Specifications establishes requirements for railing system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods, including structural analysis, preconstruction testing, field testing, and in-service performance.
  1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

### **2.4 METALS, GENERAL**

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

### **2.5 ALUMINUM**

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Extruded Bars and Shapes, Including Extruded Tube: ASTM B 221, Alloy 6063-T5/T52.
- C. Extruded Structural Pipe and Round Tube: ASTM B 429/B 429M, Alloy 6063-T6.
  1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.
- E. Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

### **2.6 STAINLESS STEEL**

- A. Tubing: ASTM A 554, Grade MT 304.
- B. Pipe: ASTM A 312/A 312M, Grade TP 304.

- C. Sheet, Strip, Plate, and Flat Bar: ASTM A 666 or ASTM A 240/A 240M, Type 304.
- D. Bars and Shapes: ASTM A 276, Type 304.

## 2.7 GLASS AND GLAZING PRODUCTS, GENERAL

- A. Laminated Glass (Refer to requirements in Section 08 88 00 for Laminated glass type):
  - 1. Glass Plies for Structural Glass Balusters: Thickness required by structural loads, but not less than 6.0 minimum thickness each.
  - 2. Glass Plies for Glass Infill Panels: Thickness required by structural loads, but not less than 6.0 mm minimum thickness each.
  - 3. Both plies of glass to be same thickness when assembled as laminated panel with interlayer of clear ionoplast polymer interlayer.
- B. Safety Glazing: Glazing is to comply with 16 CFR 1201, Category II.
- C. Safety Glazing Labeling: Permanently mark glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label is to indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- D. Glazing Accessories for Dry Structural Glazing: Setting blocks, tapers, tools and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal subrails.

## 2.8 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
  - 1. Aluminum Components: Type 304 stainless steel fasteners.
  - 2. Stainless Steel Components: Type 304 stainless steel fasteners.
  - 3. Dissimilar Metals: Type 304 stainless steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless exposed fasteners are unavoidable.
  - 1. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941/ASTM F 1941M, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F 593, and nuts; ASTM F 594.

## 2.9 MISCELLANEOUS MATERIALS

- A. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

**2.10 FABRICATION OF METAL RAILINGS**

- A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
  - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- H. Form changes in direction as follows:
  - 1. Mitered.
- I. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- J. Close exposed ends of hollow railing members with prefabricated end fittings.
- K. Brackets, Flanges, Fittings, and Anchors: Provide brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other work where indicated.
- L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

**2.11 GLAZING PANEL FABRICATION**

- A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.
  - 1. Clean-cut or flat-grind edges at butt-glazed sealant joints to produce square edges with slight chamfers at junctions of edges and faces.
  - 2. Grind smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.
- B. Infill Panels: Provide laminated, heat-strengthened for both straight and curved sections.
- C. Structural Balusters: Provide laminated, heat-strengthened glass panels of same thickness for both plies and with ionoplast interlayer for both straight and curved sections.
- D. Cap Railing: Stainless steel channel standard cap railing for glass panel with minimum 3/4 inch bite.



**2.12 METAL FINISH REQUIREMENTS, GENERAL**

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

**2.13 ALUMINUM FINISHES**

- A. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 1. Color and Gloss: Match Architect's sample.

**2.14 STAINLESS STEEL FINISHES**

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run grain of directional finishes with long dimension of each piece.
  - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
  - 3. Directional Satin Finish: No. 4.

**PART 3 - EXECUTION****3.1 INSTALLATION, GENERAL**

- A. Comply with Drawings and manufacturer's written instructions for installing glazed decorative metal railings, accessories, and other components.
- B. Fit exposed connections together to form tight, hairline joints.
- C. Windborne-Debris Resistance: Anchor glazed decorative metal railings to structure using anchoring method, fastener type, and fastening frequency identical to that used in windborne-debris-resistance testing.
- D. Perform cutting, drilling, and fitting required for installing metal railings.
  - 1. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and levels are free of rack.
  - 2. Do not weld, cut, or abrade surfaces of metal railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 3. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 4. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- F. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- G. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### **3.2 METAL RAILING CONNECTIONS**

- A. Nonwelded Connections:
1. Use mechanical or adhesive joints for permanently connecting railing components.
  2. Use wood blocks and padding to prevent damage to railing members and fittings.
  3. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Expansion Joints: Install expansion joints at locations indicated, but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

### **3.3 INSTALLATION OF GLASS PANELS**

- A. Glass-Supported Railings: Install assembly to comply with railing manufacturer's written instructions, and approved Shop Drawings.
1. Attach base channel to building structure.
  2. Adhere pressure blocks to the bottom edge of glass and insert glass into base channel.
  3. Install tapers and lock glass into place.
  4. Install glazing gaskets.
  5. Erect glass railings under direct supervision of manufacturer's authorized technical personnel.

### **3.4 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports. Payment for these services will be made by Owner.
- B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings in accordance with ASTM E 894 and ASTM E 935, for compliance with performance requirements.
- C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.
- D. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

### **3.5 CLEANING**

- A. Clean aluminum and stainless steel by washing thoroughly with water and soap, rinsing with clean water, and wiping dry.
- B. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

**3.6 PROTECTION**

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 05 75 00 - DECORATIVE FORMED METAL****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Paints and coatings.
  2. Closures and trim.
  3. Escalator enclosures.
  4. Filler panels between dissimilar construction.
  5. Mullion cladding.
  6. Window stools.
  7. Exterior fins.
  8. Exterior formed-metal-shaped panels.
  9. Exterior sunshades.
10. Section 05 70 00 "Decorative Metal" for decorative items made primarily from plate, bars, extrusions, tubes, castings, and other forms of metal, but which may include sheet metal components.
11. Section 07 62 00 "Sheet Metal Flashing and Trim" for items made of formed metal for flashings and trim.
12. Section 07 71 00 "Roof Specialties" for items made of formed metal for parapets and copings.

**1.2 COORDINATION**

- A. Coordinate installation of anchorages for decorative formed metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.
- B. Coordinate installation of decorative formed metal with adjacent construction to ensure that wall assemblies, flashings, trim, and joint sealants, are protected against damage from the effects of weather, age, corrosion, and other causes of deterioration.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for decorative formed metal.
1. Include plans, elevations, component details, and attachment details.
  2. Indicate materials and profiles of each decorative formed metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.
- D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch-square Samples of metal of same thickness and material indicated for the Work.

- E. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: For decorative formed metal elements that house items specified in other Sections. Show dimensions of housed items, including locations of housing penetrations and attachments, and necessary clearances.
- B. Qualification Data: For fabricator and professional engineer.
- C. Mill Certificates: Signed by stainless steel manufacturers certifying that products furnished comply with requirements.
- D. Evaluation Reports: For post-installed anchors, from ICC-ES.

### **1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For mirrorlike stainless-steel finish to include in maintenance manuals.

### **1.7 QUALITY ASSURANCE**

- A. Fabricator Qualifications: A firm experienced in producing decorative formed metal similar to that indicated for this Project and with a record of successful in-service performance as well as sufficient production capacity to produce required units.
- B. Organic-Coating Applicator Qualifications: A firm experienced in successfully applying organic coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- C. Anodic Finisher Qualifications: A firm experienced in successfully applying anodic finishes of type indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- D. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- E. Installer Qualifications: Fabricator of products.
- F. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver decorative formed metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.
- B. Store products on elevated platforms in a dry location.

### **1.9 FIELD CONDITIONS**

- A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with decorative formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.

## **PART 2 - PRODUCTS**

### **2.1 SOURCE LIMITATIONS**

- A. For decorative metal items, obtain each color, grade, finish, type, and variety of metal from single source with resources to provide products of consistent quality in appearance and physical properties.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design decorative formed metal, including attachment to building construction.
- B. Structural Performance: Decorative formed metal items, including anchors and connections, are to withstand the effects of gravity loads and the following loads and stresses without exceeding the allowable design working stress of materials involved and without exhibiting permanent deformation in any components:
  - 1. Wind Loads on Exterior Items: As indicated on Drawings.
- A. Windborne-Debris-Impact Resistance: Exterior glazed decorative metal railings passing ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E 1996 for project's Wind Zone classification for protection.
  - 1. Large-Missile Test: For exterior glazing located within 30 feet (9.1m) above grade.
  - 2. Small-Missile Test: For exterior glazing located between 30 feet (9.1 m) above grade.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### **2.3 SHEET METAL**

- A. General: Fabricate products from sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.
- B. Aluminum Sheet: Flat sheet complying with ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties of not less than Alloy 5005-H32.
- C. Steel Sheet: Uncoated, cold-rolled, ASTM A1008/A1008M, commercial steel, exposed or electrolytic zinc-coated, ASTM A879/A879M, with steel sheet substrate complying with ASTM A1008/A1008M, commercial steel, exposed.
- D. Stainless Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness.

### **2.4 MISCELLANEOUS MATERIALS**

- A. Gaskets: As required to seal joints in decorative formed metal and remain weathertight; as recommended in writing by decorative formed metal manufacturer.

1. ASTM D 1056, Type 1, Class A, grade as recommended by gasket manufacturer to obtain seal for application indicated.
  2. Closed-cell polyurethane foam, adhesive on two sides, release paper protected.
- B. Sealants, Exterior: ASTM C 920; elastomeric silicone sealant; of type, grade, class, and use classifications required to seal joints in decorative formed metal and remain weathertight; and as recommended in writing by decorative formed metal manufacturer.
- C. Sealants, Interior: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834; of type and grade required to seal joints in decorative formed metal and as recommended in writing by decorative formed metal manufacturer.
- D. Filler Metal and Electrodes: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded or brazed and as necessary for strength, corrosion resistance, and compatibility in fabricated items.
1. Use filler metals that will match the color of metal being joined and will not cause discoloration.
- E. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.
1. Provide concealed fasteners for interconnecting decorative formed metal items and for attaching them to other work unless otherwise indicated or exposed fasteners are unavoidable or are the standard fastening method.
  2. Provide Phillips tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- F. Structural Anchors: For applications indicated to comply with certain design loads, provide fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
- G. Nonstructural Anchors: For applications not indicated to comply with design loads, provide fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
- H. Anchor Materials:
1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
  2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F 593, and nuts, ASTM F 594.
- I. Sound-Deadening Materials:
1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C 665, Type I, and passing ASTM E 136 test.
  2. Mastic: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- J. Backing Materials: Provided or recommended by decorative formed metal manufacturer.
- K. Laminating Adhesive: Adhesive recommended by metal fabricator that will fully bond metal to metal, will prevent telegraphing and oil-canning, and is compatible with substrate and noncombustible after curing.
- L. Isolation Coating: Manufacturer's standard alkali-resistant coating.

## 2.5 PAINTS AND COATINGS

- A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20, Type II-Organic, are the following:
1. Zinc Content: 95 percent, minimum.
  2. Solids: 52 percent by volume, minimum.
  3. Dry film thickness not less than 1.5 mils per coat.



4. Color: Flat grey finish matching original hot-dipped galvanizing.
  5. Available Product: ZRC Cold Galvanizing Compound; ZRC Worldwide.
- B. Shop Primers: Comply with Section 09 91 13 "Exterior Painting." and Section 09 96 00 "High-Performance Coatings."
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

## 2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble decorative formed metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Coordinate dimensions and attachment methods of decorative formed metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
- C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch-wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch and support with concealed stiffeners.
- D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.
1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
- E. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce decorative formed metal items as needed to attach and support other construction.
- F. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install decorative formed metal items.
- G. Where welding or brazing is indicated, weld or braze joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.
1. Use welding and brazing procedures that will blend with and not cause discoloration of metal being joined.

## 2.7 CLOSURES AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Fry Reglet Corporation.
  2. Pittcon Industries.
- B. Form closures and trim from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction, with weathertight joints at exterior installations.
1. Aluminum Sheet: Thickness required to comply with performance requirements.
    - a. Finish: Baked enamel or powder coat or High-performance organic coating to match adjacent similar materials.
  2. Closures and trim may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view and not exposed to weather.
- C. Conceal fasteners where possible; otherwise, locate where they are as inconspicuous as possible. Size fasteners to support closures and trim, with fasteners spaced to prevent buckling or waviness in finished surfaces.

- D. Drill and tap holes needed for securing closures and trim to other surfaces.
- E. Incorporate gaskets where indicated or needed for concealed, continuous seal at abutting surfaces.
- F. Miter or cope trim members at corners and reinforce with bent metal splice plates to form tight joints.

## 2.8 ESCALATOR ENCLOSURES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Hi-Tech Metals, Inc.
  - 2. Metal Sales & Service, Inc.; Metalwerks Division.
  - 3. Southwest Metalsmiths.
- B. Form escalator enclosures from metal of type and thickness indicated below. Coordinate size of enclosures, location of cutouts, and method of attachment to adjoining construction.
  - 1. Stainless Steel Sheet: Thickness required to comply with performance requirements.

## 2.9 FILLER PANELS

- A. Form filler panels for closing ends of partition systems and for other applications indicated. Form from two sheets of metal of type and thickness indicated below, separated by channels formed from the same material, producing a panel of same thickness as mullions unless otherwise indicated. Incorporate reveals, trim, and concealed anchorages for attaching to adjacent surfaces.
  - 1. Aluminum Sheet: 0.063 inch or as required to meet performance requirements.
    - a. Finish: As indicated to match adjacent surfaces.
  - 2. Filler panels may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.
- B. Fill interior of panel with sound-deadening insulation permanently attached to inside panel faces.
- C. Adhesively attach gaskets to filler panel edges where they abut mullions or glazing. Use 1-inch-square material, unless otherwise indicated, set approximately 1/4 inch into channeled edge of filler panel.
- D. Attach gaskets to all edges of panels that abut adjacent surfaces to form a continuous seal. Use compressible gaskets or mastic sealing tape, applied to center of panel edges to be concealed from view, unless otherwise indicated.
- E. Do not mechanically fasten filler panels to mullions.

## 2.10 MULLION CLADDING

- A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
  - 1. Hi-Tech Metals, Inc.
  - 2. Metal Sales & Service, Inc.; Metalwerks Division.
  - 3. Southwest Metalsmiths.
- B. Form mullion cladding from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction.
  - 1. Aluminum Sheet: Thickness required to comply with performance requirements .
    - a. Finish: Baked enamel or powder coat or High-performance organic coating.

**2.11 WINDOW STOOLS**

- A. Form window stools from metal of type and thickness indicated below, with end closures:
  - 1. Aluminum Sheet: Thickness required to comply with performance requirements .
    - a. Finish: Baked enamel or powder coat or High-performance organic coating.
- B. Weld seams at end closures.
- C. Apply sound-deadening insulation to underside of window stools.

**2.12 GENERAL FINISH REQUIREMENTS**

- A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

**2.13 ALUMINUM FINISHES**

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.
- C. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

**2.14 STEEL SHEET FINISHES**

- A. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
- B. Pretreatment: Immediately after cleaning, apply a conversion coating of type suited to organic coating.
- C. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
- D. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat.

Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

1. Color and Gloss: As selected by Architect from manufacturer's full range.
- E. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils. Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.
1. Color and Gloss: As selected by Architect from manufacturer's full range.

## **2.15 STAINLESS STEEL FINISHES**

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  1. Run grain of directional finishes with long dimension of each piece.
- C. Directional Satin Finish: No. 4.
- D. Dull Satin Finish: No. 6.
- E. Satin, Reflective, Directional Polish: No. 7.
- F. Mirrorlike Reflective, Nondirectional Polish: No. 8 finish.
- G. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative formed metal.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.
  1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.
- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
- D. Install concealed gaskets, joint fillers, sealants, and insulation, as the Work progresses, to make interior decorative formed metal items soundproof or lightproof as applicable to type of fabrication indicated.
- E. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

- F. Install decorative-formed-metal-clad doors and frames to comply with requirements specified in Section 08 11 13 "Hollow Metal Doors and Frames."

### **3.3 ADJUSTING AND CLEANING**

- A. Unless otherwise indicated, clean metals by washing thoroughly with water and soap, rinsing with clean water, and drying with soft cloths.
- B. Touchup Painting:
  - 1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting," Section 09 91 23 "Interior Painting," and Section 09 96 00 "High-Performance Coatings."
- C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

### **3.4 PROTECTION**

- A. Protect finishes of decorative formed metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 06 10 00 - ROUGH CARPENTRY****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
  - 1. Section 03300 - "Cast in Place Concrete"
  - 2. Section 04200 - "Unit Masonry"
  - 3. Section 07411 - "Manufactured Roof Panels"
  - 4. Section 07552 - "SBS-Modified Bituminous Membrane Roofing"
  - 5. Section 07600 - "Flashing and Sheet Metal": for special flashing over roof sheathing.
  - 6. Section 06200 - "Finish Carpentry"
  - 7. Section 09250 - "Gypsum Drywall"

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Framing with dimension lumber.
  - 2. Wood grounds, nailers, and blocking.
  - 3. Roof and wall sheathing (plywood).
  - 4. Framing anchors and miscellaneous accessories.
  - 5. Air infiltration barrier over all sheathing (roofs, walls, etc.).

**1.3 DEFINITIONS**

- A. Rough carpentry includes carpentry work not specified as part of other Sections and generally not exposed, unless otherwise specified.

**1.4 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for the following products:
  - 1. Air infiltration barrier.
  - 2. Metal framing anchors.
  - 3. Plywood sheathing.
  - 4. Construction adhesives.
- C. Material certificates for dimensional lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use as well as design values approved by the Board of Review of American Lumber Standards Committee.
- D. Wood treatment data as follows including chemical treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material:
  - 1. For each type of preservative treated wood product include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
  - 2. For water-borne treated products include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to project site.
  - 3. Warranty of chemical treatment manufacturer for each type of treatment.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.
  - 1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.
- B. Refer to Division 1 Sections "Summary of Work" and "Special Conditions" for additional information and requirements regarding stored materials.

**PART 2 - PRODUCTS****2.1 LUMBER, GENERAL**

- A. Lumber Standards: Furnish lumber manufactured to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
- B. Inspection Agencies and Standards: Inspection agencies and standards and the abbreviations used to reference them with lumber grades and species include the following:
  - 1. AFPA - American Forest and Paper Association (formerly NFPA)
  - 2. AITC - American Institute of Timber Construction
  - 3. AWWA - American Wood Preservers Association
  - 4. AWPB - American Wood Preservers Bureau
  - 5. NLGA - National Lumber Grades Authority (Canadian).
  - 6. SPIB - Southern Pine Inspection Bureau.
  - 7. TPI - Truss Plate Institute.
  - 8. WCLIB - West Coast Lumber Inspection Bureau.
  - 9. WWPA - Western Wood Products Association.
- C. Grade Stamps: Provide lumber with each piece factory-marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
  - 1. For exposed lumber furnish pieces with grade stamps applied to ends or back of each piece; or omit grade stamps entirely and provide certificates of grade compliance issued by inspection agency.
- D. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.
  - 1. Provide dressed lumber, S4S, unless otherwise indicated.
  - 2. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.

**2.2 DIMENSION LUMBER**

- A. For light framing provide "Stud," or "Standard" grade lumber for stud framing (2 to 4 inches thick, 2 to 4 inches wide, 10 feet and shorter) and "Standard" grade for other light framing (2 to 4 inches thick, 2 to 6 inches wide), and as follows:
  - 1. Southern Yellow Pine graded under SPIB rules, No 2 or better.
- B. For structural light framing (2 to 4 inches thick, 2 to 4 inches wide), provide the following grade and species:
  - 1. "No. 2" grade, Stress Rated, with the following minimum properties:
    - a. Fb = 1,150 psi.
    - b. E = 1,500,000 psi.
  - 2. Species: Southern yellow pine or approved equivalent.



- C. For structural framing (2 to 4 inches thick, 5 inches and wider), provide the following grade and species:
  - 1. Same as indicated above for structural light framing.

### 2.3 BOARDS

- A. Concealed Boards: Where boards will be concealed by other work, provide lumber of 19 percent maximum moisture content (S-DRY or KD-19) and of following species and grade:
  - 1. Southern Pine No. 2 boards per SPIB rules, or any species graded construction boards per WCLIB, or WWPA rules.

### 2.4 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.
- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
- C. Moisture content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.
- D. Grade: "Standard" grade light-framing-size lumber of any species or board-size lumber as required. "No. 3 Common" or "Standard" grade boards per WCLIB or WWPA rules or "No. 2 Boards" per SPIB rules.

### 2.5 CONSTRUCTION PANELS, GENERAL

- A. Construction Panel Standards: Comply with DOC PS 1 "U.S. Product Standard for Construction and Industrial Plywood" for plywood construction panels and, for products not manufactured under PS 1 provisions, with APA PRP-108.
  - 1. Oriented Strand Board: Comply with DOC PS 2.
- B. Trademark: Furnish construction panels that are each factory- marked with APA trademark evidencing compliance with grade requirements.

### 2.6 CONCEALED PERFORMANCE-RATED CONSTRUCTION PANELS

- A. General: Where construction panels are indicated for the following concealed types of applications, provide APA Performance-Rated Panels complying with requirements designated under each application for grade designation, span rating, exposure durability classification, edge detail (where applicable), and thickness.
- B. Wall Sheathing: APA RATED SHEATHING, Veneer Core Plywood.
  - 1. Exposure Durability Classification: EXTERIOR.
  - 2. Span Rating: As required to suit stud spacing indicated.
  - 3. Thickness: 5/8 inch (nominal), unless otherwise indicated, or as required to match thickness of any contiguous gypsum or other sheathing.
- C. Wall Sheathing: Glass-Mat Gypsum Sheathing, Walls: ASTM C 1177/C 1177M.: EXTERIOR.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corporation; GlasRoc.
    - b. G-P Gypsum Corporation; Dens-Glass.
    - c. National Gypsum Company; Gold Bond eXP.
    - d. United States Gypsum Co.; Securock.
  - 2. Type and Thickness: Type X, 5/8 inch thick.
- C. Roof Sheathing: APA RATED SHEATHING, Veneer Core Plywood; Tongue-and-Groove Edges.
  - 1. Exposure Durability Classification: EXPOSURE 1.
  - 2. Span Rating: As required to suit rafter spacing indicated.

3. 40/20 minimum, unless otherwise indicated.
4. Thickness: 5/8 inch at sloped roofs and where required at parapet walls, unless otherwise indicated; 3/4-inch at any roofing substrates with less than 3:12 slope.

## 2.7 CONSTRUCTION PANELS FOR BACKING

- A. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels with grade designation, APA C-D PLUGGED EXPOSURE 1, in thickness indicated, or, if not otherwise indicated, not less than 3/4 inch.

## 2.8 AIR INFILTRATION BARRIER

- A. Asphalt-saturated organic felt complying with ASTM D 226, Type I (No. 15 asphalt felt), unperforated.
  1. Refer to roofing sections in Division 7 for requirements for roofing felts and waterproofing underlayments, which are in addition to any felts furnished under this Section 06100.

## 2.9 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  1. Where rough carpentry is exposed to weather, in ground contact, in area of high relative humidity, or in contact with preservative pressure treated (P.T.) wood or fire-retardant treated wood, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of AISI Type 304 or 316 stainless steel.
- B. Nails, Wire, and Brads: FS FF-N-105.
- C. Power Driven Fasteners (screws): National Evaluation Report NER-272.
- D. Wood Screws: ANSI B18.6.1.
- E. Lag Bolts: ANSI B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.

## 2.10 METAL FRAMING ANCHORS

- A. General: Provide metal framing anchors of type, size, metal, and finish indicated that comply with requirements specified including the following:
  1. Current Evaluation/Research Reports: Provide products for which model code evaluation/research reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with the building code in effect for this Project.
  2. Allowable Design Loads: Provide products for which manufacturer publishes allowable design loads that are determined from empirical data or by rational engineering analysis and that are demonstrated by comprehensive testing performed by a qualified independent testing laboratory.
- B. Galvanized Steel Sheet: Steel sheet zinc-coated by hot-dip process on continuous lines prior to fabrication to comply with ASTM A 525 for Coating Designation G90 and with ASTM A 446, Grade A (structural quality); ASTM A 526 (commercial quality); or ASTM A 527 (lock-forming quality); as standard with manufacturer for type of anchor indicated.
  1. Use galvanized steel framing anchors for rough carpentry exposed to weather, in ground contact, or in area of high relative humidity, and all other locations, and at every point of bearing.
  2. Minimum Thickness: 18-gauge.

## 2.11 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by both adhesive and panel manufacturer.
- B. Intermediate Supports for any Square-edge Roof Sheathing: Mill finish aluminum H-clip type supports/spacers, with flat top at roof side, internal "points" for pushing into sheathing to prevent sliding or dislodgement, of size required for sheathing thickness, and in compliance with referenced standards.

## **2.12 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS**

- A. General: Where lumber is indicated as preservative- treated wood or is specified herein to be treated, comply with applicable requirements of AWWA Standards C2 (Lumber). Mark each treated item with the AWPB or SPIB Quality Mark Requirements.
- B. Pressure-treat above-ground items with water-borne preservatives to a minimum retention of 0.25 pcf. For interior uses, after treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Treat indicated items and the following:
  - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
  - 3. Wood framing members less than 18 inches above grade.
    - a. Exception: Not required above treated bottom plate for framing which is bearing on concrete floor slab on grade.
  - 4. Wood floor plates installed on concrete slabs or directly in contact with earth.
- C. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces to comply with AWWA M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION, GENERAL**

- A. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.
- B. Set rough carpentry to required levels and lines, with members plumb and true to line and cut and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.
- E. Countersink nail heads on exposed carpentry work and fill holes.
- F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

### **3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS**

- A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

- B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
- C. Install permanent grounds of dressed, preservative treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

### 3.3 WOOD FRAMING, GENERAL

- A. Framing Standard: Comply with A.F.P.A. "Manual for Wood Frame Construction", unless otherwise indicated.
- B. Install framing members of size and spacing indicated, or if not indicated, to comply with referenced standard.
- C. Anchor and nail as shown, and to comply with the following:
  - 1. Published requirements of manufacturer of metal framing anchors.
  - 2. "Fastening Schedule," of the International Building Code.
- D. Fire stop concealed spaces of wood framed walls and partitions at each floor level and at the ceiling line of the top story. Where fire stops are not automatically provided by the framing system used, use closely fitted wood blocks of nominal 2-inch-thick lumber of the same width as framing members.

### 3.4 STUD FRAMING

- A. General: Arrange studs so that wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel. Install single bottom plate and double top plates using 2-inch thick members whose widths equal that of studs. Nail or anchor plates to supporting construction, as indicated and as required by applicable codes and standards, authorities having jurisdiction, and project conditions.
  - 1. Anchor bottom plates to concrete slabs with at least 2-inch diameter galvanized anchor bolts with nuts and washers at 4'-0" o.c. (minimum) and otherwise as required by code and project conditions.
  - 2. For exterior walls install 2-inch by 6-inch wood studs spaced 24 inches o.c., unless otherwise indicated.
  - 3. For interior partitions and walls install 2-inch by 4-inch wood studs spaced 16 inches o.c., unless otherwise indicated.
  - 4. The extent of wood stud framing, if any, is indicated on the Drawings.
- B. Construct corners and intersections with not less than 3 studs. Install miscellaneous blocking and framing as shown and as required for support of facing materials, fixtures, specialty items, and trim.
  - 1. Install continuous horizontal blocking row at mid-height of single-story partitions over 8 feet high and at midpoint of multi-story partitions, using 2-inch thick members of same width as wall or partitions.
- C. Frame openings with multiple studs and headers. Install nailed header members of thickness equal to width of studs. Set headers on edge and support on jamb studs.
  - 1. For nonbearing partitions, install double-jamb studs and headers not less than 4 inches deep for openings 3 feet and less in width, and not less than 6 inches deep for wider openings.
  - 2. For load-bearing partitions, install double-jamb studs for openings 6 feet and less in width, and triple-jamb studs for wider openings. Install headers of depth shown, or if not shown, as recommended by A.F.P.A. "Manual for Wood Frame Construction".
- D. Install diagonal bracing in stud framing of exterior walls, except as otherwise indicated. Brace both walls at each external and internal corner, full story height, at a 45 degree angle, using either a let-in 1 by 4 or 2 by 4 blocking or metal diagonal bracing. Omit bracing where following types of sheathing are indicated.

1. Plywood sheathing or corner bracing, 8-foot-wide panels, vertically, at each face of any wall framing at corners.

### 3.5 INSTALLATION OF CONSTRUCTION PANELS

- A. General: Comply with applicable recommendations contained in Form No. E30, "APA Design/Construction Guide - Residential & Commercial," for types of construction panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
  1. Roof Sheathing and Wall Sheathing: Nail to framing.
  2. Subfloor Sheathing: Glue and screw to supports.
  3. Plywood Backing Panels, if any: Nail to wood supports; toggle-bolt or expansion bolt anchors to masonry back-up; screw to metal supports.
- C. Intermediate Supports: Provide H-clip spacers at midpoints between supports for any square-edge roof sheathing, which is otherwise unsupported; Not required at engaged tongue-and-groove edges.

### 3.6 AIR INFILTRATION BARRIER

- A. Cover exterior sheathing with air infiltration barrier as follows:
  1. Apply asphalt-saturated organic felt horizontally with 2-inch overlap and 6-inch endlap; fasten to sheathing with corrosion-resistant staples, or round-head corrosion-resistant nails installed through 1 inch minimum diameter discs row with 1 inch diameter heads.
  2. Apply air infiltration barrier to cover upstanding flashing with 4-inch overlap.
  3. Refer to Division 7 Section "Flashing and Sheet Metal" for locations where waterproofing underlayment is required, as replacement for temporary felts and/or in addition to felts specified in this Section 06100, whether or not indicated on the Drawings.
    - a. Note that waterproofing underlayments / "special flashing" is to be adhered to deck and covered with air infiltration barrier / felt.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 06 20 00 - FINISH CARPENTRY****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Related work specified elsewhere includes:
  - 1. Section 05 50 00 - "Metal Fabrications"
  - 2. Section 06 10 00 - "Rough Carpentry"
  - 3. Section 06 40 00 - "Architectural Woodwork"
  - 4. Section 07 90 00 - "Joint Sealers"
  - 5. Section 08 71 00 - "Finish Hardware"
  - 6. Section 09 90 00 - "Painting"

**1.2 DESCRIPTION OF WORK**

- A. Definition: Finish carpentry includes carpentry work which is exposed to view, is non-structural, and which is not specified as part of other sections.
- B. Types of finish carpentry work in this section include:
  - 1. Interior and exterior running and standing trim.
  - 2. Plywood and panels for opaque finish.
- C. Refer to Section 06 10 00 - "Rough Carpentry", Section 05 50 00 - "Metal Fabrications" and Structural Drawings for framing anchors.
- D. Finish carpentry is intended to be finish painted on site, under section 09 90 00.
  - 1. All standing and running trim and all exposed lumber and wood products shall be back-primed prior to installation.
  - 2. Framing and deck above any soffit vents and any perforated soffit materials shall be painted with minimum 1-coat non-specular flat black enamel prior to installation of soffit vents, under Section 09900.

**1.3 QUALITY ASSURANCE**

- A. Factory-mark each piece of lumber and plywood with type, grade, mill and grading agency identification; except omit marking from surfaces to receive transparent finish, and submit mill certificate that material has been inspected and graded in accordance with requirements if it cannot be marked on a concealed surface.

**1.4 SUBMITTALS**

- A. Product Data: Submit manufacturer's specifications and installation instructions for each item of factory-fabricated products, siding, paneling, trim, etc. Include color samples for items requiring color selection.
- B. Samples: Submit the following samples for each species and cut or pattern of finish carpentry.
  - 1. Interior Standing and Running Trim: 2'-0" long x full board or molding width, unfinished.
  - 2. Exterior Standing and Running Trim: 2'-0" long x full board or molding width, unfinished.
- C. Wood Treatment Data: Submit chemical treatment manufacturer's instructions for handling, storage, installation and finishing treated materials, if required.

**1.5 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Protect finish carpentry materials during transit, delivery, storage, and handling to prevent damage, soiling and deterioration.
- B. Do not deliver finish carpentry materials, until painting, wet work, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed in installation areas. If, due to unforeseen circumstances, finish carpentry materials must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

## 1.6 JOB CONDITIONS

- A. Conditioning: Installer shall advise Contractor of temperature and humidity requirements for finish carpentry installation areas. Do not install finish carpentry until required temperature and relative humidity conditions have been stabilized and will be maintained in installation areas.
- B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed finish carpentry within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. The fabricator of woodwork shall determine optimum moisture content and required temperature and humidity conditions.

## PART 2 - PRODUCTS

### 2.1 WOOD PRODUCT QUALITY STANDARDS

- A. Softwood Lumber Standards: Comply with PS 20 and with applicable grading rules of the respective grading and inspecting agency for the species and product indicated.
- B. Plywood Standard: Comply with PS 1/ANSI A199.1.
- C. Hardwood Lumber Standard: Comply with National Hardwood Lumber Association (NHLA) rules.
- D. Woodworking Standard: Where indicated for a specific product comply with specified provisions of the following:
  - 1. Architectural Woodwork Institute (AWI) "Quality Standards".

### 2.2 MATERIALS

- A. General:
  - 1. Nominal sizes are indicated, except as shown by detailed dimensions. Provide dressed or worked and dressed lumber, as applicable, manufactured to the actual sizes as required by PS 20 or to actual sizes and pattern as shown, unless otherwise indicated.
  - 2. Moisture Content of Softwood Lumber: Provide kiln-dried (KD) lumber having a moisture content from time of manufacture until time of installation not greater than values required by the applicable grading rules of the respective grading and inspecting agency for the species and product indicated.
  - 3. Moisture Content of Hardwood Lumber: Provide kiln-dried (KD) lumber having a moisture content from time of manufacture until time of installation within the ranges required in the referenced woodworking standard.
  - 4. Lumber for Transparent Finish (Stained or Clear): Refer to Section 06400 - "Architectural Woodwork".
  - 5. Lumber for Painted Finish: At Contractor's option, use pieces which are either glued-up lumber or made of solid lumber stock.
- B. Interior and Exterior Finish Carpentry:
  - 1. WM/Series Wood Molding Patterns: For stock molding patterns graded under Wood Molding and Millwork Producers Industry WM 4, provide the following grade based on finish indicated and fabricated from any Western hardwood species graded and inspected by WWPA or other referenced standard or agency.
    - a. Moldings for Transparent Finish: N-Grade (finger joints not permitted); Refer to Section 06 40 00 - "Architectural Woodwork".
    - b. Moldings for Painted Finish: P-Grade.



2. Standing and Running Trim for Painted Finish: Any Western hardwood species (interior) graded and inspected by WWPA, and softwood (exterior) as indicated, complying with following requirements:
  - a. Grade for Standard Sizes and Patterns:
    - 1) "C Select" or "Choice" for White Pine or Spruce (exterior);
    - 2) "C Select" or "Choice" for White or Yellow Poplar (interior), except where trim is associated with woodwork specified in Section 06400, in which case such trim shall match the stained and sealed hardwood indicated therein.
  - b. Grade for Special (Custom) Sizes and Patterns: Custom for quality of materials and manufacture as required in referenced woodworking standard.
3. Hardwood Plywood Stock Panels: Provide manufacturer's stock hardwood plywood panels complying with applicable requirements of PS 51 for species and grade of face veneers and backing, adhesive, construction, thickness, panel size, and finish.
  - a. Face Veneer Species for Painted Finish: Rotary cut Natural Birch.
  - b. Grade: Premium.
  - c. Backing Veneer Species: Any hardwood compatible with face species.
  - d. Construction: Veneer core.
  - e. No. of Plies: 5.
  - f. Thickness: As indicated on the Drawings, or if not indicated, at least 3/4-inch.
  - g. Panel Size: As required.
  - h. Plywood Type (Water Resistance Capability): Type I at Exterior and Type II at Interior.
  - i. Face Pattern: Plain (no grooves) with veneer edge matched within each panel face to comply with type of match required by referenced product standard.
  - j. Face Veneer Matching (Panel-to-Panel): No match required.
  - k. Finish: Polish sanded.
4. Softwood Plywood: Comply with DOC PS 1, "U.S. Product Standard for Construction and Industrial Plywood."
  - a. Face Veneer Species for Painted Finish: SYP, or any similar species permitted by referenced standards.
  - b. Grade:
    - 1) Plywood Soffits (if any): A-C, minimum.
    - 2) Exposed Roof Decking for Opaque Finish (if any): B-C, minimum.
    - 3) Exposed Roof Decking for Transparent (stained) Finish (if any): A-C, minimum.
    - 4) Sub-flooring: Tongue-and-groove, and as follows:
      - a) Below Carpet and at Attics: B-C, minimum.
      - b) Below Vinyl Floor Coverings: A-C, minimum.
  - c. Backing Veneer Species: Same as face veneer.
  - d. Construction: Veneer core.
  - e. Thickness: As indicated on the Drawings, or if not indicated, at least as follows:
    - 1) Soffits: 1/2-inch.
    - 2) Sub-flooring: 3/4-inch, tongue-and-groove.
  - f. Panel Size: As required.
  - g. Plywood Type (Water Resistance Capability): Type I (exterior).
  - h. Finish: Exterior pieces primed at back and edges prior to installation (typical), with face finish as follows:
    - 1) Typical: Sanded.

### 2.3 MISCELLANEOUS MATERIALS

- A. Fasteners and Anchorages: Provide nails, screws and other anchoring devised of the type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible, and complying with applicable Federal Specifications and the Standard Building Code.
  1. Where finish carpentry is exposed on exterior or in areas of high relative humidity, provide fasteners and anchorages with a hot-dipped zinc coating (ASTM A 153).

## PART 3 - EXECUTION

**3.1 PREPARATION**

- A. Condition wood materials to average prevailing humidity conditions in installation areas prior to installing.
- B. Backprime Lumber and panel products for painted finish exposed on the exterior and where exposed to moisture and high relative humidity on the interior. Comply with requirements of Section 09900 - "Painting", for primers and their application.
- C. Pre-Installation Meeting: Meet at project site prior to delivery of finish carpentry materials and review coordination and environmental controls required for proper installation and ambient conditioning in areas to receive work. Include in meeting the Contractor, Architect and other Owner Representatives (if any), Installers of finish carpentry, wet work including plastering, other finishes, painting, mechanical work and electrical work, and firms and persons responsible for continued operation (whether temporary or permanent) of HVAC system as required to maintain temperature and humidity conditions.

**3.2 INSTALLATION**

- A. Discard units of material which are unsound, warped, bowed twisted, improperly treated, not adequately seasoned or too small to fabricate work with minimum of joints or optimum jointing arrangements, or which are of defective manufacture with respect to surfaces, sizes or patterns.
- B. Install the work plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8" in 8'-0" for plumb and level countertops; and with 1/16" maximum offset in flush adjoining 1/8" maximum offsets in revealed adjoining surfaces.
- C. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.
- D. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum lengths of lumber available) to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns, miter at corners, to produce tight fitting joints with full surface contact throughout length of joint. Use scarf joints for end-to-end joints.
- E. Anchor finish carpentry work to anchorage devices or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fasteners heads are required, use fine finishing nail for exposed nailings, countersunk and filled flush with finished surface, and matching final finish where transparent is indicated.
- F. Hardwood Plywood Paneling: Where grain character or color variations are noticeable, select and arrange panels on each wall for best match of adjacent panels. Install with uniform, tight joints between panels.
  - 1. Attach panels to supports with panel adhesive and fasteners, plus nailing, in accordance with manufacturer's current written instructions for concealed-fastener installation.
  - 2. Apply panel adhesive on supports, immediately prior to panel placement and nailing.
- G. Plywood Panels: Install panels with edges over continuous framing or blocking. Nail at 6-inch (150-mm) intervals at panel perimeter and 12-inch (300-mm) intervals at intermediate supports, unless manufacturer recommends other intervals. Leave 1/16-inch (1.5-mm) gap between adjacent panels, unless otherwise recommended in writing by panel manufacturer. Leave 1/8-inch (3-mm) gap at perimeter and openings, unless otherwise recommended by panel manufacturer.
  - 1. Seal unavoidable butt joints at inside and outside corners and at trim locations.
  - 2. Conceal fasteners to greatest practical extent by countersinking and filling.

**3.3 ADJUSTMENT, CLEANING, FINISHING AND PROTECTION**

- A. Repair damaged and defective finish carpentry work wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace woodwork.
- B. Clean finish carpentry work on exposed and semi-exposed surfaces. Touch-up shop-applied finishes to restore damaged or soiled areas.

- C. Refer to Section 09 90 00 - "Painting", for final finishing of installed finish carpentry work, not the work of this Section 06 20 00.
- D. Protection: Installer of finish carpentry work shall advise Contractor of final protection and maintained conditions necessary to ensure that work will be without damage at time of acceptance.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 06 40 00 - ARCHITECTURAL WOODWORK****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Related work specified elsewhere includes:
  - 1. Section 06 10 00 - "Rough Carpentry"
  - 2. Section 06 20 00 - "Finish Carpentry"
  - 3. Section 06 65 00 - "Solid Surface Fabrications"
  - 4. Section 07 90 00 - "Joint Sealers"
  - 5. Section 08 21 10 - "Flush Wood Doors"
  - 6. Section 08 71 00 - "Finish Hardware"
  - 7. Section 09 90 00 - "Painting"

**1.2 DESCRIPTION OF WORK**

- A. Extent of each type of architectural woodwork is indicated on drawings and in schedules.
- B. Types of architectural woodwork include the following, and related work and trim:
  - 1. Laminate clad cabinets and countertops (millwork), with typical balance sheets and exposed edges finished to match laminate facings, and as otherwise indicated and specified; Similar laminate clad wall and ceiling panels with balance sheet, self-edged and concealed anchorage.
  - 2. Closet and utility shelving (paint on site, under Section 09 90 00).
  - 3. Wood frames, sidelights, panels, base, and miscellaneous trim; For stained finish, unless specifically indicated otherwise on the Drawings.
  - 4. Wood frames, panels, base, and miscellaneous trim, for opaque finish, at locations specifically indicated on the Drawings.
  - 5. Hardware for architectural woodwork.
- C. Architectural woodwork and components for natural, stained and/or transparent finish are intended to be painted in woodwork fabricator's shop under controlled conditions, under the work of this Section 06 40 00; Typical wood finish unless specifically indicated otherwise on the Drawings.
- D. Architectural woodwork and components intended for opaque finish are intended to be finish painted on-site, under Section 09900; Only where specifically indicated on the Drawings.

**1.3 QUALITY ASSURANCE**

- A. AWI Quality Standard: Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI), except as otherwise indicated.
- B. Fabricator Qualifications: Fabricators shall be experienced firms specializing in the types of architectural woodwork required for this project for at least the past 5-verifiable years and on at least 10-verifiable projects of similar size, scope, complexity, and quality as this project. Prequalification is required.
- C. Installer Qualifications: Arrange for installation of architectural woodwork by the fabricator, or by a firm under the control and direction of the fabricator, which can demonstrate at least 5-verifiable years successful experience in installing architectural woodwork items on at least 5-verifiable projects, similar in type and quality to those required for this project.

- D. Refer to Division 1 Section “Special Conditions”, for additional information and minimum experience requirements.

#### **1.4 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Shop Drawings: Submit shop drawings showing location of each item, dimensioned plans and elevations, large scale details, attachment devices and other components.
  - 1. Manufacturer’s current and complete product data, for manufactured units of work, including color selection data and samples; and design load capacities for any wood columns, and their components, capitals, plinths and anchorage systems.
- C. Samples: Submit the following samples:
  - 1. Lumber and panel products with or for transparent finish; 6-inches x 3/4-inch x 18-inches, for each species and cut, finished on 1-side and 1-edge.
  - 2. Lumber and panel products with factory-applied opaque finish, 8-inches x 10-inches, for each finish system and color.
  - 3. Plastic Laminate Products: Manufacturer’s standard samples, approximately 3-inches x 3-inches, with finish as required for this project, and representative color range anticipated.
  - 4. Exposed Cabinet Hardware Support Hardware: One unit of each type and finish, which will be returned for use on the project, upon request by the Contractor.
- D. Qualification data for manufacturer and installer.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with manufacturer’s current written instructions and recommendations.
- B. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soiling, and deterioration.
- C. Do not deliver woodwork, until painting, wet work, grinding and similar operations which could damage, soil, or deteriorate woodwork have been completed in installation areas. If, due to unforeseen circumstances, woodwork must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.
- D. Refer to Division 1 Sections “Summary of Work” and “Special Conditions” for additional information and requirements regarding stored materials.

#### **1.6 PROJECT CONDITIONS**

- A. Conditioning: Woodwork Manufacturer and Installer shall advise Contractor of temperature and humidity requirements for woodwork installation and storage areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.
- B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0-percent tolerance of optimum moisture content, from date of installation through remainder of construction period. Require Woodwork Manufacturer to establish optimum moisture content and required temperature and humidity conditions.

### **PART 2 - PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Laminate Clad Cabinet Manufacturers: Subject to compliance with requirements, provide premium grade custom made cabinets and woodwork from a millwork shop complying with requirements of “Quality Assurance” article above.

- B. Plastic Laminate Manufacturer: Subject to compliance with requirements, provide solid, stippled, textured, and/or patterned high pressure decorative laminates of one of the following:
1. Ralph Wilson Plastics Co.
  2. Formica Corporation.
  3. Micarta Division, Westinghouse Electric Corporation.
  4. Any additional manufacturers indicated on the Drawings (if any).
- C. Pre-Approved Woodwork, Wood and Laminate Clad Cabinet Manufacturers: Subject to compliance with requirements, provide premium grade custom made cabinets of one of the following:
1. ALCO Enterprises, Inc.; Montgomery, AL; (334) 264-3998.
  2. Architectural Specialties Trading Company; Pensacola, FL; (850) 435-2507.
  3. Cabinets By Design; Duluth, GA; (770) 418-1200
  4. Columbus Cabinet Company; Columbus, GA; (706) 561-6497.
  5. Commercial Millwork, Inc.; Montgomery, AL (334) 288-0683.
  6. Deas Construction, Inc.; Mobile, AL; (251) 478-1060.
  7. Distinctive Cabinets, Inc.; Mobile, AL; (251) 478-6054.
  8. Fabrication Specialists, Inc.; Mobile, AL; (251) 660-1080.
  9. Hartley Woodcraft, LLC; Montgomery, AL; (334) 593-7653.
  10. Hunters Trail Cabinets; Deatsville, AL; (334) 569-1227.
  11. Imperial Woodworking Co.; Palatine, IL; (847) 358-6920.
  12. JIMCO, Inc.; Montgomery, AL; (334) 264-5032.
  13. Luttrell Architectural Woodworks, Inc.; Birmingham, AL; (205) 324-3421.
  14. Marshall Lumber & Mill Company; Montgomery, AL; (334) 263-0525.
  15. Mortensen Woodwork, Inc.; Union City, GA; (770) 969-1475.
  16. Phipps Cabinets, Inc.; Dothan, AL; (334) 983-4512.
  17. Varner Woodworks, Inc.; Montgomery, AL; (334) 284-1675
  18. Woodcraft Mfg.; Gulf Breeze, FL; (850) 932-9366.
  19. Other manufacturers shall be as properly submitted at least 10-days prior to Bid Date and subsequently approved for bidding by Architect, in writing or by Addendum. Refer to Division 1 Section "Special Conditions", for additional information and requirements regarding submittals and substitutions.

## 2.2 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber at time of fabrication and for relative humidity conditions in the installation areas.
- B. Fabricate woodwork to dimensions, profiles, and details indicated with dowel, dado, glue and screw construction, with openings and mortises precut, where possible, to receive hardware and other items and work.
1. Ease edges to a 1/16-inch radius, for corners of cabinets and edges of solid wood (lumber) members less than 1-inch in nominal thickness, 1/8-inch radius for edges of rails and similar members over 1-inch in nominal thickness.
- C. Complete fabrication, assembly, hardware application, and other work before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Pre-Cut Openings: Fabricate architectural woodwork with pre-cut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing-in diagrams for proper size and shape. Smooth edges of cutoffs and, where located in countertops and similar exposures seal edges of cutouts with a water-resistant coating.
- E. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit. A tight fit of less than 1/8-inch is expected.

**2.3 FIRE-RETARDANT MATERIALS**

- A. Where fire-retardant treated lumber is indicated, provide materials which are pressure impregnated with fire-retardant chemicals and comply with the following requirements:
  - 1. As required to comply with referenced standards and finish classifications necessary as per the International Building Code, NFPA 101 - Life Safety Code, authorities having jurisdiction, and acceptable in all respects for indoor use and finish requirements.
  - 2. Fire-Retardant Chemicals: Use chemicals of type and for applications indicated which do not bleed-through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated lumber from untreated lumber.
- B. Fire Performance Characteristics: Provide materials which are identical to those tested per ASTM methods and time periods indicated, are marked and listed for fire performance characteristics by Underwriters Laboratories, Inc., or other testing and inspecting agency acceptable to authorities having jurisdiction, and comply with the following requirements:
  - 1. Mill lumber after treatment, within limits set for wood removal which does not affect listed fire performance characteristics, using a woodworking plant certified by testing and inspecting agency.
- C. Marking: Identify treated lumber with separable paper classification marking of inspecting and testing agency, unless otherwise indicated.
- D. Surface Burning Characteristics: Not exceeding values required by latest edition of the "International Building Code" and "NFPA 101" (with amendments), tested per ASTM E 84 for standard time period.
  - 1. Flame Spread: Per Code.
  - 2. Smoke Developed: Per Code.
- E. Kiln-dry woodwork after treatment to levels required for non-fire-retardant treated woodwork materials. Maintain moisture content required by kiln drying, before and after treatment.
  - 1. Discard treated lumber which does not comply with requirements of referenced woodworking standard. Do not use twisted, warped, bowed, discolored, or otherwise damaged or defective lumber.

**2.4 STANDING AND RUNNING TRIM**

- A. Quality Standard: Comply with AWI Section 300.
- B. Rout or groove backs of flat trim members, kerf backs of other wide flat members, except for members with ends exposed in finished work.
- C. Assemble Casings in plant except where limitations of access to place of installation require field assembly.
- D. Interior Trim for Transparent Finish ("stain" or "stained"; typical finish unless specifically indicated otherwise): Comply with the following requirements:
  - 1. Grade: Premium, Grade I.
  - 2. Lumber Species: Per Finish Legend in Drawings, Rotary Cut; Consistent similar appearance on all trim, with no "green" or "brown" colored wood.
  - 3. Cut: Per Finish Legend in Drawings.
  - 4. Locations: Provide stained transparent finish where indicated on the Drawings, for wood trim (concealed anchorage), and other stained woodwork, unless indicated otherwise.
- E. Interior Trim for Opaque Finish ("paint" or "painted"; only where specifically indicated): Comply with the following requirements and Section 06200:
  - 1. Grade: Premium, Grade II.
  - 2. Lumber Species: Any closed-grain hardwood listed in referenced woodworking standard.
  - 3. Cut: Plain or Rotary cut.
  - 4. Locations: Provide opaque finish where indicated on the Drawings, and for trim within rooms which have new woodwork with opaque finish, unless indicated otherwise.



**2.5 ARCHITECTURAL CABINET TOPS**

- A. Quality Standard: Comply with applicable 400 and its Divisions 400B and 400C.
- B. Type of Top and any Sills - Laminate Clad, including in part, with typical balance sheets and exposed edges finished to match exposed laminate facings, and as otherwise indicated and specified:
  - 1. Grade: Premium; Grade I.
  - 2. Edge Treatment: HPDL to match exposed face; Back- and end-splash pieces similar.
  - 3. Core: Minimum 47-lb. density particle board, except at least 3/4-inch A-B plywood with exterior glue (approved for interior use), at tops with sinks and/or plumbing fixtures.
  - 4. Minimum Thickness: 1-1/4-inches at tops and 3/4-inch at splashes and any indicated sills, unless indicated otherwise on the Drawings.

**2.6 CABINET HARDWARE AND ACCESSORY MATERIALS**

- A. Cabinet Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 71 00 "Door Hardware."
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.
- C. Shelf Rests: BHMA A156.9, B04013; metal.
- D. Drawer Slides: ANSI/BHMA A156.9.
  - 1. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.
    - a. Type: Full extension.
    - b. Material: Stainless steel Zinc-plated ball bearing slides.
  - 2. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
  - 3. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-200.
  - 4. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-200.
- E. Slides with metal ball bearings for Sliding Glass Windows: BHMA A156.9, B07063; Aluminum.
  - 1. Basis of Design: Knappe & Vogt Roll-Ezy Ball Bearing Track Assembly, P992.
- F. Pulls Type & Finish for Premium Spaces: Per Interior Elevations.
- G. Pulls for Generic/BOH Spaces: Standard 4" wire pull.
- H. Door Locks: BHMA A156.11, E07121.
  - 1. Basis of Design: Olympus.
  - 2. Keying: TBD.
  - 3. Scope: TBD.
- G. Drawer Locks: BHMA A156.11, E07041.
  - 1. Basis of Design: Olympus.
  - 2. Keying: TBD
  - 3. Scope: TBD.
- H. Door and Drawer Silencers: BHMA A156.16, L03011.
  - 1. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
    - 1. Satin Stainless Steel: BHMA 630.
- J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- K. Grommets:
  - 1. Doug Mockett, MM3/SET – 1 7/8" MM3 Solid Brass Desk Grommet, Cap and liner set, Finish per Finish Legend on Drawings.
  - 2. Doug Mockett, PCS36AUSB, Small Pop-Up Power Grommet (Power, Dual USB Charger), Finish per Finish Legend on Drawings.

**2.7 CLOSET AND UTILITY SHELVING**

- A. Quality Standard: Comply with AWI Section 600.
- B. Shelving for Opaque Finish: Comply with the following requirements:
  - 1. Location: Typical finish for closet and utility shelving, unless specifically indicated on Drawings as "stain", "stained", "transparent" finish, etc.
  - 2. Grade: Premium.
  - 3. Shelving Material: Birch faced veneer core plywood.
  - 4. Exposed Edging: Solid hardwood.
  - 5. Thickness: 1-inch at wood shelves, unless indicated otherwise
- C. Shelving for *Transparent* Finish: Comply with the following requirements:
  - 1. Location: For closet and utility shelving, only in rooms and locations where specifically indicated on Drawings.
  - 2. Grade: Premium.
  - 3. Species: AWI Veneer Grade A, Select White or Yellow Poplar, Rotary Cut, unless otherwise indicated on the Drawings; Consistent similar appearance on all shelves, with no "green" or "brown" colored wood.
  - 4. Thickness (plywood): 1-inch (minimum), with solid wood nosing.
  - 5. Lumber for shelving, *only* where indicated on the Drawings: 5/4-inch with nosings as indicated.

**2.8 CLOSET AND UTILITY SHELVING HARDWARE**

- A. Adjustable Shelf Standards and Related Supports:
  - 1. Provide standards and supports of type indicated, with matching finish on fasteners and accessories.
  - 2. Horizontal Slotted Type:
    - a. Mortise mounted, 5/8-inch wide x 3/16-inch high x length indicated, plated steel.
    - b. Equivalent to K & V No. 255, BRN.
  - 3. Support Type:
    - a. Closed shelf rest, bronze plated steel.
    - b. Equivalent to K & V No. 256, BRN.
  - 4. Closet Hanger Rod and Support:
    - a. Rod: Equivalent to K&V No. 770-1.
    - b. Supports: Equivalent to K&V No. 734 and No. 735, one (1) each per rod.

**2.9 FASTENERS AND ANCHORS**

- A. Screws: Select material, type, size, and finish required for each use. Comply with FS FF-S-111 for applicable requirements.
- B. Nails: Select material, type, size, and finish required for each use. Comply with FS FF-N-105 for applicable requirements.
- C. Anchors: Select material, type, size, and finish required by each substrate for secure anchorage. Provide non-ferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion-resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts and anchors, as required, to be set into concrete or masonry work for subsequent woodwork anchorage.

**2.10 ARCHITECTURAL LAMINATE CLAD CABINETS**

- A. Quality Standard:
  - 1. Comply with AWI Section 400 and its Divisions 400B and 400C.
  - 2. Grade: Premium.
  - 3. Design: Flush overlay european style with exposed, 5-knuckle adjustable, self-closing hinges, and as otherwise indicated on the Drawings.

4. **NOTE:** Where indicated, any laminate clad wall and ceiling panels shall be similar to cabinet panels, of thickness indicated, with balance sheet and self-edged; Concealed anchorage.
- B. Laminate Cladding: High pressure decorative laminate complying with NEMA LD 3 and as follows:
1. Colors, Patterns and Finishes: As indicated on Finish Legend, if not otherwise indicated, as selected by Architect from laminate manufacturers' standard products in the following categories: Solid, stippled, textured, wood grain and/or patterned colors.
  2. Laminate Grade for Exposed Surfaces: Provide laminate cladding complying with the following requirements for type of surface and grade.
    - a. Horizontal Surfaces: Grade HGS.
    - b. Postformed Surfaces: Grade HGP.
    - c. Vertical Surfaces: Grade HGS.
    - d. Edges: Grade VGS.
- C. Semi-exposed Surfaces:
1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
  2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
    - a. Minimum thickness between 1/2" to 5/8".
  3. Drawer Bottoms: Thermoset decorative panels.
    - a. Drawer bottoms up to 29" to have a minimum thickness to be 1/4".
    - b. Drawer bottoms over 30" to have a minimum thickness to be 1/2".
- D. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- E. Materials/Minimum Thickness: As indicated on the Drawings, or if not indicated, no less than the following.
1. Doors, Drawer Fronts, Tops, Bottoms, Ends and Standards: 3/4-inch MDFP;
    - a. Tall Cabinets - Doors, Ends and Standards: 1-inch MDFP.
  2. Drawer Sides and Backs: 1/2-inch solid hardwood lumber, shop finished.
  3. Cabinet Backs Behind Doors and Drawer Bottoms: As indicated on the Drawings, or if not indicated, no less than 1/4-inch tempered hardboard; Shop sealed and field-painted under Section 09900, or prefinished.
  4. Exposed Cabinet Backs (not behind doors): As indicated on the Drawings, or if not indicated, no less than 1/4-inch or 3/8-inch MDFP.
  5. Shelves: Same as for closet and utility shelves, above.
- F. Hardboard: AHA A135.4 (tempered).
- G. Medium Density Fiberboard: ANSI 208.2; Made without formaldehyde.
- H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- I. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As indicated by laminate manufacturer's designations.

## 2.11 PREFINISHED WOOD PLANK SYSTEM

- A. Basis-of-Design Product: The design is based on the products named in the Finish Legend. Subject to compliance with requirements, provide either the named products or comparable products by another manufacturer. Comparable products are subject to review and approval through the submittal process specified.
1. Panel Thickness/Size: As indicated on Finish Legend.

2. Color and Pattern: As indicated on Finish Legend.
- B. Support System: Manufacturer's mechanical fasteners recommended for type of panel and substrate.

## 2.12 HARDWOOD SHEET MATERIALS

- A. Composite Wood Products: Provide materials that comply with requirements of the Architectural Woodwork Standards for each type of interior architectural woodwork and quality grade specified unless otherwise indicated.
1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
  2. Particleboard: ANSI A208.1, Grade M-2.
  3. Softwood Plywood: DOC PS 1, medium-density overlay.
  4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

## 2.13 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Nailers: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
1. Fire-Retardant Treatment: Complying with requirements; provide where indicated.
- B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.
1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
  2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- D. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

## 2.14 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.
1. Ease edges to radius indicated for the following:
    - a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
    - b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch.
- C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.
1. Disassemble components only as necessary for shipment and installation.
  2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
  3. Notify Architect seven days in advance of the dates and times interior architectural woodwork fabrication will be complete.
  4. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.
    - a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
    - b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

## 2.15 FINISHING OF INTERIOR ARCHITECTURAL WOODWORK - GENERAL

- A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated.

- B. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing of concealed surfaces and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.

## 2.16 SHOP PRIMING

- A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.
- B. Interior Architectural Woodwork for Opaque Finish: Shop prime with one coat of wood primer as specified in Section 09 91 23 "Interior Painting."
  - 1. Backpriming: Apply one coat of primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.
- C. Interior Architectural Woodwork for Transparent Finish: Shop-seal concealed surfaces with required pretreatments and first coat of finish as specified in Section 09 93 00 "Staining and Transparent Finishing."
  - 1. Backpriming: Apply one coat of sealer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

## 2.17 SHOP FINISHING

- A. Finish interior architectural woodwork indicated on Drawings at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with Architectural Woodwork Standards, Section 5 for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.
  - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.
- C. Transparent Finish:
  - 1. Architectural Woodwork Standards Grade: Premium.
  - 2. Finish System:
    - a. Lacquer, Nitrocellulose.
    - b. Lacquer, Pre Catalyzed.
    - c. Lacquer, Post Catalyzed.
    - d. Latex Acrylic, Water Based.
    - e. Varnish, Conversion.
    - f. Oil, Synthetic Penetrating.
    - g. Vinyl, Catalyzed.
    - h. Acrylic Cross Linking, Water Based.
    - i. UV Curable, Acrylated Epoxy, Polyester, or Urethane.
    - j. UV Curable, Water Based.
    - k. Polyurethane, Catalyzed.
    - l. Polyurethane, Water Based.
    - m. Polyester, Catalyzed.
  - 3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
  - 4. Staining: Match Architect's sample.
  - 5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
  - 6. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
  - 7. Sheen: [Flat, 15-30] [Satin, 31-45] [Semigloss, 46-60] [Gloss, 61-100] gloss units measured on 60-degree gloss meter in accordance with ASTM D 523.
- D. Opaque Finish:

1. Architectural Woodworking Standards Grade: Premium.
2. Finish System:
  - a. Lacquer, Nitrocellulose.
  - b. Lacquer, Pre Catalyzed.
  - c. Lacquer, Post Catalyzed.
  - d. Latex Acrylic, Water Based.
  - e. Varnish, Conversion.
  - f. Vinyl, Catalyzed.
  - g. Acrylic Cross Linking, Water Based.
  - h. UV Curable, Acrylated Epoxy, Polyester, or Urethane.
  - i. UV Curable, Water Based.
  - j. Polyurethane, Catalyzed.
  - k. Polyurethane, Water Based.
  - l. Polyester, Catalyzed.
3. Color: Match Architect's sample.
4. Sheen: [Flat, 15-30] [Satin, 31-45] [Semigloss, 46-60] [Gloss, 61-100] gloss units measured on 60-degree gloss meter in accordance with ASTM D 523.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Condition woodwork to average prevailing humidity conditions in installation areas prior to installing.
- B. Pre-Installation Meeting: Meet at project site prior to delivery of architectural woodwork and review coordination and environmental controls required for proper installation and ambient conditioning in areas to receive work. Include in meeting the Contractor; Architect and other Owner Representatives (if any); Installers of architectural woodwork, wet work such as plastering, other finishes, painting, mechanical work and electrical work; and firms or persons responsible for continued operation (whether temporary or permanent) of HVAC system as required to maintain temperature and humidity conditions. Proceed with woodwork installation only when everyone concerned agrees that required ambient conditions can be maintained.
- C. Deliver concrete inserts and similar anchoring devices to be built into substrates, well in advance of time substrates are to be built.
  1. Coordinate location and placement of concealed treated blocking (by others) prior to finish materials installations.
- D. Prior to installation of architectural woodwork, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing.

#### **3.2 INSTALLATION**

- A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.
- B. Install woodwork plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8-inch in 8'-0" for plumb and level (including tops); and with no variations in flushness of adjoining surfaces.
- C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.
  1. Seal all hardware cuts, routed slots, etc., before installation of hardware.
- D. Anchor woodwork to anchors or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fasteners heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork, and matching final finish where transparent finish is indicated.

- E. Standing and Running Trim: Install with maximum number of joints possible, using full-length pieces (from maximum length of lumber available) to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns, miter at corners and comply with referenced Quality Standards for joinery.
- F. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated. Maintain veneer sequence matching (if any) of cabinets with transparent finish.
  - 1. Install cabinets with no more than 1/8-inch in 96-inches sag, bow, or other variation from a straight line.
- G. Wood Storage Shelving: Complete the assembly of units and install in the areas indicated, including hardware and accessories as indicated.
- H. Tops: Anchor securely to base units and other support systems indicated. Caulk space between backsplash and wall with specified sealant.
  - 1. Install countertops with no more than 1/8-inch in 96-inches (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
- I. Refer to Section 09900 – “Painting”, only for final finishing of installed architectural woodwork which is indicated to be painted on site.

### 3.3 ADJUSTMENT, CLEANING, FINISHING, AND PROTECTION

- A. Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate and adjust hardware.
- C. Clean woodwork on exposed and semi-exposed surfaces. Touch-up shop-applied finishes to restore damaged or soiled areas.
- D. Complete the finishing work specified as work of this section, to whatever extent not completed at shop or prior to installation of woodwork.
- E. Provide final protection and maintain conditions, in a manner acceptable to Fabricator and Installer, which ensures architectural woodwork being without damage or deterioration at time of substantial completion.

### 3.4 CABINET HARDWARE SCHEDULE

- A. General: Subject to requirements and finishes stated above, furnish the following items in quantities and at locations indicated, by named manufacturers or equivalent products acceptable to Architect.
  - 1. Cabinet Hinges: Equivalent to 5-knuckle exposed self-closing hinges as manufactured by Julius Blum, Inc., Grass or Stanley.
- B. Cabinet Door and Drawer Pulls:
  - 1. Pulls: Equivalent to Amerock 128mm Stainless Steel Pull, SKU # BP19003SS, complete with fasteners and any necessary accessories. Website: [www.amerock.com](http://www.amerock.com); Phone: 1.800.435.6959.
    - a. Collection: Stainless Steel.
    - b. Center to Center: 5.04”.
    - c. Length: 5.97”.
    - d. Width: 0.38”
    - e. Finish: Stainless Steel.
  - 2. Provide any other pulls as indicated on the Drawings, if any.
- C. Cabinet Door Catches: Manufacturer’s standard 2-screw sill mounted unit made of molded nylon, lipped over sill to form bumper and hold in place, with 2-screw mounted heavy door mounted unit with nylon roller; provide spring-mounted units where required.

1. Acceptable Manufacturers: Any of manufacturers listed for other cabinet hardware.
- D. Drawer Slides: Heavy Duty, non-corrosive (galvanized) full extension ball bearing slides rated at 100-pounds, with positive stop, and self-closing and lift-out disconnect features; Model No. 1429, as manufactured by Knape & Vogt, or equivalent by Blum or Grant.
1. At legal size drawers, use K&V No. 1483 or equivalent, rated at 150-pounds, with same features as noted above.
- E. Shelf Standards: Manufacturer's standard steel units with anchors and supports 5/8-inch wide x 3/16-inch high, adjustable on 1/2-inch centers; Series 255, as manufactured by K&V, or equivalent by Grant or Stanley.
1. Wood Cabinets: Model No. 255 BRN with No. 256 BRN supports and matching fasteners.
  2. Omit standards where fixed shelves are indicated.
  3. All standards to be recess mounted (flush in routed dados), unless specifically indicated otherwise.
- F. Locks: Where indicated on the Drawings, provide cabinet manufacturer's standard 5-disc tumbler, cam type, keyed differently at each room, and master keyed.
1. Furnish 2-keys for each lock.
  2. Furnish 5-master keys
  3. Finish to match Section 08710 – "Finish Hardware" finish in room(s) where occurs.

END OF SECTION



**SECTION 06 42 16 - FLUSH WOOD PANELING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Flush wood paneling (wood-veneer wall surfacing).
  - 2. Wood furring, blocking, shims, and hanging strips for installing flush wood paneling unless concealed within other construction before paneling installation.
  - 3. Fire-retardant-treated materials.
  - 4. Installation materials.
  - 5. Shop finishing of flush wood paneling.
- B. Related Requirements:
  - 1. Section 05 70 00 "Decorative Metal" for metal reveals at wood paneling.
  - 2. Section 06 10 00 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing paneling and that are concealed within other construction before paneling installation.

**1.2 COORDINATION**

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product, including panel products, adhesives, fire-retardant-treated materials, and finishing materials and processes.
  - 1. Include fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: Show location of paneling, large-scale details, attachment devices, and other components. Include dimensioned plans and elevations.
  - 1. Show details full size.
  - 2. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.
  - 3. For paneling produced from premanufactured sets, show finished panel sizes, set numbers, sequence numbers within sets, and method of cutting panels to produce indicated sizes.
  - 4. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
- C. Samples for Initial Selection:
  - 1. Shop-applied transparent finishes.
  - 2. Shop-applied opaque finishes.
- D. Samples for Verification: For the following:
  - 1. Lumber for Transparent Finish: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.

2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished paneling.
3. Veneer-Faced Panel Products for Transparent Finish: 8 by 10 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Fabricator.
- B. Product Certificates: For each type of product.
- C. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

### **1.6 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

### **1.7 MOCKUPS**

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  1. Build mockups of typical paneling as shown on Drawings.
  2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Do not deliver paneling until painting and similar operations that might damage paneling have been completed in installation areas. Store paneling in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

### **1.9 FIELD CONDITIONS**

- A. Environmental Limitations without Humidity Control: Do not deliver or install paneling until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed/concealed by construction and indicate measurements on Shop Drawings.

## **PART 2 - PRODUCTS**

### **2.1 PANELING FABRICATORS, SOURCE LIMITATIONS**

- A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of paneling and wood doors faced with veneers from same flitches as paneling.

## 2.2 PANELING, GENERAL

- A. Quality Standard: Unless otherwise indicated, reference the "Architectural Woodwork Standards" for grades of flush wood paneling (wood-veneer wall surfacing) indicated for construction, finishes, installation, and other requirements.

## 2.3 FLUSH WOOD PANELING (WOOD-VENEER WALL SURFACING)

- A. Grade: Custom.
- B. Wood Species and Cut: As indicated on Drawings.
- C. Veneer Matching Method:
  - 1. Adjacent Veneer Leaves: Book match.
  - 2. Within Panel Face: Center-balance match.
  - 3. Adjacent Veneer Leaves and within Panel Face: Book match.
- D. Panel-Matching Method:
  - 1. Premanufactured panel sets selectively reduced in width within each separate area.
    - a. See Section 01 10 00 "Summary" for requirements concerning flitches reserved by Architect.
- E. Vertical Panel-Matching Method: Continuous end match; veneer leaves of upper panels are continuations of veneer leaves of lower panels.
- F. Panel Core Construction: Fire-retardant particleboard or fire-retardant medium-density fiberboard (MDF).
  - 1. Thickness: As indicated on Drawings.
- G. Exposed Panel Edges: Inset solid-wood or wood-veneer matching faces.
- H. Panel Reveals: Stainless steel channels, 1 by 1 by 1/16 inch thick.
- I. Fire-Retardant-Treated Paneling: Panels are to consist of wood-veneer and fire-retardant particleboard or fire-retardant, medium-density fiberboard (MDF). Panels are to have a flame-spread index of 25 or less and a smoke-developed index of 450 or less per ASTM E 84 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
- J. Assemble panels by gluing and concealed fastening.

## 2.4 MATERIALS

- A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
- B. Wood Moisture Content: 8 to 13 percent.
- C. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

## 2.5 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
  2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
  3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
  2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
  3. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
- C. Fire-Retardant Fiberboard: Medium-density fiberboard (MDF) panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Panel Source International, Inc., McKillican America, Inc.; Pyroblock Platinum.
    - b. SierraPine; Medite FR.

## 2.6 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.

## 2.7 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Arrange paneling in shop or other suitable space in proposed sequence for examination by Architect. Mark units with temporary sequence numbers to indicate position in proposed layout.
1. Lay out one elevation at a time if approved by Architect.
  2. Notify Architect seven days in advance of the date and time when layout will be available for viewing.
  3. Provide lighting of similar type and level as that of final installation for viewing layout unless otherwise approved by Architect.
  4. Rearrange paneling as directed by Architect until layout is approved.
  5. Do not trim end units and other nonmodular-size units to less than modular size until after Architect's approval of layout. Indicate trimming by masking edges of units with nonmarking material.
  6. Obtain Architect's approval of layout before start of assembly. Mark units and Shop Drawings with assembly sequence numbers based on approved layout.

- C. Complete fabrication, including assembly, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

## **2.8 SHOP FINISHING**

- A. General: Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.
  - 1. Backpriming: Apply two coats of sealer or primer, compatible with finish coats, to concealed surfaces of paneling. Concealed surfaces of plastic-laminate-clad paneling do not require backpriming when surfaced with plastic laminate.
- C. Transparent Finish:
  - 1. Grade: Same as item to be finished.
  - 2. Finish: System - 11, catalyzed polyurethane.
  - 3. Staining: Match Architect's sample.
  - 4. Sheen: Flat, 15-30Satin, 31-45 Semigloss, 46-60 Gloss, 61-100 gloss units measured on 60-degree gloss meter per ASTM D 523.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Before installation, condition paneling to humidity conditions in installation areas.
- B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

### **3.2 INSTALLATION**

- A. Grade: Install paneling to comply with quality standard grade of paneling to be installed.
- B. Install paneling level, plumb, true, and straight with no distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.
  - 1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/32 inch.
- C. Anchor paneling to supporting substrate with concealed panel-hanger clips.
  - 1. Do not use face fastening unless covered by trim otherwise indicated.
- D. See Section 09 93 00 "Staining and Transparent Finishing" for final finishing of installed paneling.

### **3.3 ADJUSTING AND CLEANING**

- A. Repair damaged and defective paneling, where possible, to eliminate defects. Where not possible to repair, replace paneling. Adjust for uniform appearance.

- B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

**SECTION 06 65 00 - SOLID SURFACE FABRICATIONS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

**1.2 SUMMARY**

- A. The extent of solid polymer and/or quartz fabrications includes:
  - 1. Countertops, including in part, built-up edges, backsplash where indicated, and plywood substrates.
  - 2. As indicated on the Drawings.
- B. Locations, configurations, type of material and colors for solid polymer and/or quartz fabrications are indicated herein and on the Drawings, or if not indicated, as selected by Architect from manufacturer's full line.

**1.3 REFERENCES**

- A. Applicable Standards: Standards of the following, as referenced herein:
  - 1. American National Standards Institute (ANSI).
  - 2. American Society for Testing and Materials (ASTM).
  - 3. National Electrical Manufacturers Association (NEMA).
  - 4. Federal Specifications (FS).

**1.4 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Shop Drawings: Indicate dimensions, component sizes, fabrication details, attachment provisions and coordination requirements with adjacent work.
- C. Samples: Submit minimum 2 inch by 2-inch samples. Indicate full range of color and pattern variation. Approved samples will be retained as a standard for work.
- D. Product Data: Indicate product description, fabrication information and compliance with specified performance requirements.
- E. Maintenance Data: Submit manufacturer's care and maintenance data, including care, repair and cleaning instructions and maintenance video. Provide maintenance kit for matte finishes. Include in project closeout documents.

**1.5 DELIVERY, STORAGE AND HANDLING**

- A. Comply with manufacturer's current written instructions and recommendations.
- B. Deliver no components to project site until areas are ready for installation. Store indoors.
- C. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.
- D. Refer to Division 1 Sections "Summary of Work" and "Special Conditions" for additional information and requirements regarding stored materials.

**1.6 QUALITY ASSURANCE**

- A. Allowable Tolerances:
1. Variation in component size: +1/8 inch.
  2. Location of openings: +1/8 inch from indicated location.

**1.7 WARRANTY**

- A. Provide manufacturer's warranty against defects in materials, fabrication and installation, excluding damages caused by physical or chemical abuse or excessive heat. Warranty shall provide for replacement or repair of material and labor for a period of **10 years**, beginning at date of Substantial Completion.
1. For fabrications with installed warranty coverage, identify by affixing manufacturer's fabrication/installation source plate.
  2. Maintain surfaces in accordance with manufacturer's care and maintenance instructions.
- B. The above warranty and guarantee shall be in addition to, shall be in effect simultaneously with, and shall not alter or limit other project or product warranties or guarantees, nor shall they serve as limitations to other remedies available to the Owner.

**PART 2 - PRODUCTS****2.1 SOLID POLYMER AND/OR QUARTZ FABRICATIONS**

- A. Solid-Surfacing Material: Refer to Drawings and acceptable manufacturers below.
1. Homogeneous solid sheets Equivalent to "Corian" from DuPont Polymers of cast, filled acrylic resin complying with material and performance requirements in ANSI Z124.3, for Type 6, without a precoated finish, and FS WW-P-541E/GEN, laminated or of composite construction as required by project conditions; **AND/OR**
  2. Homogeneous quartz surfaces material. Equivalent to "Zodiaq" quartz surfaces from DuPont and/or "Ceasarstone" quartz surfaces (*Basis of Design, quality, performance and color*)
  3. Products: Subject to compliance with requirements, provide preapproved equivalent to the "Basis of Design" product and color(s) indicated on the Drawings, by one of the following:
    - a. Avonite Surfaces; Aristech Surfaces LLC
    - b. Ceasarstone; Caesarstone US.
    - c. Corian and/or Zodiaq; DuPont Polymers.
    - d. Surell; Formica Corporation.
    - e. Gibraltar; Wilsonart International, Div. of Premark International, Inc.
- B. Material shall have minimum physical and performance properties specified.
1. Superficial damage to a depth of 1/32 inch shall be repairable by sanding or polishing.
  2. Material Thickness: 1/2 inch or 3/4 inch, as indicated.
- C. Type Material and Colors: As indicated on the Drawings, or equivalent priced color(s) selected by Architect after bidding from manufacturer's full line.
- D. Edge Treatments: As indicated on the Drawings, or if not indicated, built-up 1-1/4 inches with eased edges.
- E. Performance Characteristics: "Corian"

Property	Typical Result	Test
Tensile Strength	6,000 psi	ASTM D 638
Tensile Modulus	1.5 x 10 <sup>-6</sup> psi	ASTM D 638
Tensile Elongation	0.4% min.	ASTM D 638
Flexural Strength	10,000 psi	ASTM D 790
Flexural Modulus	1.2 x 10 <sup>-6</sup> psi	ASTM D 790
Hardness	>85	Rockwell "M" Scale ASTM D 785



	56	Barcol Impressor ASTM D 2583 ASTM D 696
Thermal Expansion	3.02 x 10 <sup>-5</sup> in./in./°C (1.80 x 10 <sup>-5</sup> in./in./°F)	
Gloss (60° Gardner)	5–75 (matte—highly polished)	ANSI Z124
Light Resistance	(Xenon Arc) No effect	NEMA LD 3-2000 Method 3.3
Wear and Cleanability	Passes	ANSI Z124.3 & Z124.6
Stain Resistance: Sheets	Passes	ANSI Z124.3 & Z124.6
Fungus and Bacteria Resistance	- Does not support microbial growth	ASTM G21&G22
Boiling Water Resistance	No visible change	NEMA LD 3-2000 Method 3.5
High Temperature Resistance	No change	NEMA LD 3-2000 Method 3.6
Izod Impact (Notched Specimen)	0.28 ft.-lbs./in. of notch	ASTM D 256 (Method A)
Ball Impact	No fracture—1/2 lb. ball:	NEMA LD 3-2000
Resistance: Sheets	1/4" slab—36" drop 1/2" slab—144" drop	Method 3.8
Weatherability	ΔE* <sub>94</sub> <5 in 1,000 hrs.	ASTM G 155
Specific Gravity †	1.7	
Water Absorption	Long-term 0.4% (3/4") 0.6% (1/2") 0.8% (1/4")	ASTM D 570
Toxicity	99 (solid colors) 66 (patterned colors)	Pittsburgh Protocol Test ("LC50" Test)
Flammability	All colors (Class I and Class A)	ASTM E 84, NFPA 255 & UL 723
Flame Spread Index	<25	
Smoke Developed Index	<25	

† Approximate weight per square foot: 1/4" (6 mm) 2.2 lbs., 1/2" (12.3 mm) 4.4 lbs.  
Shapes meet or exceed the ANSI Z124.3 and ANSI Z124.6 standards for plastic sinks and lavatories.  
NEMA results based on the NEMA LD 3-2000

F. Performance Characteristics: "Quartz"

<b>Property</b>	<b>Typical Result</b>	<b>Test Procedure</b>
Flexural Strength	>5,300 psi	ASTM D 790
Flexural Modulus	5.3–5.7E <sup>6</sup> psi	ASTM D 790
Flexural Elongation	>0.1%	ASTM D 790
Compression Strength (Dry)	~27,000 psi	ASTM C 170
Compression Strength (Wet)	~24,000 psi	ASTM C 170
Hardness	7	Mohs' Hardness Scale
Thermal Expansion	1.45 x 10 <sup>-5</sup> in./in./°C	ASTM D 696
Gloss (60° Gardner)	45–50	ANSI Z 124
Colorfastness	Passes	ANSI Z 124.6.5.1
Wear and Cleanability	Passes	ANSI Z 124.6.5.3
Stain Resistance	Passes	ANSI Z 124.6 (stain 5.2, chemical 5.5, cigarette 5.4 resistances)
Fungal & Bacterial Resistance	No growth	ASTM G 21 & G 22
High Temperature Resistance (356°F)	None to slight effect	NEMA LD 3.3.6*

Boiling Water Resistance	None to slight effect	NEMA LD 3.3.5*
Freeze-Thaw Cycling	Unaffected	ASTM C 1026
Point Impact	Passes	ANSI Z 124.6.4.2
Ball Impact	164 inches	NEMA LD 3.3.8*
Slip Resistance	Above 0.80 for textured models	ASTM C 1028
Static Coefficient of Friction (as received)	0.89/0.61 (wet/dry)	ASTM C 1028
Static Coefficient of Friction (with renovator)	0.87/0.65 (wet/dry)	ASTM C 1028
Abrasion Resistance	139	ASTM C 501
Specific Gravity	2.44	ASTM D 792
Density	~2400 kg/m <sup>3</sup>	
Water Absorption	0.12%	ASTM C 373
Long- and Short-Term	<0.04%	ASTM D 570
Moisture Expansion	<0.01% on average	ASTM C 370
Toxicity	Passes, LC50=68–128	Pittsburgh Protocol
Flammability	For all colors tested (Class I and Class A)	ASTM E 84, UL 723 and NFPA 255
Flame Spread Index	FSI <10 for 3 cm and <15 for 2 cm	
Smoke Developed Index	SDI <50 for 3 cm and <100 for 2 cm	
Nominal Thickness	2 cm and 3 cm	
Nominal Weight	10 lb./ft. <sup>2</sup> (2 cm) 15 lb./ft. <sup>2</sup> (3 cm)	

\* NEMA results based on the NEMA LD 3-2000

## 2.2 ACCESSORY PRODUCTS

- A. Joint Adhesive: Manufacturer's standard for each product; two-part adhesive kit to create inconspicuous, non-porous joints by chemical bond.
- B. Finish: Provide surfaces with a uniform finish.
  1. Matte: Gloss range of 5-20, unless otherwise directed by the Owner or Architect as required to match color selections.
- C. Thermoforming: Comply with manufacturer's data; "Corian".
  1. Construct molds of plywood in "male/female" sections. Construct molds matching component shape.
  2. Form pieces to shape prior to seaming and joining.
  3. Cut pieces to finished dimensions. Sand edges. Remove nicks and scratches.
  4. Heat entire component. Material shall be uniform, between 275-325 degrees Fahrenheit during forming.
  5. Prevent blistering, whitening, and cracking of solid polymer material during forming. Reject defective material.

## 2.3 FABRICATIONS

- A. Countertops: 1/2-inch or 3/4-inch thick solid polymer or quartz material, as indicated on the Drawings, over solid substrate, adhesively joined with inconspicuous seams, having edge details as indicated, or if not indicated, built-up 1-1/4-inches thick at tops and countertops and elsewhere only as indicated; Eased edges.
  1. Backsplash and Endsplash: 1/2-inch thick x 4-inches high, with exposed edges slightly rounded/eased, unless other dimension is indicated on the Drawings.
  2. Sink Cutouts: Countertop fabricator to make cut-outs for sinks and finish exposed edges to match top. Sinks to be provided and installed by others, under the work of Division 15.

**PART 3 - EXECUTION****3.1 JOB MOCK-UP**

- A. Prior to final approval of shop drawings, erect at project site one full size mock-up of each component required, for Architect's and Owner's review.
- B. Should mock-up not be approved, re-fabricate, and reinstall until approval is secured. Remove rejected units from project site.
- C. Approved mock-ups may remain as part of finished work.

**3.2 INSTALLATION**

- A. Install components plumb, level, and rigid, scribed to adjacent finishes, in accordance with manufacturer's current written instructions and recommendations, and reviewed submittals, shop drawings and product data.
- B. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work. Reinforce joints as required.
- C. Keep components clean during installation. Remove adhesives, sealants, and other stains. Keep clean until Date of Substantial Completion. Replace stained and damaged components.
- D. Protect surfaces from damage until Date of Substantial Completion. Repair work or replace damaged work, which cannot be repaired to Architect's satisfaction.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 07 11 13 - BITUMINOUS DAMPPROOFING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Cold-applied, asbestos-free asphalt emulsion dampproofing, "pin-hole free", that is resistant to water penetration, and which is VOC compliant.
  - 2. Applications to exterior face of all concealed back-up masonry and concrete in exterior walls.

**1.3 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified, including data substantiating that materials comply with requirements for each dampproofing material specified. Include recommended method of application, recommended primer, number of coats, coverage or thickness, and recommended protection course.
  - 1. Certification by dampproofing manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC's).

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Engage an experienced Installer who has completed bituminous dampproofing similar in material, design, and extent to that indicated for this Project and with a verifiable record of successful in-service performance.
  - 1. Refer to Section 01 01 50 - "Special Conditions", for additional information and minimum experience requirements.
- B. Single-Source Responsibility: Obtain primary dampproofing materials and primers from one source and by a single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

**1.5 PROJECT CONDITIONS**

- A. Substrate: Proceed with dampproofing only after substrate construction and penetrating work have been completed.
- B. Weather Limitations: Proceed with dampproofing only when existing and forecasted weather conditions will permit work to be performed according to manufacturer's recommendations and warranty requirements.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cold-Applied, Asphalt Emulsion Dampproofing:
  - a. BASF Building Systems.
  - b. Euclid Chemical Co.
  - c. Henry Company
  - d. Karnak Chemical Corporation.
  - e. Koppers Industries, Inc.
  - f. Meadows: W.R. Meadows, Inc.

## 2.2 BITUMINOUS DAMPPROOFING

- A. General: Provide products recommended by manufacturer for designated application.
- B. Cold-Applied, Asphalt Emulsion Dampproofing: Asphalt-based emulsions recommended by the manufacturer for dampproofing use when applied according to the manufacturer's instructions.
  1. Spray Grade: Emulsified asphalt, prepared with mineral-colloid emulsifying agents without fibrous reinforcement, complying with ASTM D 1227, Type I (spray) or Type II (brush).
- C. Product/Manufacturer: Equivalent to "Sealmastic" emulsion dampproofing, as manufactured by W.R. Meadows of Georgia; Austell, Georgia; Phone: (404) 948-1934.

## 2.3 MISCELLANEOUS MATERIALS

- A. Primer: Asphalt primer complying with ASTM D 41, for asphalt-based dampproofing.
- B. Glass Fabric Reinforcing: Woven glass fabric, treated with asphalt, complying with ASTM D 1668, Type I.
- C. Protection Course, Board Type: Premolded, 1/8-inch- (3-mm-) thick, multi-ply, semi-rigid board, consisting of a mineral-stabilized asphalt core sandwiched between layers of asphalt-saturated felt, and faced on one side with polyethylene film.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. MasterSeal 977: BASF Building Systems.
    - b. Bituthene Asphaltic Hardboard; Grace: W.R. Grace & Co.
    - c. PC-2 Protection Course; Meadows: W.R. Meadows, Inc.
  2. When rigid insulation in cavity wall is acceptable as protection board to Manufacturer of dampproofing product, and such rigid insulation is indicated to be provided, omit additional/separate protection board.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean substrate of projections and substances detrimental to work; comply with recommendations of prime materials manufacturer.
- B. Install cant strips and similar accessories as shown and as recommended by prime materials manufacturer even though not shown.
- C. Fill voids, seal joints, and apply bond breakers, if any, as recommended by prime materials manufacturer, with particular attention at construction joints.
- D. Install separate flashings and corner protection stripping, as recommended by prime materials manufacturer, where indicated to precede application of dampproofing. Comply with details shown and with manufacturer's recommendations. Pay particular attention to requirements at building expansion joints, if any.
- E. Prime substrate, if recommended by prime materials manufacturer.
- F. Protection of Other Work: Do not allow liquid and mastic compounds to enter and clog drains and conductors. Prevent spillage and migration onto other surfaces of work by masking or otherwise protecting adjoining work.

**3.2 INSTALLATION, GENERAL**

- A. Comply with manufacturer's current written instructions and recommendations except where more stringent requirements are indicated and where Project conditions require extra precautions to ensure satisfactory performance of work.
  - 1. All dampproofing applications shall be "pin-hole free".
- B. Application: Apply dampproofing to the following surfaces.
  - 1. Exterior, below-grade surfaces of exterior concrete and masonry walls in contact with earth or other backfill and where space is enclosed on opposite side.
  - 2. Back side of concrete and masonry retaining walls to prevent percolating of water through the wall or facing.
  - 3. Exterior surface of inside wythe of double-wythe, exterior masonry walls and at concrete back-up walls above grade, to prevent water-vapor penetration through the wall.
  - 4. Any additional locations indicated on the Drawings.
- C. Reinforcement: At changes in plane and/or where otherwise shown as "reinforced," install lapped course of glass fabric in first coat of dampproofing compound before it thickens.
- D. Bituminous Cant Strips: If recommended by manufacturer of primary dampproofing system, install 2-by-2-inch (50-by-50-mm) or other recommended size cant strip of bituminous grout at base of vertical dampproofing where it meets horizontal surface.
- E. Apply vertical dampproofing full height, from top of walls, down walls to top of footing. Extend 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when the Project is completed.

**3.3 COLD-APPLIED, ASPHALT EMULSION DAMPPROOFING**

- A. Spray or Brush Grade: Detailing of corners, off-sets, and similar substrates anticipated to be accomplished by brush-on application.
  - 1. Apply primer if necessary, according to current written requirements of primary coating manufacturer for substrate and location of various project applications, in accordance with current written directions and recommendations.
  - 2. Brush or spray apply a coat of asphalt emulsion dampproofing at a rate of 1.5 to 2.5 gal./100 sq. ft. (0.6 to 1 L/sq. m), depending on substrate texture, to produce a uniform, dry-film thickness of not less than 15 mils (0.4 mm). Apply in 2 coats at locations where reinforcing mesh is indicated, and if otherwise necessary to obtain required thickness, allowing time for complete drying between coats.

**3.4 PROTECTION AND CLEANING**

- A. Protect exterior, below-grade dampproofing membrane from damage until backfill is completed. Remove overspray and spilled materials from surfaces not intended to receive dampproofing.

**3.5 INSTALLATION OF PROTECTION COURSE**

- A. General: Where indicated, install protection course of type indicated over completed-and-cured dampproofing treatment. Comply with dampproofing materials manufacturer's recommendations for method of support or attaching of protection materials. Support with spot application of trowel-grade mastic where not otherwise indicated.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 07 13 26 - SHEET WATERPROOFING****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Sheet Waterproofing:
  - 1. Self-adhered rubberized asphalt/polyethylene sheet membrane including drainage mat and perimeter drain located at the base of the foundation/retaining walls and positive (exterior) side of elevator pit.

**1.2 RELATED REQUIREMENTS**

- A. Section 02 71 00 - Foundation Drainage.
- B. Section 03 30 00 - Cast-in-Place Concrete: Concrete substrate.
- C. Section 04 20 00 - Unit Masonry: Masonry substrate.
- D. Section 07 92 00 - Joint Sealants: Sealing moving joints in waterproofed surfaces that are not required to be treated in this section.

**1.3 REFERENCE STANDARDS**

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-- Tension 2016.
- B. ASTM D570 - Standard Test Method for Water Absorption of Plastics 1998 (Reapproved 2018).
- C. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting 2018.
- D. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds 1998 (Reapproved 2017).
- E. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection 2020.
- F. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes 2020.
- G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
- H. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover 2008a, with Editorial Revision (2013).
- I. ICC-ES AC380 - Acceptance Criteria for Termite Physical Barrier Systems 2014, with Editorial Revision (2017).
- J. NRCA (WM) - The NRCA Waterproofing Manual 2021.

**1.4 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data for membrane, mat, and drain.
- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Certificate: Certify that products meet or exceed specified requirements.

- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

### 1.5 QUALITY ASSURANCE

- A. Membrane Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

### 1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F (5 degrees C) for 24 hours before and during application and until liquid or mastic accessories have cured.

### 1.7 WARRANTY

- A. See Section 01780 - Closeout Submittals, for additional warranty requirements.
- B. Contractor shall correct defective Work within a five-year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.
- C. Provide full system five -year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure. Warranty shall cover self-adhered membrane, drainage mat and perimeter drain as a complete system.

## PART 2 - PRODUCTS

### 2.1 WATERPROOFING APPLICATIONS

- A. Self-Adhered Rubberized Asphalt/Polyethylene Sheet Membrane:
- B. Location: At the positive side of retaining/foundation walls, elevator pits and elsewhere as indicated on the Drawings.

### 2.2 MEMBRANE MATERIALS

- A. Self-adhered rubberized asphalt/polyethylene sheet membrane:
- B. Thickness: 60 mil, 0.060 inch (1.5 mm), minimum.
- C. Sheet Width: 36 inches (0.914 m), minimum.
- D. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC380.
- E. Tensile Strength:
  - 1. Film: 5,000 psi (34.57 MPa), minimum, measured in accordance with ASTM D882 and at grip-separation rate of 2 inches (50 mm) per minute.
  - 2. Elongation at Break: 300 percent, minimum, measured in accordance with ASTM D412.
  - 3. Water Vapor Permeance: 0.05 perm (2.9 ng/(Pa s sq m)), maximum, measured in accordance with ASTM E96/E96M.
  - 4. Low Temperature Flexibility: Unaffected when tested in accordance with ASTM D1970/D1970M at minus 20 degrees F (minus 11 C), 180 degree bend on 1 inch (25 mm) mandrel.

5. Peel Strength: 7 lb per inch (1226 N/m), minimum, when tested in accordance with ASTM D903.
  6. Puncture Resistance: 50 lb (22.67 kg), minimum, measured in accordance with ASTM E154/E154M.
  7. Water Absorption: 0.1 percent increase in weight, maximum, measured in accordance with ASTM D570, 24 hour immersion.
  8. Hydrostatic Resistance: Resists the weight of 200 ft (61 m) when tested in accordance with ASTM D5385/D5385M.
  9. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
- F. Manufacturers:
1. Carlisle Coatings & Waterproofing Inc: [www.carlisleccw.com/#sle](http://www.carlisleccw.com/#sle).
  2. GCP Applied Technologies: [www.gcpat.com/#sle](http://www.gcpat.com/#sle). (*Basis of Design – GCPAT Bituthene 3000*)
  3. W.R. Meadows, Inc: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
  4. Substitutions: See Section 01015 - Special Conditions.

### 2.3 DRAINAGE MAT

- A. Preformed 0.44 in. (11 mm) thick geo-composite drainage sheet system, comprising a hollow studded polypropylene core, covered on one side with a nonwoven, needle punched polypropylene filter fabric and on the other side with a smooth polymeric film.
- B. Manufacturer/Model: GCP Hydroduct 220, or pre-approved equivalent.

### 2.4 PERIMETER DRAIN

- A. Combination, low and high profile, drainage core, high performance geotextile and high strength backing film. The drainage core profile is 1.0 in. (25.4 mm) at the top to tie into the drainage composite system and 1 in. (25 mm) on the bottom to provide a high-flow section to transport water to the drainage exits.
- B. Manufacturer/Model: GCP Hydroduct Coil 600, or pre-approved equivalent.

### 2.5 ACCESSORIES

- A. Seaming Materials: As recommended by membrane manufacturer.
- B. Membrane Sealant: As recommended by membrane manufacturer.
- C. Sealant for Cracks and Joints in Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.
- D. Flexible Flashings: Type recommended by membrane manufacturer.
- E. Termination Bars: Aluminum; compatible with membrane and adhesives.
- F. Surface Conditioner: Primer type, compatible with membrane.
- G. Adhesives: As recommended by membrane manufacturer.
- H. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- C. Verify items that penetrate surfaces to receive waterproofing are securely installed.

**3.2 PREPARATION**

- A. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.
- B. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
- C. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.
- D. Seal moving cracks with sealant and non-rigid filler, using procedures recommended by sealant and waterproofing manufacturers.
- E. Prepare building expansion joints at locations as indicated on drawings.
- F. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.

**3.3 INSTALLATION - MEMBRANE**

- A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- B. Roll out membrane, and minimize wrinkles and bubbles.
- C. Self-Adhering Membrane: Remove release paper layer, and roll out onto substrate with a mechanical roller to provide full contact bond.
- D. Overlap edges and ends, minimum 3 inches (76 mm), seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.
- E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
- F. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
- G. Seal membrane and flashings to adjoining surfaces.
- H. The waterproofing membrane should lap onto/over the precast (where precast extends below grade) and always terminate below the grade line.
- I. Preparation of Precast (where precast extends below grade): Grout solid the base of precast horizontal shimmed joints resting on the concrete foundation/ retaining wall haunches and the vertical joints up to grade level. This is necessary to accept the below grade waterproofing.
- J. An additional 12-inch outside edge strip should be applied to corner transitions, bituthene liquid membrane fillet should be applied to inside corner transitions, and below grade terminations be detailed with continuous termination bar covered with bituthene liquid membrane from the same manufacturer.
- K. Sheet membrane should not continue above grade. Coordinate transitions of exterior wall air & water barrier membrane to occur above at grade level.

**3.4 INSTALLATION – DRAINAGE MAT**

- A. Position drainage mat so that the geotextile fabric filter is facing toward the groundwater, soil or overburden. The solid polymeric film provides extra protection for waterproofing and should not be removed. In vertical applications, drainage mat can be applied to the substrate vertically but should extend from the perimeter discharge pipe to a point approximately 6 in. (150 mm) below the anticipated grade line.
- B. When adhering drainage mat directly to waterproofing membranes, Detail Tape should be used. When using Detail Tape, press firmly to ensure good adhesion.
- C. Substrate and job site conditions will determine the attachment pattern. Additional consideration should be given in high wind exposures. Abut adjacent rolls with excess fabric overlapping in shingle fashion.
- D. For inside and outside corners, abut adjoining drainage composite at the corner. Cover open core with extra geotextile filter fabric. The exposed core along the top terminations should be covered with a strip of geotextile to prevent intrusion of soil into core. At the bottom termination extend the drainage mat out from the structure so that it passes behind and under the perimeter discharge pipe. Additional geotextile should be wrapped over the pipe to prevent soil intrusion.

**3.5 INSTALLATION – PERIMETER DRAIN**

- A. The first row of drain to be installed is the perimeter drain at the bottom of the wall. If not using perimeter drain for full wall coverage, close the top end of the drain to prevent soil intrusion by folding the fabric behind the drain. Close the high profile section with 3 in. (75 mm) underground tape.
- B. Attach the next roll of perimeter drain by cutting one row of low profile dimples from each end of the two sections to be joined. Do not cut fabric. Interlock one row of the high profile section and secure connection. Overlap fabric and apply 3 in. (75 mm) wide underground tape from the top to the bottom of the joint to prevent soil intrusion.
- C. Bend drain to make inside corners. For outside corners, cut the low profile core flush with corner and tape edges. Slit fabric on high profile section, bend around corner, and place corner guard with fabric over slit of high profile drain. Secure with underground tape.
- D. When the drainage mat is installed, the flange should be facing the direction opposite of the perimeter drain water flow. When the drainage mat is installed horizontally, the edge of the core with the flange should be at the top. This flange position, similar to roof shingle applications, minimizes seepage of water behind the drain. Fold back the fabric at the top of the perimeter drain and place the mat on top of the drain core flange. Fold fabric from sheet drain section down over the drain section and secure with 3 in. (75 mm) tape.
- E. Fold back edge of fabric on lower (or downstream) drain. Do not detach from dimples. Place cones of upper (upstream) drain over flange of lower drain. Overlap fabric of upper drain over lower drain. Seal seam with 3 in. (75 mm) tape.
- F. Overlap fabric in direction of water flow. Use tape or spray adhesive, if necessary, to keep fabric at joint in place prior to backfilling. All edges of drain should have extra fabric tucked behind core edge to prevent soil from entering core (see Figure 4).
- G. All edges of drain should have extra fabric tucked behind core edge seal to prevent soil from entering core.
- H. Soil should be placed and compacted directly against the drain. Use care during backfill operation to avoid damage to the waterproofing system. Follow generally accepted practices for backfill compacted in 6 in. to 12 in. (150 mm to 300 mm) lifts to avoid stresses on the waterproofing system. Direct compactor exhaust away from the drain to prevent damage. Backfill to a minimum of 6 in. (150 mm) above drain to allow for coverage after settlement.

**3.6 PROTECTION**

- A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

**SECTION 07 18 00 - TRAFFIC COATINGS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Traffic coatings and pavement markings for the following applications:
  - 1. Pedestrian traffic.
- B. Related Requirements:
  - 1. Section 09 67 23 "Resinous Flooring" for fluid-applied, high-performance resinous flooring that does not serve as a waterproofing membrane with integral wearing surface.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.3 ACTION SUBMITTALS**

- A. Product Data Submittals: For each type of product.
  - 1. Include installation instructions and details, material descriptions, dry- or wet-film thickness requirements, and finish.
- B. Shop Drawings: For traffic coatings.
  - 1. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions that are not included in manufacturer's product data.
- C. Samples for Initial Selection: For each type of exposed finish.
- D. Samples for Verification: For each type of exposed finish, prepared on rigid backing.
  - 1. Provide stepped Samples on backing to illustrate buildup of traffic coatings.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and manufacturer's on-site technical representative.
- B. Product Certificates: For each type of traffic coating.
- C. Field quality-control reports.
- D. Sample Warranty: For manufacturer's warranty.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For traffic coatings to include in maintenance manuals.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation.

- C. Mockups: Build mockups to set quality standards for materials and execution.
  - 1. Build mockup for each traffic coating and substrate to receive traffic coatings.
  - 2. Size: 200 sq. ft. of each substrate to demonstrate surface preparation, joint and crack treatment, thickness, texture, color, and standard of workmanship.
    - a. Include 96-inch length of deck-to-wall transitions and terminations with inside and outside corner.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
  - 5. Coordinate with manufacturer for requirements for no concrete sealers prior to placement of traffic coatings.

### 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Apply traffic coatings within the range of ambient and substrate temperatures recommended in writing by manufacturer. Do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.
  - 1. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of substrate.
- B. Do not install traffic coating until items that penetrate membrane have been installed.

### 1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace traffic coating that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Adhesive or cohesive failures.
    - b. Abrasion or tearing failures.
    - c. Surface crazing or spalling.
    - d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
  - 2. Warranty Period: Five (5) years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain traffic coatings from single source from single manufacturer.
- B. Obtain primary traffic-coating materials, including primers, from traffic-coating manufacturer. Obtain accessory materials including aggregates, sheet flashings, joint sealants, and substrate repair materials of types and from sources recommended in writing by primary material manufacturer.
- C. Obtain pavement-marking paint from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with applicable provisions in The Department of Justice's 2010 ADA Standards, and IBC and ICC/ANSI A117.1 or other locally enforced accessibility standards, Owner and the Owner's insurance and legal counsels, for slip resistance of flooring.



## 2.3 MATERIALS, GENERAL

- A. Material Compatibility: Provide primers; base-, intermediate-, and topcoat; and accessory materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

## 2.4 TRAFFIC COATINGS

- A. Traffic Coating : Manufacturer's standard, traffic-bearing, seamless, high-solids-content, cold liquid-applied, elastomeric, water-resistant membrane system with integral wearing surface for pedestrian traffic and vehicular traffic; according to ASTM C 957.
  - 1. Basis of Design: Subject to compliance with requirements, provide Tremco Incorporated; Vulkem 360NF/950NF/951NF Heavy Duty Deck Coating System, or comparable product by one of the following:
    - a. Master Builders Solutions, an Sika Corporation.
    - b. LymTal International Inc; Iso-Flex brand of products.
    - c. Neogard; A part of Hempel.
    - d. Sika Corporation.
- B. Primer: Liquid primer as recommended in writing for substrate and conditions by traffic-coating manufacturer.
- C. Preparatory and Base Coats: Two-part, high solids, Polyurethane.
  - 1. Thicknesses: Minimum dry- or wet-film thickness as recommended in writing by manufacturer for substrate and service conditions indicated, but not less than 25 mils wet.
- D. Intermediate Coat: Two-part, high solids, Aromatic urethane.
  - 1. Thicknesses: Minimum dry- or wet-film thickness as recommended in writing by manufacturer for substrate and service conditions indicated, but not less than 12 mils wet, measured excluding aggregate.
- E. Topcoat: Two-part, high solids, Aliphatic urethane.
  - 1. Thicknesses: Minimum dry- or wet-film thickness as recommended in writing by manufacturer for substrate and service conditions indicated, but not less than 12 mils wet, measured excluding aggregate.
  - 2. Aggregate Content: As recommended in writing by traffic-coating manufacturer for substrate and service conditions indicated.
  - 3. Color: As selected by Architect from manufacturer's full range
- F. Aggregate: Uniformly graded, washed silica sand of particle sizes, shape, and minimum hardness recommended in writing by traffic-coating manufacturer.

## 2.5 ACCESSORY MATERIALS

- A. Joint Sealants: ASTM C920 and recommended in writing by traffic-coating manufacturer
- B. Sheet Flashing: Nonstaining sheet material recommended in writing by traffic-coating manufacturer.
- C. Adhesive: Contact adhesive recommended in writing by traffic-coating manufacturer.
- D. Reinforcing Strip: Fiberglass mesh recommended in writing by traffic-coating manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, surface smoothness, and other conditions affecting performance of traffic-coating work.
- B. Verify that substrates are visibly dry and free of moisture.
  - 1. Test for moisture content by method recommended in writing by traffic-coating manufacturer.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of traffic-coating work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Begin coating application only after substrate construction and penetrating work have been completed.
  - 2. Begin coating application only after minimum concrete-curing and -drying period recommended in writing by traffic-coating manufacturer has passed and after substrates are dry.
  - 3. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. General: Before applying traffic coatings, clean and prepare substrates according to ASTM C 1127 and manufacturer's written instructions to produce clean, dust-free, dry substrate for traffic-coating application. Remove projections, fill voids, and seal joints if any, as recommended in writing by traffic-coating manufacturer.
- B. Schedule preparation work so dust and other contaminants from process do not fall on wet, newly coated surfaces.
- C. Mask adjoining surfaces not receiving traffic coatings to prevent overspray, spillage, leaking, and migration of coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and drains.
- D. Concrete Substrates: Mechanically abrade surface to a uniform profile acceptable to manufacturer, according to ASTM D 4259. Do not acid etch.
  - 1. Remove grease, oil, paints, and other penetrating contaminants from concrete.
  - 2. Remove concrete fins, ridges, and other projections.
  - 3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
  - 4. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D 4258.

### 3.3 TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written instructions.
- B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.
- C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.
- D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

### 3.4 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C1 127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.
  - 1. Comply with recommendations in ASTM C 1193 for joint-sealant installation.
- B. Apply reinforcing strip in traffic-coating system where recommended in writing by traffic-coating manufacturer.

### **3.5 INSTALLATION OF TRAFFIC COATINGS**

- A. Apply traffic coating according to ASTM C 1127 and manufacturer's written instructions.
- B. Apply number of coats of specified compositions for each type of traffic coating at locations as indicated on Drawings.
- C. Start traffic-coating application in presence of manufacturer's technical representative.
- D. Verify that wet-film thickness of each coat complies with requirements every 100 sq. ft..
- E. Uniformly broadcast and embed aggregate in each coat indicated to receive aggregate according to manufacturer's written instructions. After coat dries, sweep away excess aggregate.
- F. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surfaces.
- G. Cure traffic coatings. Prevent contamination and damage during coating application and curing.

### **3.6 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform the following field tests and inspections:
  - 1. Materials Testing:
    - a. Samples of material delivered to Project site are to be taken, identified, sealed, and certified in presence of Contractor.
    - b. Testing agency must perform tests for characteristics specified, using applicable referenced testing procedures.
    - c. Testing agency must verify thickness of coatings during traffic-coating application for each 600 sq. ft. of installed traffic coating or part thereof.
  - 2. If test results show traffic coating does not comply with requirements, remove and replace or repair the membrane as recommended in writing by traffic-coating manufacturer and make further repairs after retesting until traffic-coating installation passes.
- B. Final Traffic-Coating Inspection: Arrange for traffic-coating manufacturer's technical personnel to inspect membrane installation on completion.
  - 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

### **3.7 PROTECTING AND CLEANING**

- A. Protect traffic coatings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 07 21 00 - THERMAL INSULATION****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Polyisocyanurate foam-plastic board insulation installed at cavity space behind masonry brick veneer.
  - 2. Mineral-wool blanket insulation.
- B. Related Requirements:
  - 1. Section 04 20 00 "Unit Masonry" for insulation installed in masonry cells.
  - 2. Section 07 54 23 "Thermoplastic-Polyolefin (TPO) Roofing" for insulation specified as part of roofing construction.
  - 3. Section 09 29 00 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E 84.
- B. Fire-Resistance Ratings: Comply with ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.
- C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- D. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

**2.2 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION**

- A. Polyisocyanurate Board, Glass-Reinforced-Faced: ASTM C 1289, Type II, Class 1, Grade 2 (20 psi), with glass fiber reinforced cellulosic felt facers on both major surfaces of the core foam, and thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Johns Manville or ; Flat & Tapered, ENRGY R-12, 2" thick insulation or a comparable product acceptable by Architect.
2. Fire Propagation Characteristics: Basis-of-Design product is part of an approved wall assembly that passes NFPA 285 testing. Do not submit comparable products without coordination of compliance.

### 2.3 MINERAL-WOOL BLANKET INSULATION

- A. Mineral-Wool Blanket Insulation, Unfaced : ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke developed indexes of 25 and 50, respective, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Industrial Insulation Group, LLC (IIG-LLC); MinWool Sound Attenuation Fire Batt.
    - b. Roxul Inc.
    - c. Thermafiber, Inc.; an Owens Corning company.
- B. Mineral-Wool Blanket Insulation, Reinforced-Foil Faced: ASTM C 665, Type III (reflective faced); Class A (faced surface with a flame-spread index of 25 or less per ASTM E 84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Mansville.
    - b. Roxul, Inc;
    - c. Thermafiber, Inc.; an Owens Corning company.

### 2.4 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. AGM Industries, Inc; Series T TACTOO Insul-Hangers.
    - b. Gemco; Spindle Type.
  2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.
- B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. AGM Industries, Inc; RC150 or SC150.
    - b. Gemco; R-150 or S-150.
  2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
    - a. Ceiling plenums.
    - b. Perimeter air spaces between precast and masonry walls.
- C. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch between face of insulation and substrate to which anchor is attached.
  1. Products: Subject to compliance with requirements, provide the following:
    - a. Gemco; Clutch Clip.
- D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. AGM Industries, Inc; TACTOO Adhesive.

- b. Gemco; Tuff Bond Hanger Adhesive.

## 2.5 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
  - 1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

### 3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

### 3.3 INSTALLATION OF CAVITY-WALL INSULATION

- A. Mineral-wool Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer.
  - 1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
  - 2. Press units firmly against inside substrates.
  - 3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 20 00 "Unit Masonry."
  - 4. Insulation shall be installed so thermal barrier runs continuous.

### 3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
  - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
  - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

5. As indicated on Drawings, insulation shall be installed so thermal barrier runs continuous.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
  1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..

### **3.5 INSTALLATION OF ALUMINUM-SHEET-FACED INSULATION**

- A. Install according to manufacturer's written instructions, with mechanical attachments, sealed joints, and capped closure system.

### **3.6 PROTECTION**

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION



**SECTION 07 26 16 - BELOW-GRADE VAPOR RETARDERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Vapor retarders for below slabs-on-grade.
- B. Related Requirements:
  - 1. Section 03 30 00 "Cast-In-Place Concrete" for cast-in-place concrete.
  - 2. Section 07 11 26 "Sheet Waterproofing" for below-grade waterproofing.
  - 3. Section 07 21 00 "Thermal Insulation" for vapor retarders installed with insulation.

**1.2 ACTION SUBMITTALS**

- A. Product Data.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Material Certificates: For vapor retarder, signed by manufacturer.

**PART 2 - PRODUCTS****2.1 VAPOR RETARDERS**

- A. Sheet Vapor Retarder: ASTM E 1745, Class A, except with maximum perm rating of 0.01. Include manufacturer's recommended adhesive or pressure-sensitive tape.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fortifiber Building Systems Group; Moistop Ultra 15.
    - b. Stego Industries, LLC; Stego Wrap 15 mil Class A.
    - c. W.R. Meadows; Perminator 15 mil.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the vapor retarder.
  - 1. Verify that compacted subgrade and granular course is dry, smooth, sound, and ready to receive vapor barrier.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 VAPOR RETARDERS**

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
  - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.

**3.3 PROTECTION, REPAIR, AND CLEANING**

- A. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

END OF SECTION

**SECTION 07 27 26 - FLUID-APPLIED MEMBRANE AIR BARRIERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: fluid-applied and sheet-applied, vapor-permeable membrane air barriers, including substrate joint treatment.
  - 1. High-build air barriers, vapor permeable.
- B. Related Requirements:
  - 1. Section 06 16 00 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

**1.2 DEFINITIONS**

- A. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- B. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.
- C. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.
  - 2. Schedule conference, two weeks prior to start of air barrier installation. Attendees shall include Contractor, certified installer, and air barrier manufacturer's representative. Optional attendees Owner's representative and Architect.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.
- B. Shop Drawings: For air-barrier assemblies.
  - 1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
  - 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
  - 3. Include details of interfaces with other materials that form part of air barrier.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.
- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
- D. Field quality-control reports.

### **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
  - 1. Installer to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and to employ ABAA-certified installers and supervisors on Project.
- B. Mockups: Build mockups to set quality standards for materials and execution and for preconstruction testing.
  - 1. Build integrated mockups of exterior wall assembly as indicated on Drawings but not less than 150 sq. ft., incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
    - a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
    - b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
    - c. If Architect determines mockups do not comply with requirements, reconstruct mockups, and apply air barrier until mockups are approved.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

### **1.7 PRECONSTRUCTION TESTING**

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups.
- B. Mockup Testing: Air-barrier assemblies must comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.
  - 1. Air-Leakage-Location Testing: Mockups will be tested for evidence of air leakage in accordance with ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
  - 2. Air-Leakage-Volume Testing: Mockups will be tested for air-leakage rate in accordance with ASTM E 2357.
  - 3. Adhesion Testing: Mockups will be tested for required air-barrier adhesion for a minimum of 30 lbf/sq. to substrate in accordance with ASTM D 4541.
  - 4. Notify Architect seven days in advance of the dates and times when mockups will be tested.

### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage, weather, excessive temperatures, freezing or extreme heat, and construction operations. Remove damaged material from site and dispose of in accordance with applicable regulations. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Protect stored materials from direct sunlight.

**1.9 FIELD CONDITIONS**

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
  - 1. Protect substrates from environmental conditions that affect air-barrier performance.
  - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

**1.10 WARRANTY**

- A. System Warranty: Manufacturers shall warranty system including the primary air barrier and installed accessories, sealants and sheet materials to be free from defects in material and workmanship, and agreeing to replace defective materials and components.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a continuous vapor-permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Building envelope air leakage: ASTM E 779 or ASTM E 1827, < 0.40 cfm/ft<sup>2</sup> (2.0 L/s·m<sup>2</sup>) of the building thermal envelope area at a pressure differential of 0.3 inch water gauge (75 Pa).
- C. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (equal to 0.2 L/s. x sq. m. at 75 Pa), when tested in accordance with ASTM E 2357.
  - 1. Assembly shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air and vapor seal materials at such locations, changes in substrate and perimeter conditions.
    - a. Assembly shall be capable of withstanding combined positive and negative design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure.
    - b. Assembly shall not displace adjacent materials under full load.
    - c. Assembly shall be joined in an airtight and flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations and creep, and anticipated seismic movement.
- D. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. pressure difference; ASTM E 2178.
- E. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
- F. Adhesion to Substrate: tested in accordance with ASTM D 4541.
- G. Fire Propagation Characteristics: Basis-of-Design product is part of an approved wall assembly that passes NFPA 285 testing as part of an approved assembly. Do not submit comparable products without coordination of compliance.

- H. UV Resistance: Can be exposed to sunlight for maximum of 180 days in accordance with manufacturer's written instructions.

### 2.3 HIGH-BUILD AIR BARRIERS, VAPOR PERMEABLE

- A. High-Build, Vapor-Permeable Air Barrier, Synthetic Polymer Type: Synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils or thicker over smooth, void-free substrates.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide GCP Applied Technologies; Perm-A-Barrier VPL or comparable product by one of the following:
    - a. Carlisle Coatings & Waterproofing, Inc.
    - b. Henry Company, Sealants Division.
- B. Vapor Permeance: Minimum 10 perms; ASTM E 96/E 96M, Procedure B, Water Method.

### 2.4 ACCESSORY MATERIALS

- A. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal. Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.
- B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.
- C. Stainless Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless steel fasteners.
- D. Counterflashing Strip: Modified bituminous, 40-mil-thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil-thick, cross-laminated polyethylene film with release liner backing.
- E. Interface With Adjacent Materials: Provide the following transition strips as applicable to suit conditions and maintain continuity of air barrier:
  - 1. Counterflashing: As recommended by air barrier Manufacturer.
  - 2. Roof flashing: As recommended and approved in writing by both the air barrier and the roof membrane Manufacturers. Submit a coordinated detail for review by Architect.
- F. Butyl Strip: Vapor retarding, 30 to 40 mils thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.
- G. Modified Bituminous Strip: Vapor retarding, 40 mils thick, smooth surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil-thick polyethylene film with release liner backing.
- H. Joint Reinforcing Strip: Air-barrier manufacturer's glass-fiber-mesh tape.
- I. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- J. Joint Reinforcing Strip (If required by air barrier Manufacturer): Air-barrier manufacturer's standard joint reinforcing material(s) or sealants.
- K. Substrate-Patching Material: Substrate fillers for preparation of cracks and overdriven fasteners, as recommended by air barrier manufacturer.
- L. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

- M. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
- N. Modified Bituminous Transition Strip: Vapor retarding, 40 mils thick, smooth surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil-thick polyethylene film with release liner backing.
- O. Elastomeric Flashing Sheet: ASTM D 2000, minimum 50- to 65-mil-thick, cured sheet neoprene with manufacturer-recommended contact adhesives and lap sealant with stainless-steel termination bars and fasteners.
- P. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
- Q. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 07 92 00 "Joint Sealants."
- R. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.
- S. Sheathing Joint Sealant: Single or multi-component, moisture curing, low-modulus, high-movement polyether / silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing and air barrier manufacturer for application indicated.
  - 1. Comply with ASTM C 920 and other requirements for each liquid-applied chemically curing sealant, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
  - 2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
  - 3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method in accordance with ASTM D 4263.
  - 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 SURFACE PREPARATION**

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
- H. Bridge isolation joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

### 3.3 JOINT TREATMENT

- A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.
  - 1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of fluid air-barrier material and embed a joint reinforcing strip in preparation coat.
- B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of fluid air-barrier material at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air-barrier material over joint reinforcing strip.

### 3.4 INSTALLATION OF ACCESSORIES (TRANSITION STRIP INSTALLATION)

- A. Install strips, transition strips, and accessory materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
  - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
  - 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
  - 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  - 4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
  - 5. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.



- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply modified bituminous transition strip adhesive-coated transition, or preformed silicone-sealant extrusion so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
  - 1. Transition Strip: Roll firmly to enhance adhesion.
  - 2. Adhesive-Coated Transition Strip: Roll firmly to enhance adhesion.
  - 3. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
  - 4. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
  - 5. Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches (150 mm) o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
  - 6. Silicone Sheets Transition Assemblies: Set in full bed of silicone sealant applied to walls, door and window frames, and air-barrier material.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material as recommended by air barrier manufacturer.
- G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch-wide, transition strip.
  - 1. Counterflashing strip for metal flashings.
  - 2. Modified bituminous strip for nonmetallic flashings.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets, with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

### 3.5 INSTALLATION OF FLUID AIR-BARRIER MEMBRANE

- A. Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier in accordance with air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
  - 1. Apply air barrier membrane primers within manufacturer's recommended application temperature ranges and recommendations (If required by air barrier Manufacturer).
  - 2. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  - 3. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
  - 4. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- B. Membrane Air Barriers: Apply continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.
  - 1. Vapor-Permeable, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils, applied in one or more equal coats.

- C. Apply strip and transition strip a minimum of 1 inch onto cured air-barrier material or strip and transition strip over cured air-barrier material overlapping 3 inches onto each surface according to air-barrier manufacturer's written instructions.
- D. Do not cover air barrier until it has been tested and inspected by testing agency.
- E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

### 3.6 FIELD QUALITY CONTROL

- A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
  - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
  - 2. Air-barrier dry film thickness.
  - 3. Continuous structural support of air-barrier system has been provided.
  - 4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
  - 5. Site conditions for application temperature and dryness of substrates have been maintained.
  - 6. Maximum exposure time of materials to UV deterioration has not been exceeded.
  - 7. Surfaces have been primed, if applicable.
  - 8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
  - 9. Termination mastic has been applied on cut edges.
  - 10. Strips and transition strips have been firmly adhered to substrate.
  - 11. Compatible materials have been used.
  - 12. Transitions at changes in direction and structural support at gaps have been provided.
  - 13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
  - 14. All penetrations have been sealed.
- D. Tests: As determined by testing agency from among the following tests:
  - 1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage in accordance with ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
  - 2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate in accordance with ASTM E 2357.
  - 3. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of 30 lbf/sq. in accordance with ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.
- E. Air barriers will be considered defective if they do not pass tests and inspections.
  - 1. Apply additional air-barrier material, in accordance with manufacturer's written instructions, where inspection results indicate insufficient thickness.
  - 2. Remove and replace deficient air-barrier components for retesting as specified above.
- F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- G. Prepare test and inspection reports.

**3.7 CLEANING AND PROTECTION**

- A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.
  - 1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for more than 60 days , remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials in accordance with air-barrier manufacturer's written instructions.
  - 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 07 42 13 - INSULATED METAL WALL PANELS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Foamed-insulation-core metal wall panels.
  - 2. Prefinished sheet metal trim and flat seam window sills to match wall panels.
- B. Related Requirements:
  - 1. Section 05 12 00 "Structural Steel Framing" for steel support framing of foamed-insulation-core metal wall panels.
  - 2. Section 07 27 26 "Fluid-Applied Membrane Air Barrier" for air barrier on sheathing above or below foamed-insulation-core metal wall panels to provide a continuous air and water exterior wall envelope.
  - 3. Section 07 92 00 "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
  - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
  - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
  - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
  - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
  - 7. Review temporary protection requirements for metal panel assembly during and after installation.
  - 8. Review procedures for repair of metal panels damaged after installation.
  - 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

**1.3 ACTION SUBMITTALS**

- A. Product Data Submittals: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
  - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
  - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

- C. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below.
  - 1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For metal panels to include in maintenance manuals.

#### **1.6 QUALITY ASSURANCE**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to conduct field observations of permanent work at progress completions of 25, 50, and 75 percent, including start of sub-framing and furring systems and start of panel installation. Submit written observation report to Contractor, Installer, Architect, and Owner within three calendar days of completion of each field observation.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer. Installer shall have a record of successful completion of no fewer than 15 composite wall panel installations of similar type and scope to this Project over a period of the last five contiguous years.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical metal panel assembly as shown on Drawings, including corner, soffits, supports, attachments, and accessories.
  - 2. Water-Spray Test: Conduct water-spray test of metal panel assembly mockup, testing for water penetration in accordance with AAMA 501.2.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

**1.8 FIELD CONDITIONS**

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

**1.9 COORDINATION**

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

**1.10 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested in accordance with ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  2. Finish Warranty Period: 20 years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E 72:
1. Wind Loads: As indicated on Drawings.
  2. Other Design Loads: As indicated on Drawings.
  3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- B. Air Infiltration: Air leakage of not more than 0.04 cfm/sq. ft. in compliance with 2016 NYS ECC C402.5.1.2; when tested in accordance with ASTM E 283 at the following test-pressure difference:
1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- C. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E 331 at the following test-pressure difference:
1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

- E. Fire-Test-Response Characteristics: Provide metal wall panels and system components with the following fire-test-response characteristics, as determined by testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E 119.
  2. Intermediate-Scale Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which wall panel is a part, complies with NFPA 285 for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies.
  3. Radiant Heat Exposure: No ignition when tested in accordance with NFPA 268.
  4. Potential Heat: Acceptable level when tested in accordance with NFPA 259.
  5. Surface-Burning Characteristics: Provide wall panels with a flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E 84.

## 2.2 FOAMED-INSULATION-CORE METAL WALL PANELS

- A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and insulation core foamed in place during fabrication, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.
1. Insulation Core: Modified isocyanurate or polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
    - a. Closed-Cell Content: 90 percent when tested in accordance with ASTM D 6226.
    - b. Density: 2.0 to 2.6 lb/cu. ft. when tested in accordance with ASTM D 1622.
    - c. Compressive Strength: Minimum 20 psi when tested in accordance with ASTM D 1621.
    - d. Shear Strength: 26 psi when tested in accordance with ASTM C 273/C 273M.
  - B. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels (Type EX-2): Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.
    1. Basis-of-Design: Subject to compliance with requirements, provide CENTRIA Architectural Systems; Formawall FWGX with Integral Attachment System, Smooth, Flat Profile, attached to 6" cold-formed metal framing with between framing R-13 insulation, and soffit framing; or comparable product by one of the following:
      - a. MBCI; a division of NCI Group, Inc..
      - b. Metl-Span.
    2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
      - a. Nominal Thickness: 0.0375 inch.
      - b. Exterior Finish: Three-coat fluoropolymer.
        - 1) Color: Dark Bronze.
      - c. Interior Finish: Siliconized polyester.
        - 1) Color: As selected by Architect from manufacturer's full range.
    3. Panel Coverage: 36 inches nominal.
    4. Panel Thickness: 3.0 inches.
    5. Thermal-Resistance Value (R-Value): 25 in accordance with ASTM C 1363.

## 2.3 MISCELLANEOUS MATERIALS



- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
  - 1. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
    - a. Minimum Base-Metal Thickness: 0.018 inch.
    - b. Depth: 3/4 inch.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  - 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
  - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Backer Board: Hardboard complying with ANSI A135.4, Class 1 tempered, 1/4 inch thick unless otherwise indicated.
- D. Flashing, Trim, and Window Sills: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- E. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- F. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
  - 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
  - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.
- G. Self-Adhering Sheet Waterproofing: Provide 30 mil thick, butyl rubber based adhesive backed high density cross-laminated polyethylene, self-adhering roofing underlayment designed for use at high temperatures. Basis of Design as GCP; Grace Ultra HT or approved equal. Membrane to resist temperatures up to 300 degrees F without degradation of the butyl adhesive.

## 2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

- C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- D. Where indicated on drawings provide outside corners by cutting and removing a portion of the interior face of the insulated metal panel and mitered the core insulation material, then bending panel metal face to form straight and true edge required for the change in plane. Provide metal trim on the back of the panel at fabricated outside corners to reconnect the metal on the panel back side. Provide sealant at top, bottom and both edges of the panel to provide a weathertight seal at the fabricated corner.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

## 2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
  - 1. Exterior finish on G90 galvanized steel shall be Fluoropolymer Two-Coat Mica System: 0.25 mil primer with 0.8 mil 70 percent PVDF fluoropolymer color coat providing a pearlescent appearance, AAMA 621.
  - 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C 754 and metal panel manufacturer's written recommendations.

**3.3 INSTALLATION OF METAL PANELS**

- A. General: Install metal panels in accordance with manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Shim or otherwise plumb substrates receiving metal panels.
  - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  - 3. Install screw fasteners in predrilled holes.
  - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 5. Install flashing and trim as metal panel work proceeds.
  - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
  - 1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal wall panel manufacturer.
  - 1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
  - 2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

### 3.4 INSTALLATION OF INSULATION-CORE METAL WALL PANELS

- A. General: Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.
1. Fasten foamed-insulation-core metal wall panels to supports with fasteners at each lapped joint at location and spacing and with fasteners recommended by manufacturer.
  2. Apply panels and associated items true to line for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
  3. Provide metal-backed washers under heads of exposed fasteners on weather side of insulated metal wall panels.
  4. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
  5. Provide sealant tape at lapped joints of insulated metal wall panels and between panels and protruding equipment, vents, and accessories.
  6. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to make panels weathertight.
- B. Foamed-Insulation-Core Metal Wall Panels: Fasten metal wall panels to supports with concealed clips at each joint at location and spacing and with fasteners recommended by manufacturer. Fully engage tongue and groove of adjacent panels.
1. Install clips to supports with self-tapping fasteners.
- C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- D. Flashing, Trim, and Window Sills: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
  2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
  3. Install self-adhering and sealing sheet waterproofing over sheathing and upside walls a minimum of 4 inches or greater as recommended by waterproofing sheet manufacturer. Do not leave exposed for greater than 60 days. Membrane to run continuously under window frame.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration in accordance with AAMA 501.2.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

- D. Metal wall panels will be considered defective if they do not pass test and inspections.
- E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

### **3.6 CLEANING AND PROTECTION**

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 07 42 93 - SOFFIT PANELS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Metal soffit panels.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.3 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Metal soffit panels.
- B. Product Data Submittals:
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- C. Shop Drawings:
  - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
  - 2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
  - 1. Include similar Samples of trim and accessories involving color selection.
- E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
  - 1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For metal panels to include in maintenance manuals.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical roof eave, including fascia, and soffit as shown on Drawings; approximately four panels wide by full eave width, including attachments and accessories.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

**1.8 FIELD CONDITIONS**

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

**1.9 COORDINATION**

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

**1.10 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  - 2. Warranty Period: Two (2) years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.



1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
  - a. Color fading more than 5 Delta E units when tested according to ASTM D 2244.
  - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
  - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 (twenty) years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
  1. Wind Loads: As indicated on Drawings.
  2. Other Design Loads: As indicated on Drawings.
  3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than [0.06 cfm/sq. ft.] when tested according to ASTM E 283 at the following test-pressure difference:
  1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
  1. Test-Pressure Difference: 2.86 lbf/sq. ft.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 METAL SOFFIT PANELS

- A. Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Flush-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. AEP Span; A BlueScope Steel Company.
    - b. Architectural Building Components.
    - c. ATAS International, Inc.
    - d. Berridge Manufacturing Company.
    - e. CENTRIA Architectural Systems.
    - f. Dimensional Metals, Inc.
    - g. Englert, Inc.
    - h. Fabral.
    - i. Firestone Building Products.
    - j. Innovative Metals Company, Inc.
    - k. MBCI; a division of NCI Group, Inc.
    - l. McElroy Metal, Inc.
    - m. Merchant & Evans Inc.
    - n. Metal Sales Manufacturing Corporation.
    - o. Metal-Fab Manufacturing, LLC.
    - p. Petersen Aluminum Corporation.
    - q. Ultra Seam Incorporated.

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
  - a. Gauge: 22 gauge.
  - b. Exterior Finish: Three-coat fluoropolymer.
  - c. Color: As selected by Architect from manufacturer's full range.
3. Panel Coverage: 16 inches.
4. Panel Height: 1.5 inches.

### 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 hot-dip galvanized coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
  2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
  3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

### 2.4 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

## 2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
  - 1. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 2. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.
  - 3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.
  2. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.
    - a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Miscellaneous Supports: Install sub-framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.
1. Soffit Framing: Wire tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

### 3.3 INSTALLATION OF METAL SOFFIT PANELS

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Shim or otherwise plumb substrates receiving metal panels.
  2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  3. Install screw fasteners in predrilled holes.
  4. Locate and space fastenings in uniform vertical and horizontal alignment.
  5. Install flashing and trim as metal panel work proceeds.
  6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
  2. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
  3. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
  4. Stainless Steel Panels: Use stainless steel fasteners.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Apply panels and associated items true to line for neat and weathertight enclosure.
  2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
  3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.

4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
- E. Watertight Installation:
1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
  2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
  3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
  2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

### 3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 07 46 46 - FIBER-CEMENT SIDING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Fiber-cement siding.

**1.2 COORDINATION**

- A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 ACTION SUBMITTALS**

- A. Product Data Submittals: For each type of product; Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples for Initial Selection: For fiber-cement siding including related accessories.
- C. Samples for Verification: For each type, color, texture, and pattern required.
  - 1. 24-inch-wide-by-36-inch-high Sample panel of siding assembled on plywood backing.
  - 2. 12-inch-long-by-actual-width Samples of trim and accessories.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: For each type of fiber-cement siding.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.
- C. Research/Evaluation Reports: For each type of fiber-cement siding required, from ICC-ES.
- D. Sample Warranty: For special warranty.

**1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For each type of product , including related accessories, to include in maintenance manuals.

**1.7 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish full lengths of fiber-cement siding including related accessories, in a quantity equal to 2 percent of amount installed.

**1.8 MOCKUPS**

- A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Build mockups for fiber-cement siding including accessories.
  - a. Size: 48 inches long by 60 inches high.
  - b. Include outside corner on one end of mockup.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover, and in a dry location.

### **1.10 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Structural failures including cracking and deforming.
    - b. Deterioration of materials beyond normal weathering.
  2. Warranty Period: 20 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 SOURCE LIMITATIONS**

- A. Obtain products, including related accessories, from single source from single manufacturer.

### **2.2 FIBER-CEMENT SIDING (TYPE EX-3)**

- A. Fiber-Cement Siding: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested in accordance with ASTM E 136; with a flame-spread index of 25 or less when tested in accordance with ASTM E 84.
  1. Basis-of-Design: Subject to compliance with requirements, provide Cladding Group "Equitone", Cementitious Wall Panels over Centria MetalWrap MR-300 Composite Back-Up System, over 6" cold-formed metal framing with R-13 batt insulation between framing; or comparable product by one of the following:
    - a. American Fiber Cement.
    - b. Swisspearl Fiber Cement.
    - c. Nichiha Fiber Cement.
- B. Labeling: Provide fiber-cement siding that is tested and labeled in accordance with ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.
- C. Nominal Thickness: Not less than 3/8 inch (10 mm).

### **2.3 ACCESSORIES**

- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
  1. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.
- B. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated:
  1. Corner posts.
  2. Door and window casings.



3. Fasciae.
  4. Moldings and trim.
- C. Flashing: Provide aluminum flashing complying with Section 07 62 00 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.
1. Finish for Aluminum Flashing: High-performance organic finish.
- D. Fasteners:
1. For fastening to wood, use siding nails of sufficient length to penetrate a minimum of 1 inch into substrate.
  2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
  3. For fastening fiber cement, use stainless steel fasteners.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement siding and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Clean substrates of projections and substances detrimental to application.

#### **3.3 INSTALLATION**

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
  1. Do not install damaged components.
  2. Install fasteners no more than 24 inches o.c.
- B. Install joint sealants as specified in Section 07 92 00 "Joint Sealants" and to produce a weathertight installation.

#### **3.4 ADJUSTING AND CLEANING**

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 07 54 19 - PVC MEMBRANE ROOFING****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Adhered system with PVC roofing membrane.
- B. Insulation, flat and tapered.
- C. Vapor retarder.
- D. Deck sheathing.
- E. Flashings.
- F. Roofing cant strips, stack boots, roofing expansion joints, and walkway pads.

**1.2 RELATED REQUIREMENTS**

- A. Section 05 31 00 - Steel Decking: Product requirements for acoustical insulation for deck flutes, for placement by this section.
- B. Section 06 10 00 - Rough Carpentry: Wood nailers and curbs.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim: Counterflashings and reglets.
- D. Section 07 72 00 - Roof Accessories: Roof-mounted units; prefabricated curbs.
- E. Section 07 76 00 - Roof Paver & Pedestal System: Roof-mounted paver and pedestal system.
- F. Division 22 - Plumbing Specialties: Roof drains.

**1.3 REFERENCE STANDARDS**

- A. ASTM C 1177/C 1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2008.
- B. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2008.
- C. ASTM D 4434 - Standard Specification for Poly (Vinyl Chloride) Sheet Roofing; 2009.
- D. ASTM E 1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces; 2001.
- E. FM DS 1-28 - Wind Design; Factory Mutual Research Corporation; 2007.
- F. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; Fifth Edition, with interim updates.
- G. UL (RMSD) - Roofing Materials and Systems Directory; Underwriters Laboratories Inc.; current edition.

**1.4 PERFORMANCE REQUIREMENTS**

- A. General: Install a watertight, membrane roofing and base flashing system with compatible components that will not permit the passage of liquid water and will withstand wind loads, thermally induced movement, and exposure to weather without failure.
- B. FM Listing: Provide membrane, base flashings, and component materials that meet requirements of FM 4450 and FM 4470 as part of a roofing system and that are listed in FM's

“Approval Guide” for Class 1 or noncombustible construction, as applicable. Identify materials with FM markings.

1. Roofing system and warranty shall comply with the following: (Refer to Structural Drawings, General Notes, etc., for additional information and requirements regarding wind loads).
  2. Fire/Windstorm Classification: Class 1A-110.
  3. Hail Resistance Rating: SH.
- C. Project Site Wind Load: Comply with code and warranty requirements, but no less than 115 mph wind load, unless a higher wind load is otherwise required by code or authorities having jurisdiction.
- D. Contractor shall provide Manufacturer’s Wind Testing showing actual tested pressures as being in compliance with ASCE 7-06. Extrapolation of pressures will not be accepted.
- E. All Perimeter Sheet Metal Details shall meet wind uplift requirements per ANSI-SPR ES-1.

### 1.5 SUBMITTALS

- A. See Section 01 33 00 – Submittal Procedures, for submittal procedures. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
- B. Specimen Warranty: For approval.
- C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.
- D. Samples for Verification: Submit two samples 6 x 6 inches in size illustrating insulation.
- E. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section:
1. With minimum 3 years documented experience.
  2. Approved by membrane manufacturer.
- C. Certification: The roofing manufacturer shall be required to provide written documentation certifying that the roof design provided complies with the performance requirements for that particular system, as set forth in IBC Chapter 15 in Section 1504; This certification shall be included in other required submittals and be attached to completed and executed manufacturer’s roofing warranty provided at Project Closeout.
1. The written documentation from the roofing manufacturer shall also certify that roofing design and system provided comply with the requirements specified and the manufacturer’s requirements for the roofing system provided.

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
- B. Store products in weather protected environment, clear of ground and moisture.
- C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- D. Protect foam insulation from direct exposure to sunlight.

### 1.8 FIELD CONDITIONS

- A. Do not apply roofing membrane during unsuitable weather.
- B. Do not apply roofing membrane when ambient temperature is below 40 degrees F (5 degrees C).
- C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

### 1.9 WARRANTY

- A. See Section 01 77 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer's System, Labor and Materials, and Wind Warranty: Provide manufacturer's standard "No Dollar Limit" (NDL) Full-Service Warranty Agreement, including wind-load rider, flashing endorsement, signed by an authorized representative of modified bitumen roofing system manufacturer, on form published with current product literature as of date of Contract Documents.
  - 1. Warranty shall cover, in part, wind damage, leakage or failure caused by improper workmanship or materials, to include insulation, insulation adhesives, fasteners, membrane adhesives, field membranes, flashing membranes, and sheet metal work.
  - 2. Warranty Period: Manufacturer's standard 20-year "NDL" warranty, maximum of one renewal period.
  - 3. Warranty shall have no provision for 'blanket voiding', defined as a situation where Manufacturer can permanently void the entire future warranty obligations (not just a situational coverage).
  - 4. Warranty shall not charge Owner for leak investigation or storm event inspection costs for any reason.
  - 5. Warranty shall not require a maintenance program as a condition of its warranty.
  - 6. Warranty shall not exclude liability for manufacturer's design support and site inspections required by these specifications.
  - 7. Warranty is allowed to be modified into specification compliance by rider, signed by manufacturer's full-time employee.
  - 8. Installer shall provide manufacturer with a five (5) year warranty covering roofing system installation and water tightness.
- C. Special Project Warranty: Roofing Installer's warranty, on warranty form in the front-end documents, signed by roofing Installer, covering Work of this Section, in which roofing Installer agrees to repair or replace components of membrane roofing that fail in materials or workmanship within the following warranty period:
  - 1. Warranty Period: Five years from date of Substantial Completion.
- D. Standard manufacturer's roofing warrantees and guarantees which contain language regarding the governing of the warrantees and guarantees by any state other than the State of Alabama, must be amended to exclude such language, and substituting the requirement that the Laws of

the State of Alabama shall govern all such warranties and guarantees.

- E. The manufacturer of the roofing must submit a letter to the Owner certifying that the entire roofing assembly is compatible and complete as required for warranty requirements.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. PVC Membrane Materials:
  - 1. Duro-Last Roofing, Inc.; www.duro-last.com.
  - 2. IB Roof Systems; www.ibroof.com.
  - 3. Johns Manville Corporation; www.jm.com.
  - 4. Sika Sarnafil, Inc; www.sarnafilus.com.
  - 5. Substitutions: See Section 01600 - Product Requirements.
- B. Insulation:
  - 1. Atlas Roofing Corporation: www.atlasroofing.com.
  - 2. GAF Materials Corporation: www.gaf.com.
  - 3. Dow Chemical Co: www.dow.com.
  - 4. Owens Corning Corp: www.owenscorning.com.
  - 5. Substitutions: See Section 01600 - Product Requirements.

### **2.2 ROOFING - UNBALLASTED APPLICATIONS**

- A. PVC Membrane Roofing: One ply membrane, fully adhered, over insulation.
- B. Roofing Assembly Requirements:
  - 1. Solar Reflectance Index (SRI): 78, minimum, calculated in accordance with ASTM E 1980.
    - a. Field applied coating may not be used to achieve specified SRI.
  - 2. Roof Covering External Fire-Resistance Classification: UL Class A.
  - 3. Wind Uplift: Comply with UL-90. Factory Mutual classifications are not required on this project. (Revised by Addendum No. 1).
  - 4. Insulation Thermal Value (R), minimum: R-25; provide insulation of thickness required.
- C. Acceptable Insulation Types - Constant Thickness Application:
  - 1. Minimum 2 layers of polyisocyanurate board.

### **2.3 ROOFING MEMBRANE AND ASSOCIATED MATERIALS**

- A. Membrane:
  - 1. Material: Polyvinyl chloride copolymer alloy or ethylene interpolymer complying with ASTM D 4434.
  - 2. Reinforcing: Both internal fabric and backing.
  - 3. Thickness: 60 mil, 0.060 inch (1.5 mm) minimum.
  - 4. Sheet Width: Factory fabricated into largest sheets possible.
  - 5. Solar Reflectance: 0.75, minimum, initial, and 0.65, minimum, 3-year, certified by Cool Roof Rating Council.
  - 6. Thermal Emissivity: 0.80, minimum, initial, and 0.79, minimum, 3-year, certified by Cool Roof Rating Council.
  - 7. Color: White.
  - 8. Basis of Design: Sarnafil G410-15 feltback, 60 mil, thermoplastic membrane with fiberglass reinforcement and a factory applied 9 oz. felt backing.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Vapor Retarder: Reinforced Kraft paper laminate complying with requirements of fire rating

classification; compatible with roofing and insulation materials.

1. Fire-retardant adhesive.

D. Flexible Flashing Material: Material recommended by membrane manufacturer.

## 2.4 DECK SHEATHING

A. Deck Sheathing: Glass mat faced gypsum panels, ASTM C 1177/C 1177M, fire resistant type, 1/4 inch (6 mm) thick.

1. Products:

a. Equal to Georgia Pacific DensDeck® Prime roof board, with the following characteristics:

- 1) Weight: 1.15 - 1.25 lb/sq. ft.
- 2) Surfacing: Fiberglass mat with non-asphaltic coating.
- 3) Flexural Strength, Parallel (ASTM C473): 40 lbf, minimum.
- 4) Flute Span (ASTM E661): 2-5/8 inches.
- 5) Permeance (ASTM E96): Not more than 50 perms.
- 6) R-Value (ASTM C518): Not less than 0.28.
- 7) Water Absorption (ASTM C1177): Less than 10 percent of weight."

## 2.5 INSULATION

A. Polyisocyanurate Board Insulation: Rigid cellular foam, 4' x 8', complying with ASTM C 1289, Type II, Class 1, cellulose felt or glass fiber mat both faces; Grade 1 and with the following characteristics:

1. Compressive Strength: 16 psi (110 kPa) at roof areas not supporting roof paver system and 60 psi (414) at roof areas supporting roof paver system. Refer to drawings for location of roof pavers.
2. R-Value: 35 ci minimum.
3. Thickness: As required for R-value indicated.

## 2.6 ACCESSORIES

- A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
- B. Cant and Edge Strips: Wood fiberboard, compatible with roofing materials; cants formed to 45 degree angle.
- C. Sheathing Adhesive: Non-combustible type, for adhering gypsum sheathing to metal deck.
- D. Sheathing Joint Tape: Paper type, 8" wide, self-adhering.
- E. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
  1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.
- F. Membrane Adhesive: As recommended by membrane manufacturer.
- G. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.
- H. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.
- I. Sealants: As recommended by membrane manufacturer.
- J. Walkway Pads: Type as recommended by membrane manufacturer; size as indicated.
- K. Roof Expansion Joints: Equivalent to Johns Manville Expand-O-Flash PVC EJ/WC expansion joint covers:
  1. Flexible, weather-proof exterior covers for expansion joint openings with closed-cell foam

- rod support.
- 2. Bellows Width: 4".
- 3. Color: White.
- 4. Joint Filler: Provide flexible vapor barrier with fire safing insulation.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION - GENERAL**

- A. Perform work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.
- B. Do not apply roofing membrane during unsuitable weather.
- C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- F. Coordinate the work with installation of associated counter flashings installed by other sections as the work of this section proceeds.

#### **3.2 EXAMINATION**

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

#### **3.3 HOLLOW CORE PLANK PREPARATION**

- A. Install deck sheathing on deck:
  - 1. Lay with long side at right angle to any flutes; stagger end joints; provide support at ends.
  - 2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
  - 3. Adhere deck sheathing to hollow core planks as recommended by manufacturer. Metal fasteners are not to be used with hollow core planks.
  - 4. Tape joints.

#### **3.4 SOUND-ADSORBING INSULATION AT ACOUSTICAL ROOF DECK**

- A. Refer to Section 05 31 00 Steel Decking for sound-absorbing insulation to be provided by acoustical roof deck manufacturer. The "pre-molded roll" or "strip of fiberglass" sound insulation shall be installed by the membrane roof installer at all acoustical roof deck locations prior to installation of vapor barrier and roof insulation. Install sound-absorbing insulation in strict compliance with manufacturer's written instructions.

#### **3.5 VAPOR RETARDER AND INSULATION - UNDER MEMBRANE**



- A. Apply vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
  - 1. Extend vapor retarder under cant strips and blocking to deck edge.
  - 2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
- B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.
- C. Attachment of Insulation:
  - 1. Mechanically fasten insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual requirements.
- D. Lay subsequent layers of insulation with joints staggered minimum 6 inch (150 mm) from joints of preceding layer.
- E. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
- F. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- G. Do not apply more insulation than can be covered with membrane in same day.

### **3.6 MEMBRANE APPLICATION**

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Fully Adhered Application: Apply adhesive to substrate at rate as recommended by manufacturer. Fully embed membrane in adhesive except in areas directly over or within 3 inches (75 mm) of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
- D. Overlap edges and ends and seal seams by heat welding, minimum 3 inches (75 mm). Seal permanently waterproof.
- E. At intersections with vertical surfaces:
  - 1. Extend membrane over cant strips and up a minimum of 4 inches (100 mm) onto vertical surfaces.
  - 2. Fully adhere flexible flashing over membrane and up to nailing strips.
- F. Around roof penetrations, seal flanges and flashings with flexible flashing.
- G. Coordinate installation of roof drains and sumps and related flashings.
- H. Install roof mounted expansion joints in strict accordance with Manufacturer's instructions.

### **3.7 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field quality control and inspection.
- B. Require site attendance of roofing and insulation material manufacturers daily during installation of the Work.

### **3.8 CLEANING**

- A. Remove bituminous markings from finished surfaces.
- B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
- C. Repair or replace defaced or damaged finishes caused by work of this section.

**3.9 PROTECTION**

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

**SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Formed wall sheet metal fabrications.
  - 2. Manufactured through-wall flashing with counterflashing.
  - 3. Formed equipment support flashing.
- B. Related Requirements:
  - 1. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking.
  - 2. Section 07 71 00 "Roof Specialties" for manufactured copings, roof-edge specialties, roof-edge drainage systems, reglets, and counterflashings.
  - 3. Section 07 72 00 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

**1.2 COORDINATION**

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
  - 3. Review requirements for insurance and certificates if applicable.
  - 4. Review sheet metal flashing observation and repair procedures after flashing installation.

**1.4 ACTION SUBMITTALS**

- A. Product Data Submittals: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: For sheet metal flashing and trim.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
  - 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
  - 4. Include details for forming, including profiles, shapes, seams, and dimensions.
  - 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
  - 6. Include details of termination points and assemblies.
  - 7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
  - 8. Include details of roof-penetration flashing.

9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
  10. Include details of special conditions.
  11. Include details of connections to adjoining work.
  12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
- D. Samples for Verification: For each type of exposed finish.
1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
  2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
  3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
  4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of coping and roof edge flashing that is SPRI/ES-1 tested.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Evaluation Reports: For copings and roof edge flashing, from an agency acceptable to authority having jurisdiction showing compliance with ANSI/SPRI/FM 4435/ES-1.
- E. Sample Warranty: For special warranty.

### **1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
- B. Special warranty.

### **1.7 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
  1. For copings and roof edge flashings that are SPRI/ES-1 tested, shop is to be listed as able to fabricate required details as tested and approved.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  1. Build mockup of typical roof edge, including fascia approximately 10 feet long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations in writing.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
  - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
  - 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

## 1.9 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested in accordance with ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install copings tested in accordance with SPRI/ES-1 and capable of resisting the following design pressure:
  - 1. Design Pressure: As indicated on Drawings.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. Factory Prime Coating: Where painting after installation is required, pretreat metal with white or light-colored, factory-applied, baked-on epoxy primer coat; minimum dry film thickness of 0.2 mil.
2. Exposed Coil-Coated Finish:
  - a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Color: As selected by Architect from manufacturer's full range.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

### 2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Carlisle Coatings & Waterproofing Inc; CCW WIP 300HT.
    - b. Carlisle Residential; a division of Carlisle Construction Materials; WIP 300HT.
    - c. GCP Applied Technologies; Grace Ice and Water Shield HT.
    - d. Henry Company; Blueskin PE200 HT.
    - e. Kirsch Building Products, LLC; Sharkskin Ultra SA.
    - f. Metal-Fab Manufacturing, LLC; MetShield.
    - g. Owens Corning; WeatherLock Metal High Temperature Underlayment.
    - h. Polyguard Products, Inc.; Deck Guard HT.
    - i. Protecto Wrap Company; Protecto Jiffy Seal Ice & Water Guard HT.
    - j. SDP Advanced Polymer Products Inc; Palisade SA-HT.
  2. Source Limitations: Obtain underlayment from single source from single manufacturer.
  3. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
  4. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F or lower.
- C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

### 2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
  1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.

- c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
- C. Solder:
1. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- H. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D 1187/D 1187M.
- I. Asphalt Roofing Cement: ASTM D 4586/D 4586M, asbestos free, of consistency required for application.

## 2.5 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
  2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
  4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
  5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
  2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
  2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

- E. Seams:
  - 1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
  - 3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.
- F. Do not use graphite pencils to mark metal surfaces.

## 2.6 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:
  - 1. Stainless Steel: **[0.0156 inch]** thick.
- B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:
  - 1. Aluminum: 0.032 inch thick.

## 2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
  - 1. Stainless Steel: 0.019 inch thick.
- B. Overhead-Piping Safety Pans: Fabricate from the following materials:
  - 1. Stainless Steel: 0.025 inch thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
  - 1. Verify compliance with requirements for installation tolerances of substrates.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
  - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering, High-Temperature Sheet Underlayment:
  - 1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
  - 2. Prime substrate if recommended by underlayment manufacturer.
  - 3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
  - 4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.



5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
  6. Cover underlayment within 14 days.
- B. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

### 3.3 INSTALLATION, GENERAL

- A. Install Anchor sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, sealant.
  3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
  4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  5. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
  7. Do not field cut sheet metal flashing and trim by torch.
  8. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
  2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
  3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.
    - a. Embed hooked flanges of joint members not less than 1 inch into sealant.
    - b. Form joints to completely conceal sealant.
    - c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
    - d. Adjust setting proportionately for installation at higher ambient temperatures.
      - 1) Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
  2. Do not solder metallic-coated steel and aluminum sheet.
  3. Do not use torches for soldering.
  4. Heat surfaces to receive solder, and flow solder into joint.
    - a. Fill joint completely.
    - b. Completely remove flux and spatter from exposed surfaces.
  5. Stainless Steel Soldering:
    - a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
    - b. Promptly remove acid-flux residue from metal after tinning and soldering.
    - c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
- H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

### 3.4 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
  2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
  2. Extend counterflashing 4 inches over base flashing.
  3. Lap counterflashing joints minimum of 4 inches.
  4. Secure in waterproof manner by means of interlocking folded seam or blind rivets and sealant unless otherwise indicated.
- D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

### 3.5 INSTALLATION OF WALL FLASHINGS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.
- C. Reglets: Installation of reglets is specified in Section 03 30 00 "Cast-in-Place Concrete," Section 04 20 00 "Unit Masonry.,"

### 3.6 INSTALLATION OF MISCELLANEOUS FLASHING

- A. Equipment Support Flashing:
1. Coordinate installation of equipment support flashing with installation of roofing and equipment.

2. Weld or seal flashing with elastomeric sealant to equipment support member.
- B. Overhead-Piping Safety Pans:
1. Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings.
  2. Pipe and install drain line to plumbing waste or drainage system.

### 3.7 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

### 3.8 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

### 3.9 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 07 71 00 - ROOF SPECIALTIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Copings.
  - 2. Roof-edge specialties.
  - 3. Roof-edge drainage systems.
  - 4. Reglets and counterflashings.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for downspout guards and downspout boots.
  - 2. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking.
  - 3. Section 07 54 19 "PVC Membrane Roofing" for membrane roofing.
  - 4. Section 07 62 00 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
  - 5. Section 07 72 00 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
  - 6. Section 07 92 00 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.
- C. Preinstallation Conference: Conduct conference at Project site.
  - 1. Meet with Owner, Architect, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
  - 2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
  - 3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

**1.2 ACTION SUBMITTALS**

- A. Product Data Submittals: For each type of each product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof specialties.
  - 1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
  - 2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
  - 3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
  - 4. Detail termination points and assemblies, including fixed points.
  - 5. Include details of special conditions.
- C. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

- D. Samples for Verification:
  - 1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.
  - 2. Include copings, roof-edge specialties, roof-edge drainage systems, reglets and counterflashings made from 12-inch lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

### **1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For each type of roof specialty.
- C. Product Test Reports: For copings and roof-edge flashings, for tests performed by a qualified testing agency.
- D. Sample Warranty: For manufacturer's special warranty.

### **1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For roofing specialties to include in maintenance manuals.

### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are SPRI ES-1 tested to specified design pressure.

### **1.6 MOCKUPS**

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockup of typical roof edge as indicated on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
- B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

### **1.8 FIELD CONDITIONS**

- A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.
- B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

**1.9 WARRANTY**

- A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 07 54 19 "PVC Membrane Roofing".
- B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested in accordance with ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Section 07 54 23 "Thermoplastic-Polyolefin (TPO) Roofing".

**2.2 PERFORMANCE REQUIREMENTS**

- A. General Performance: Roof specialties to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. SPRI Wind Design Standard: Manufacture and install copings and roof-edge specialties tested in accordance with SPRI ES-1 and capable of resisting the following design pressures:
  - 1. Design Pressure: As indicated on Drawings.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

**2.3 COPINGS**

- A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet, concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.
  - 1. Formed Aluminum Sheet Coping Caps: Aluminum sheet, 0.050 inch thick.
    - a. Surface: Smooth, flat finish.
    - b. Finish: Three-coat fluoropolymer.
    - c. Color: As selected by Architect from manufacturer's full line of standard and custom colors.
  - 2. Corners: Factory mitered and mechanically clinched and sealed watertight.
  - 3. Coping-Cap Attachment Method: face leg hooked to continuous cleat with back leg fastener exposed, fabricated from coping-cap material.
    - a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches wide, with integral cleats.

## 2.4 ROOF-EDGE SPECIALTIES

- A. Canted Roof-Edge Fascia and Gravel Stop: Manufactured, two-piece, roof-edge fascia consisting of compression-clamped metal fascia cover in section lengths not exceeding 12 feet and a continuous formed galvanized-steel sheet cant, 0.028 inch thick, minimum, with extended vertical leg terminating in a drip-edge cleat. Provide matching corner units.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Architectural Products Company.
    - b. ATAS International, Inc.
    - c. Castle Metal Products.
    - d. Cheney Flashing Company.
    - e. Hickman Company, an MTL Company.
    - f. Merchant & Evans, Inc.
    - g. Metal-Era, Inc.
    - h. Metal-Fab Manufacturing, LLC.
    - i. Petersen Aluminum Corporation (Pac-Clad).
  2. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, 0.050 inch thick.
    - a. Surface: Smooth, flat finish.
    - b. Finish: Three-coat fluoropolymer.
    - c. Color: As selected by Architect from manufacturer's full line of standard and custom colors.
  3. Corners: Factory mitered and mechanically clinched and sealed watertight.
  4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
  5. Fascia Accessories: Fascia extenders with continuous hold-down cleats and Soffit trim.

## 2.5 ROOF-EDGE DRAINAGE SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Architectural Products Company.
  2. ATAS International, Inc.
  3. Castle Metal Products.
  4. Cheney Flashing Company.
  5. Hickman Company, an MTL Company.
  6. Merchant & Evans, Inc.
  7. Metal-Era, Inc.
  8. Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.
- B. Gutters, expose (surface mounted): Manufactured in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
1. Provide steel material, thickness, color and finish to match Standing Seam Metal Roof manufacturer's standard zinc-coated (galvanized) steel sheet with PVDF Fluoropolymer (Kynar 500) resin color coat finish
  2. Gutter Profile: As indicated in accordance with SMACNA's "Architectural Sheet Metal Manual."
  3. Corners: Factory mitered and mechanically clinched and sealed watertight.
  4. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.
  5. Downspout Drop Outlet Tube: Provide plastic outlet transition to coordinate with location and size of downspout to support metal protection procedures for connection between steel gutters and aluminum downspout.



6. Gutter Accessories: Continuous hinged leaf guard of solid metal designed to shed leaves.
- C. Downspouts: Plain rectangular formed metal complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Formed Aluminum: 0.050 inch.
  2. Downspout Profile: As indicated on Drawings according to SMACNA's "Architectural Sheet Metal Manual."
  3. Corners: Factory mitered and continuously welded.
  4. Downspout Supports: Straps with finish matching the downspouts.

## 2.6 REGLETS AND COUNTERFLASHINGS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Castle Metal Products.
  - b. Cheney Flashing Company.
  - c. Fry Reglet Corporation.
  - d. Heckmann Building Products Inc.
  - e. Hickman Company, W. P.
  - f. Keystone Flashing Company, Inc.
  - g. Metal-Era, Inc.
  - h. Metal-Fab Manufacturing, LLC.
- B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
  1. Formed Aluminum: 0.050 inch thick.
  2. Stainless Steel: 0.0250 inch thick.
  3. Corners: Factory mitered and mechanically clinched and sealed watertight.
  4. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
  5. Concrete Type, Embedded: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
  6. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.
- C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:
  1. Formed Aluminum: 0.032 inch thick.
  2. Stainless Steel: 0.0250 inch thick.
- D. Accessories:
  1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
  2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
- E. Aluminum Finish: Three-coat metallic fluoropolymer.
  1. Color: As selected by Architect from manufacturer's full range.
- F. Stainless Steel Finish: ASTM A 480/A 480M No. 2B (bright, cold rolled, unpolished).

## 2.7 MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.
- C. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:
- D. Stainless Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

## 2.8 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.
    - b. GCP Applied Technologies; Grace Ice and Water Shield HT.
    - c. Henry Company; Blueskin PE200 HT.
    - d. Metal-Fab Manufacturing, LLC; MetShield.
    - e. Owens Corning; WeatherLock Metal High Temperature Underlayment.
  - 2. Thermal Stability: ASTM D 1970/D 1970M; stable after testing at 240 deg F.
  - 3. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F.
- B. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- C. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. minimum.

## 2.9 MISCELLANEOUS MATERIALS

- A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
  - 1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
  - 2. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
- B. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- C. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- E. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

## 2.10 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- D. Coil-Coated Galvanized-Steel Sheet Finishes:
  - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A 755/A 755M and coating and resin manufacturers' written instructions.
    - a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- E. Coil-Coated Aluminum Sheet Finishes:
  - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION OF UNDERLAYMENT**

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
  - 1. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.
- B. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- C. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

#### **3.3 INSTALLATION, GENERAL**

- A. Install roof specialties in accordance with manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use

fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
  2. Provide uniform, neat seams with minimum exposure of solder and sealant.
  3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
  4. Torch cutting of roof specialties is not permitted.
  5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of uncoated aluminum and stainless steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
  2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

### 3.4 INSTALLATION OF COPINGS

- A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.
  1. Interlock face-leg drip edge into continuous cleat anchored to substrate at manufacturer's required spacing that meets performance requirements. Anchor back leg of coping with screw fasteners and elastomeric washers at manufacturer's required spacing that meets performance requirements.

### 3.5 INSTALLATION OF ROOF-EDGE SPECIALTIES

- A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

**3.6 INSTALLATION OF ROOF-EDGE DRAINAGE SYSTEMS**

- A. Install components to produce a complete roof-edge drainage system in accordance with manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches apart. Attach ends with rivets and solder to make watertight. Slope to downspouts.
  - 1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion-joint caps.
  - 2. Install continuous leaf guards on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.
- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.
  - 1. Provide elbows at base of downspouts at grade to direct water away from building.
  - 2. Connect downspouts to underground drainage system indicated.

**3.7 INSTALLATION OF REGLETS AND COUNTERFLASHINGS**

- A. Coordinate installation of reglets and counterflashings with installation of base flashings.
- B. Embedded Reglets: See Section 03 30 00 "Cast-in-Place Concrete" and Section 04 20 00 "Unit Masonry" for installation of reglets.
- C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.
- D. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant. Fit counterflashings tightly to base flashings.

**3.8 CLEANING AND PROTECTION**

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.
- D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 07 72 00 - ROOF ACCESSORIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Roof curbs.
  - 2. Equipment supports.
  - 3. Roof hatches.
  - 4. Pipe and duct supports.
  - 5. Pipe portals.
  - 6. Preformed flashing sleeves.
  - 7. Roof walkways.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
  - 2. Section 05 52 13 "Pipe and Tube Railings" for safety railing systems not attached to roof-hatch curbs.
  - 3. Section 07 54 19 "PVC Membrane Roofing" for membrane roofing.
  - 4. Section 07 62 00 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
  - 5. Section 07 71 00 "Roof Specialties" for manufactured fasciae, copings, gravel stops, gutters and downspouts, and counterflashing.

**1.2 COORDINATION**

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of roof accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories.
  - 1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.
- C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.
- D. Delegated Design Submittals: For roof curbs, equipment supports and walkways indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.

2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
  1. Size and location of roof accessories specified in this Section.
  2. Method of attaching roof accessories to roof or building structure.
  3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
  4. Required clearances.
- B. Sample Warranties: For manufacturer's special warranties.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

#### **1.6 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of roof hath system that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Five (5) years from date of Substantial Completion.
- B. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
  1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  2. Finish Warranty Period: Twenty (20) years from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. General Performance: Roof accessories to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design roof curbs and equipment supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Wind-Restraint Performance: As indicated on Drawings.

#### **2.2 ROOF CURBS**

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded



or mechanically fastened and sealed corner joints, and integrally formed deck-mounting flange at perimeter bottom.

- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.
- D. Aluminum: 0.125 inch thick sheet.
  - 1. Finish: Three-coat fluoropolymer
  - 2. Color: As selected by Architect from manufacturer's full range.
- E. Construction:
  - 1. Curb Profile: Manufacturer's standard compatible with roofing system.
  - 2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
  - 3. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
  - 4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or by use of leveler frame.
  - 5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
  - 6. Insulation: Factory insulated with 1-1/2-inch- thick glass-fiber board insulation.
  - 7. Liner: Same material as curb, of manufacturer's standard thickness and finish.
  - 8. Nailer: Factory-installed wood nailer along top flange of curb under top flange on side of curb, continuous around curb perimeter.
  - 9. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
  - 10. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch-thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
  - 11. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

## 2.3 EQUIPMENT SUPPORTS

- A. Equipment Supports: Internally reinforced perimeter or Rail-type metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, integral metal cant, stepped integral metal cant raised the thickness of roof insulation, and integrally formed structure-mounting flange at bottom.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Supported Load Capacity: Refer to Division 23 sections.
- D. Aluminum: 0.125 inch thick sheet.
  - 1. Finish: Three-coat fluoropolymer.
  - 2. Color: As selected by Architect from manufacturer's full range.
- E. Construction:
  - 1. Curb Profile: Manufacturer's standard compatible with roofing system.
  - 2. Insulation: Factory insulated with 1-1/2-inch- thick glass-fiber board insulation.
  - 3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.

4. Nailer: Factory-installed continuous wood nailers 3-1/2 inches wide on top flange of equipment supports, continuous around support perimeter.
5. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
6. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch-thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
7. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
8. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
9. Fabricate equipment supports to minimum height of 12 inches above roofing surface unless otherwise indicated.
10. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.
11. Security Grille: Provide where indicated on Drawings.

## 2.4 ROOF HATCHES

- A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Bilco Company (The); Type F-50TB (with LU-1 and RL2-ETB or a comparable product by one of the following:
    - a. Babcock-Davis.
    - b. Dur-Red Products.
    - c. JL Industries, Inc.; a division of the Activar Construction Products Group.
    - d. Milcor; Commercial Products Group of Hart & Cooley, Inc.
    - e. Nystrom, Inc.
    - f. O'Keeffe's Inc.
    - g. Precision Ladders, LLC.
- B. Type and Size:
  1. Single-leaf lid, size indicated on Drawings.
- C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load unless otherwise noted in the Structural Drawings.
- D. Hatch Material: Aluminum sheet
  1. Thickness: 11 gauge .
  2. Finish: Mil finish.
- E. Construction:
  1. Insulation: Cellulosic-fiber board or Glass-fiber board.
  2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
  3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
  4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
  5. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
  6. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.

- F. Hardware: Spring operators, hold-open arm, stainless steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.
- G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
  - 1. Height: 42 inches above finished roof deck.
  - 2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches in diameter or galvanized-steel tube, 1-5/8 inches in diameter.
  - 3. Flat Bar: Galvanized steel, 2 inches high by 3/8 inch thick.
  - 4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.
  - 5. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
  - 6. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
  - 7. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
  - 8. Provide ladder safety telescoping post. Basis of Design: Bilco LadderUP safety post model number LU-1.
  - 9. Fabricate joints exposed to weather to be watertight.
  - 10. Fasteners: Manufacturer's standard, finished to match railing system.
  - 11. Finish: Manufacturer's standard.
    - a. Color: As selected by Architect from manufacturer's full range.

## 2.5 PIPE AND DUCT SUPPORTS

- A. Fixed-Height Cradle-Type Pipe Supports: Polycarbonate pipe stand accommodating up to 1-1/2-inch- diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.
- B. Fixed-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand with stainless steel roller carrying assembly accommodating up to 7-inch- diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.
- C. Adjustable-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand base, pipe support, and roller housing, with stainless steel threaded rod designed for adjusting support height, accommodating up to 18 inch diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.
- D. Adjustable-Height Structure-Mounted Pipe Supports: Extruded-aluminum tube, filled with urethane insulation; 2 inches in diameter; accommodating up to 7-inch- diameter pipe or conduit, with provision for pipe retainer; with aluminum baseplate, EPDM base seal, manufacturer's recommended hardware for mounting to structure or structural roof deck as indicated, stainless steel roller and retainer, and extruded-aluminum carrier assemblies; as required for quantity of pipe runs and sizes.
- E. Curb-Mounted Pipe Supports: Galvanized steel support with welded or mechanically fastened and sealed corner joints, straight sides, integral metal cant, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom; with adjustable-height roller-bearing pipe support accommodating up to 20-inch- diameter pipe or conduit and with provision for pipe retainer; as required for quantity of pipe runs and sizes.

- F. Duct Supports: Extruded-aluminum, urethane-insulated supports, 2 inches in diameter; with manufacturer's recommended hardware for mounting to structure or structural roof deck.
  - 1. Finish: Manufacturer's standard.

## 2.6 PIPE PORTALS

- A. Curb-Mounted Pipe Portal: Insulated roof-curb units with welded or mechanically fastened and sealed corner joints, straight sides, integral metal cant, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom; with weathertight curb cover with single or multiple collared openings and pressure-sealed conically shaped EPDM protective rubber caps sized for piping indicated, with stainless steel snaplock swivel clamps.
- B. Flashing Pipe Portal: Formed aluminum membrane-mounting flashing flange and sleeve with collared opening and pressure-sealed conically shaped EPDM protective rubber cap sized for piping indicated, with stainless steel snaplock swivel clamps.

## 2.7 PREFORMED FLASHING SLEEVES

- A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, **[12 inches]** high, with removable metal hood and **[slotted] [perforated]** metal collar.
  - 1. Metal: Aluminum sheet, 0.063 inch thick.
  - 2. Diameter: As indicated on Drawings.
  - 3. Finish: Manufacturer's standard.
- B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.
  - 1. Metal: Aluminum sheet, 0.063 inch thick.
  - 2. Height: 7 inches.
  - 3. Diameter: As indicated on Drawings .
  - 4. Finish: Manufacturer's standard.

## 2.8 ROOF WALKWAYS

- A. Roof Walkway: Metal planking formed from multiple C-shaped channels with upper surface punched in serrated diamond or rectangular shapes to produce raised slip-resistant surface and drainage holes. Provide support framing, brackets, connectors, nosings, and other accessories and components needed for complete installation.
  - 1. Include step units or stairs of similar construction for changes in elevation. Comply with ASCE-7, 29 CFR 1910.23, and requirements of authorities having jurisdiction.
  - 2. Equip walkways with safety railings where required.
  - 3. Plank Width: As indicated.
  - 4. Walkway Width: As indicated.
  - 5. Channel Depth: As indicated.
  - 6. Metal Material: 0.108-inch-thick zinc-coated (galvanized) steel sheet, perforated, with serrated slip-resistant walking surface.
  - 7. Support Stands: Manufacturer's standard, with protective pads compatible with roofing material.
  - 8. Support Pads: Continuous wood isolation pads, pressure-preservative treated as specified in Section 06 10 00 "Rough Carpentry"; attach roof-walkway supports to pads so that supports are separated from roof membrane surface and walkway support loads are distributed evenly.
  - 9. Wind Restraint: Provide wind restraint attachment to roof structure of size and spacing required to meet wind uplift requirements.
  - 10. Finish: Manufacturer's standard.

**2.9 METAL MATERIALS**

- A. Aluminum Sheet: ASTM B 209, standard alloy for finish required, with temper to suit forming operations and performance required; with smooth, flat surface.
- B. Aluminum Extrusions : ASTM B 221, standard alloy and temper for type of use, finish indicated.
- C. Steel Tube: ASTM A 500/A 500M, round tube.

**2.10 MISCELLANEOUS MATERIALS**

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, thickness as indicated.
- C. Glass-Fiber Board Insulation: ASTM C 726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.
- D. Wood Nailers: Softwood lumber, pressure treated according to Section 06 10 53 "Miscellaneous Rough Carpentry and complying with AWPA C2; not less than 1-1/2 inches thick.
  - 1. .
- E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- F. Underlayment:
  - 1. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
  - 2. .
  - 3. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
  - 4. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
- G. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- H. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

**2.11 GENERAL FINISH REQUIREMENTS**

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install roof accessories according to manufacturer's written instructions.
  - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
  - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
  - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  - 1. Coat concealed side of roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  - 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
  - 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.
- E. Roof-Hatch Installation:
  - 1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
  - 2. Attach safety railing system to roof-hatch curb.
- F. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.
  - 1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
- G. Preformed Flashing-Sleeve and Flashing-Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.
- H. Roof Walkway Installation:
  - 1. Verify that locations of access and servicing points for roof-mounted equipment are served by locations of roof walkways.
  - 2. Install roof walkway support pads prior to placement of roof walkway support stands onto low-slope roofing.
  - 3. Redistribute removed ballast after installation of support pads.
- I. Seal joints with elastomeric sealant as required by roof accessory manufacturer.

### 3.3 REPAIR AND CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.

- B. Clean off excess sealants.
- C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 07 76 00 - ROOF PAVER AND PEDESTAL SYSTEM****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SECTION INCLUDES**

- A. Furnish and install a completed architectural concrete roof paver and adjustable pedestal system.

**1.3 RELATED REQUIREMENTS**

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete substrate.
- B. Section 06 10 00 – Rough Carpentry: miscellaneous framing and blocking.
- C. Section 07 54 19 - PVC Membrane Roofing: Membrane roofing.
- D. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal counterflashings.
- E. Section 07 90 00 - Joint Sealers: Sealant for joints in substrates.

**1.4 REFERENCE STANDARDS**

- A. ASTM C150 - Specification for Portland Cement.
- B. ASTM C33 - Specification for Concrete Aggregates.
- C. ASTM C140 - Specification for Concrete.
- D. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension; 2006a.
- E. ASTM D 429 - Standard Test Methods for Rubber Property--Adhesion to Rigid Substrates; 2003.
- F. ASTM D 471 - Standard Test Method for Rubber Property--Effect of Liquids; 2006.
- G. ASTM D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers; 2000 (Reapproved 2007).
- H. ASTM D 746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact; 2007.
- I. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.
- J. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; Fifth Edition, with interim updates.

**1.5 SUBMITTALS**

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.

- C. Shop Drawings: Showing all components required for the paver and pedestal requirements. Shop drawings shall include plan drawings showing layout of all paver areas and detail drawings showing how the various components of the system fit together. Include manufacturer's literature completely describing all components of the paver pedestal systems and giving detailed installation recommendations and instructions. Also include detailed installation drawings for all porcelain pavers.
- D. Structural Analysis: Provide confirmation of (1) the structural capability and adequacy of the structure to carry the dead and live load weights involved, and (2) that the density of any insulation is satisfactory to resist crushing and damaging the waterproofing membrane.
- E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
  - 1. Architectural Concrete Pavers: Submit samples for type, color, and texture available.
- F. Certificate: Certify that products meet or exceed specified requirements.
- G. Manufacturer's Installation Instructions: Indicate special procedures.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

#### **1.6 QUALITY ASSURANCE**

- A. Perform Work in accordance with NRCA Roofing and Waterproofing Manual for specified system.
- B. Membrane Manufacturer Qualifications: Company specializing in waterproofing sheet membranes with five-years experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum three-years experience. All Work shall comply with paver manufacturer's installation and application procedures for pedestal mounted porcelain pavers.

#### **1.7 MOCK-UP**

- A. Construct mock-up 100 sq ft of horizontal waterproofed panel; to represent finished work including internal and external corners. Do not proceed with remaining work until workmanship is approved by Architect.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until cured.
- B. Protect Pavers/Tiles and Pedestal System during shipment, storage, and construction against damage. Store a minimum of 4 inches (102 mm) off the ground in a dry location and cover with polyethylene to protect from contact with materials which would cause staining or discoloration.
- C. Handling: Handle materials to avoid damage.

#### **1.9 PROJECT CONDITIONS**

- A. System specified shall be used with pedestrian traffic only with all four sides of a deck system shall be designed to restrain and contain the decking panels with perimeter blocking or walls. Decking panels shall not be allowed to move laterally.

- B. All membrane waterproofing and protection board surfaces to receive pedestals shall be broom clean, frost free, and free of dirt, oil or any rough foreign matter, which may impair the waterproofing / roofing manufacturers guarantee or protection requirements.
- C. The substrate that is to receive pedestals shall have slope and provide positive and adequate drainage in accordance with good building practice and applicable building codes.
- D. Installation or anticipated installation of additional items on top of the deck such as planters, hot tubs, sculptures, or industrial equipment shall be supported directly by additional pedestals that are in addition to the main deck paver/tile pedestal system. Failure to adequately support the additional weight of any such features or items may cause significant damage to the deck, underlying structure, or waterproofing.

### 1.10 WARRANTY

- A. See Section 01 77 00 – Closeout Procedures, for additional warranty requirements.
- B. Manufacturer's Warranty: Paver and pedestal system manufacturer (Concrete pavers and pedestals) shall warrant the materials to remain free from defects for a period of five years.
- C. Contractor's Warranty: The Contractor shall warrant the Work to remain free from defects of labor and materials used in conjunction with his work in accordance with the General Conditions for this Project for a maximum of two years.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Rubberized Asphalt Manufacturers:
  1. Bison Innovative Products; [www.bisonip.com](http://www.bisonip.com).
  2. Hanover Architectural Products: [www.hanoverpavers.com](http://www.hanoverpavers.com).
  3. Tile Tech Pavers, Inc.; [www.tiletechpavers.com](http://www.tiletechpavers.com).
- B. Substitutions: See Section 01 25 00 Substitution Procedures.

### 2.2 PAVER AND PEDESTAL MATERIALS

- A. Architectural Concrete Pavers:
  1. Basis of Design: Hanover Architectural Products, "Guardian" Paver System, 2" thick, 24" x 24" square, meeting the following physical properties:
 

PROPERTY	TEST METHOD	VALUES
Flexural Strength	ASTM C293	>1,100 psi average min
Water Absorption	ASTM C140	Not greater than 5%
Freeze/Thaw	ASTM C67	<1% loss/dry weight (50 Cycles)
Centerload		Min. 1,750 lbs
  2. Color: As selected by Architect from manufacturer's standard colors available.
- B. Adjustable Height pedestals with edge restraint, hidden lock down, wind uplift resistant system as recommended by manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify existing roof conditions are acceptable before starting work.

**3.2 PREPARATION**

- A. Protect adjacent surfaces not designated to receive roof paver and pedestal system.
- B. Clean and prepare surfaces to receive roof paver and pedestal system in accordance with manufacturer's instructions.
- C. Verify all elevations, required pedestal heights and deck dimensions. Commencement of work shall imply acceptance of surfaces and deck conditions.

**3.3 INSTALLATION**

- A. Insulation required to be installed within a roofing system below paver pedestal supports shall meet the roofing membrane manufacturers' specifications and shall have a minimum core density of 60 psi (414 kPa). Refer to Section 07 54 19 PVC Membrane Roofing for additional information on roof insulation and protection board.
- B. Install in accordance with manufacturer's instructions. Installation requirements vary for each individual project site. Decking paver or tile used, pattern, grid layout, starting point, and finished elevation shall be shown on plan view shop drawings.

**3.4 QUALITY CONTROL**

- A. Field Quality Control: Inspect often during installation to assure that grid spacer lines are being maintained in a straight and consistent pattern and that Pavers are level and not rocking. Particular attention shall be made to assure that all pedestrian entry or access points to the deck are level and that the deck surface tiles are not randomly raised or uneven creating a tripping or safety hazard
- B. Confirm that deck pedestal height excess of 24 inches (610 mm) have been braced in accordance with manufacturer's written instructions.
- C. Placement Tolerance:
  - 1. Maximum of 1/16 inch (1.6 mm) height variation between adjacent pavers.
  - 2. Individual pavers shall not vary more than 1/16 inch (1.6 mm) from level across width of the paver.
  - 3. Paved areas shall not vary more than 1/4 inch (6 mm) from level in a distance of 10 feet (3 m) measured at any location and in any direction.
  - 4. Joints between pavers to be 3/16 inch (4.8 mm) or 1/8 inch (3 mm).

**3.5 PROTECTION**

- A. Protect completed paver and pedestal system from damage until Date of Substantial Completion.
- B. Replace any broken or damaged components of the roof paver and pedestal system to original condition.

END OF SECTION

**SECTION 07 81 00 - APPLIED FIRE PROTECTION****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Sprayed fire-resistive materials.
- B. Related Requirements:
  - 1. Section 05 12 00 "Structural Steel Framing" for framing member coatings on steel not to receive applied fireproofing.

**1.2 DEFINITIONS**

- A. SFRM: Sprayed fire-resistive materials.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
  - 1. Extent of fire protection for each construction and fire-resistance rating.
  - 2. Type and location of each type of Fireproofing.
  - 3. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
  - 4. Minimum sprayed fire-resistive material thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
  - 5. Treatment of sprayed fire-resistive material after application.
- C. Samples: For each exposed product and for each color and texture specified, 4 inches square in size.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and testing agency.
- B. Product Certificates: For each type of sprayed fire-resistive material.
- C. Evaluation Reports: For sprayed fire-resistive material, from ICC-ES.
- D. Preconstruction Test Reports: For fire protection.
- E. Field quality-control reports.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as experienced and with sufficient trained staff to install manufacturer's products in accordance with specified requirements.

- B. Mockups: Build mockups to set quality standards for materials and execution and for preconstruction testing.
  - 1. Build mockup of each type of fire protection and different substrate and each required finish as shown on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### 1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups of fire protection.
- B. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.
  - 1. Bond Strength: Test for cohesive and adhesive strength in accordance with ASTM E 736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
  - 2. Density: Test for density in accordance with ASTM E 605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
  - 3. Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with sprayed fire-resistive material.
  - 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 5. For materials failing tests, obtain sprayed fire-resistive material manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers.

### 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fire protection when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fire protection, providing complete air exchanges in accordance with manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fire protection dries thoroughly.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Assemblies: Provide fire protection, including auxiliary materials, in accordance with requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fire protection for each fire-resistance design from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested in accordance with ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Refer to Structural Drawings for requirements. Steel members are to be considered unrestrained unless specifically noted otherwise. If noted otherwise, UL design listings must state that the loading was determined by Allowable Stress Design (ASD) Method or Load and Resistance Factor Design (LRFD) Method. UL design listings requiring a load restriction factor are not allowed.

- D. Asbestos: Provide products containing no detectable asbestos.

## 2.2 SPRAYED FIRE-RESISTIVE MATERIALS

- A. (Type 1) Sprayed Fire-Resistive Material for Dry Interior Surfaces Concealed from View:
1. UL-Design Numbers: As indicated on the Drawings, or if not indicated, selected from the following for applications and ratings required:
    - a. Wide Flange Steel Columns: X854.
    - b. Steel Pipe or Tube Columns: Y710.
    - c. Beam Designs for Floor-Ceiling Assemblies: N782.
    - d. Roof-Ceiling: P732.
    - e. Floor-Ceiling Designs: D925.
    - f. Beam Designs for Roof-Ceiling Assemblies: P732.
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Carbolite Company; a subsidiary of RPM International; Pyrolite 15.
    - b. GCP Applied Technologies; Monokote MK-6 Series.
    - c. Isolatek International; Cafco 300.
  3. Bond Strength: Minimum 150-lbf/sq. ft. cohesive and adhesive strength based on field testing in accordance with ASTM E 736.
  4. Density: Not less than density specified in the approved fire-resistance design, in accordance with ASTM E 605.
  5. Thickness: As required for fire-resistance design indicated, measured in accordance with requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch.
  6. Combustion Characteristics: ASTM E 136.
  7. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 10 or less.
    - b. Smoke-Developed Index: 0 or less.
  8. Compressive Strength: Minimum 10 lbf/sq. in. in accordance with ASTM E 761.
  9. Corrosion Resistance: No evidence of corrosion in accordance with ASTM E 937.
  10. Deflection: No cracking, spalling, or delamination in accordance with ASTM E 759.
  11. Effect of Impact on Bonding: No cracking, spalling, or delamination in accordance with ASTM E 760.
  12. Air Erosion: Maximum weight loss of 0.005 g/sq. ft. in 24 hours in accordance with ASTM E 859.
  13. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21.
- B. (Type 2) Sprayed Fire-Resistive Material Exterior Surface Exposed to View and Subject to Moisture, and Interior Surfaces within the Architectural Plenum:
1. UL-Design Numbers: As indicated on the Drawings, or if not indicated, selected from the following for applications and ratings required:
    - a. Wide Flange Steel Columns: X854.
    - b. Steel Pipe or Tube Columns: X710.
    - c. Beam Designs for Floor-Ceiling Assemblies: N782.
    - d. Roof-Ceiling: P732.
    - e. Floor-Ceiling Designs: D925.
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Carbolite Company; a subsidiary of RPM International; Pyrocrete 241.
    - b. GCP Applied Technologies; Monokote Z146.
    - c. Isolatek International; Fendolite M-II.
  3. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.
  4. Bond Strength: Minimum 10,000-lbf/sq. ft. cohesive and adhesive strength based on field testing in accordance with ASTM E 736.

5. Density: Not less than density specified in the approved fire-resistance design, in accordance with ASTM E 605.
  6. Thickness: As required for fire-resistance design indicated, measured in accordance with requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch.
  7. Combustion Characteristics: ASTM E 136.
  8. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 0 or less.
    - b. Smoke-Developed Index: 0 or less.
  9. Compressive Strength: Minimum 500 lbf/sq. in. in accordance with ASTM E 761.
  10. Corrosion Resistance: No evidence of corrosion in accordance with ASTM E 937.
  11. Deflection: No cracking, spalling, or delamination in accordance with ASTM E 759.
  12. Effect of Impact on Bonding: No cracking, spalling, or delamination in accordance with ASTM E 760.
  13. Air Erosion: Maximum weight loss of 0.0 g/sq. ft. in 24 hours in accordance with ASTM E 859.
  14. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21.
  15. Finish: Spray-textured finish.
- C. (Type 3) Sprayed Fire-Resistive Material for Dry Interior Surfaces Exposed to View:
1. UL-Design Numbers: As indicated on the Drawings, or if not indicated, selected from the following for applications and ratings required:
    - a. Wide Flange Steel Columns: X738.
    - b. Steel Pipe or Tube Columns: X794.
    - c. Beam Designs for Floor-Ceiling Assemblies: N720.
    - d. Roof-Ceiling: P725.
    - e. Floor-Ceiling Designs: D916.
    - f. Beam Designs for Roof-Ceiling Assemblies: S701.
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Carbolite Company; a subsidiary of RPM International; Pyrocrete 239.
    - b. GCP Applied Technologies; Monokote Z-106/HY.
    - c. Isolatak International; Cafco 400.
  3. Bond Strength: Minimum 1000-lbf/sq. ft. cohesive and adhesive strength based on field testing in accordance with ASTM E 736.
  4. Density: Not less than density specified in the approved fire-resistance design, in accordance with ASTM E 605.
  5. Thickness: As required for fire-resistance design indicated, measured in accordance with requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch.
  6. Combustion Characteristics: ASTM E 136.
  7. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 3 or less.
    - b. Smoke-Developed Index: 3 or less.
  8. Compressive Strength: Minimum 50 lbf/sq. in in accordance with ASTM E 761.
  9. Corrosion Resistance: No evidence of corrosion in accordance with ASTM E 937.
  10. Deflection: No cracking, spalling, or delamination in accordance with ASTM E 759.
  11. Effect of Impact on Bonding: No cracking, spalling, or delamination in accordance with ASTM E 760.
  12. Air Erosion: Maximum weight loss of 0.0 g/sq. ft. in 24 hours in accordance with ASTM E 859.
  13. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21.



14. Sound Absorption: NRC of 0.50 to 0.75 in accordance with ASTM C 423 for Type A mounting in accordance with ASTM E 795.

### 2.3 AUXILIARY MATERIALS

- A. Provide auxiliary materials that are compatible with sprayed fire-resistive material and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by sprayed fire-resistive material manufacturer and complying with one or both of the following requirements:
  1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
  2. Primer's bond strength in required fire-resistance design complies with specified bond strength for sprayed fire-resistive material and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests in accordance with ASTM E 736.
- C. Bonding Agent: Product approved by sprayed fire-resistive material manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.
- D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, in accordance with fire-resistance designs indicated and sprayed fire-resistive material manufacturer's written instructions. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.
- E. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by sprayed fire-resistive material manufacturer.
- F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by sprayed fire-resistive material manufacturer. Include pins and attachment.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and in accordance with each fire-resistance design.
  1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fire protection with substrates under conditions of normal use or fire exposure.
  2. Verify that objects penetrating fire protection, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
  3. Verify that substrates receiving fire protection are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fire protection application.
- B. Verify that concrete work on steel deck is complete before beginning Work.
- C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning Work.

- D. Conduct tests in accordance with sprayed fire-resistive material manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.
- E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fire protection materials during application.
- B. Clean substrates of substances that could impair bond of fire protection.

### 3.3 APPLICATION

- A. Construct fire protection assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fire protection Work.
- B. Comply with sprayed fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fire protection; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fire protection with other construction to minimize need to cut or remove fire protection.
  - 1. Do not begin applying fire protection until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
  - 2. Defer installing ducts, piping, and other items that would interfere with applying fire protection until application of fire protection is completed.
- D. Metal Decks:
  - 1. Do not apply fire protection to underside of metal deck substrates until concrete topping, if any, is completed.
  - 2. Do not apply fire protection to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fire protection.
- E. Install auxiliary materials as required, as detailed, and in accordance with fire-resistance design and sprayed fire-resistive material manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by sprayed fire-resistive material manufacturer.
- F. Spray apply fire protection to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by sprayed fire-resistive material manufacturer.
- G. Extend fire protection in full thickness over entire area of each substrate to be protected.
- H. Install body of fire protection in a single course unless otherwise recommended in writing by sprayed fire-resistive material manufacturer.
- I. Where sealers are used, apply products that are tinted to differentiate them from fire protection over which they are applied.
- J. Provide a uniform finish complying with description indicated for each type of fire protection material and matching finish approved for required mockups.
- K. Cure fire protection in accordance with sprayed fire-resistive material manufacturer's written instructions.

- L. Do not install enclosing or concealing construction until after fire protection has been applied, inspected, and tested and corrections have been made to deficient applications.
- M. Finishes: Where indicated, apply fire protection to produce the following finishes:
  - 1. Spray-Textured Finish: Finish left as spray applied with no further treatment.

### **3.4 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Test and inspect as required by the IBC, Subsection 17 05 .14, "Sprayed Fire-Resistant Materials."
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire protection for the next area until test results for previously completed applications of fire protection show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Fire protection will be considered defective if it does not pass tests and inspections.
  - 1. Remove and replace fire protection that does not pass tests and inspections, and retest.
  - 2. Apply additional fire protection, in accordance with manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

### **3.5 CLEANING**

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

### **3.6 PROTECTION**

- A. Protect fire protection, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fire protection is without damage or deterioration at time of Substantial Completion.

### **3.7 REPAIRS**

- A. As installation of other construction proceeds, inspect fire protection and repair damaged areas and fire protection removed due to work of other trades.
- B. Repair fire protection damaged by other work before concealing it with other construction.
- C. Repair fire protection by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 07 81 23 - INTUMESCENT FIRE PROTECTION****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Intumescent fire-resistive coatings.
- B. Related Requirements:
  - 1. Section 07 81 00 "Applied Fire Protection" for sprayed fire-resistive materials (SFRM).

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review products, design ratings, restrained and unrestrained conditions, thicknesses, and other performance requirements.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
  - 1. Extent of fire protection for each construction and fire-resistance rating.
  - 2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
  - 3. Minimum mastic and intumescent fire-resistive coating thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
  - 4. Treatment of mastic and intumescent fire-resistive coating after application.
- C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard dimensions in size.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and testing agency.
- B. Product Certificates: For each type of intumescent fire-resistive coating.
- C. Evaluation Reports: For intumescent fire-resistive coating, from ICC-ES.
- D. Field quality-control reports.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by mastic and intumescent fire-resistive coating manufacturer as experienced and with sufficient trained staff to install manufacturer's products in accordance with specified requirements.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Build mockup of each type of fire protection and different substrate and each required finish as shown on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fire protection when ambient or substrate temperature is 50 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fire protection, providing complete air exchanges in accordance with manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fire protection dries thoroughly.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Assemblies: Provide fire protection, including auxiliary materials, in accordance with requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fire protection from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested in accordance with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- D. Asbestos: Provide products containing no detectable asbestos.

### 2.2 INTUMESCENT FIRE-RESISTIVE COATINGS

- A. Intumescent Fire-Resistive Coating: Manufacturer's standard, factory-mixed formulation or factory-mixed, multicomponent system consisting of intumescent base coat and topcoat, and complying with indicated fire-resistance design.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ALBI Protective Coatings; Albi Clad TF
    - b. Carboline Company; a subsidiary of RPM International; A/D Firefilm III: 191 mils; Thermo-Sorb VOC: 164 mils.
    - c. International Protective Coatings; a subsidiary of Akzo Nobel; Interchar 1120.
    - d. Isolatek International; CAFCO SprayFilm WB 5.
  2. Application: Designated for "interior general purpose" and "conditioned interior space purpose" use by a qualified testing agency acceptable to authorities having jurisdiction.
  3. Thickness: As required for fire-resistance design indicated, measured in accordance with requirements of fire-resistance design.
  4. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  5. Hardness: Not less than 65, Type D durometer, in accordance with ASTM D2240.
  6. Finish: Rolled, spray-textured finish.
    - a. Color and Gloss: Refer to Finish Schedule on Drawings for color selection.

**2.3 AUXILIARY MATERIALS**

- A. Provide auxiliary materials that are compatible with mastic and intumescent fire-resistive coating and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by mastic and intumescent fire-resistive coating manufacturer and complying with required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by mastic and intumescent fire-resistive coating manufacturer.
- D. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by mastic and intumescent fire-resistive coating manufacturer. Include pins and attachment.
- E. Topcoat: Suitable for application over mastic and intumescent fire-resistive coating; of type recommended in writing by mastic and intumescent fire-resistive coating manufacturer for each fire-resistance design.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and in accordance with each fire-resistance design.
  - 1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fire protection with substrates under conditions of normal use or fire exposure.
  - 2. Verify that steel is coated with primer acceptable to fireproofing manufacturer and there is no rust bleed through of the coating.
  - 3. Verify that no condensation is present on members to be fireproofed before or during fireproofing application.
  - 4. Verify that primer is not over cured or under cured per fireproofing manufacturer's recommendations.
  - 5. Verify that objects penetrating fire protection, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
  - 6. Verify that substrates receiving fire protection are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fire protection application.
- B. Conduct tests in accordance with mastic and intumescent fire-resistive coating manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Cover other work subject to damage from fallout or overspray of fire protection materials during application.
- B. Clean substrates of substances that could impair bond of fire protection.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by mastic and intumescent fire-resistive coating manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fire protection.
- D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fire protection. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

**3.3 APPLICATION**

- A. Construct fire protection assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, topcoats, finishing, and other materials and procedures affecting fire protection Work.
- B. Comply with mastic and intumescent fire-resistive coating manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fire protection; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fire protection with other construction to minimize need to cut or remove fire protection.
  - 1. Do not begin applying fire protection until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
  - 2. Defer installing ducts, piping, and other items that would interfere with applying fire protection until application of fire protection is completed.
- D. Install auxiliary materials as required, as detailed, and in accordance with fire-resistance design and mastic and intumescent fire-resistive coating manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by mastic and intumescent fire-resistive coating manufacturer.
- E. Spray apply fire protection to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by mastic and intumescent fire-resistive coating manufacturer.
- F. Extend fire protection in full thickness over entire area of each substrate to be protected.
- G. Install body of fire protection in a single course unless otherwise recommended in writing by mastic and intumescent fire-resistive coating manufacturer.
- H. Provide a uniform finish complying with description indicated for each type of fire protection material and matching finish approved for required mockups.
- I. Cure fire protection in accordance with mastic and intumescent fire-resistive coating manufacturer's written instructions.
- J. Do not install enclosing or concealing construction until after fire protection has been applied, inspected, and tested and corrections have been made to deficient applications.



- K. Finishes: Where indicated, apply fire protection to produce the following finishes:
1. Manufacturer's Standard Finishes: Finish in accordance with manufacturer's written instructions for each finish selected.
  2. Spray-Textured Finish: Finish left as spray applied with no further treatment.
  3. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.

### **3.4 FIELD QUALITY CONTROL**

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
1. Test and inspect as required by the IBC, Subsection 1705 .51, "Mastic and Intumescent Fire-Resistant Coatings."
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire protection for the next area until test results for previously completed applications of fire protection show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Fire protection will be considered defective if it does not pass tests and inspections.
1. Remove and replace fire protection that does not pass tests and inspections, and retest.
  2. Apply additional fire protection, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

### **3.5 CLEANING**

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

### **3.6 PROTECTION**

- A. Protect fire protection, in accordance with advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fire protection is without damage or deterioration at time of Substantial Completion.

### **3.7 REPAIRS**

- A. As installation of other construction proceeds, inspect fire protection and repair damaged areas and fire protection removed due to work of other trades.
- B. Repair fire protection by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 07 82 00 - BOARD FIRE PROTECTION****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Calcium-silicate board fire protection for isolation of high temperature components from the structure.
  - 2. Mineral-fiber board fire protection for concealed applications.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Locations and types of surface preparations required before applying board fire protection.
  - 2. Structural framing plan showing extent of board fire protection for each location and fire-resistance rating, including the following:
    - a. Applicable fire-resistance design designations of qualified testing and inspecting agency acceptable to authorities having jurisdiction.
      - 1) For steel joist assemblies, include applicable fire-resistance design designations, with each steel joist tested with same maximum tensile stress as each steel joist indicated on Drawings. Design designations with steel joists tested at lower maximum tensile stress than those indicated are not permitted.
    - b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.

**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Obtain board fire protection for each fire-resistance design from single source.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from listings of another testing and inspecting agency acceptable to authorities having jurisdiction, for board fire protection serving as direct-applied protection tested in accordance with ASTM E 119.

**2.3 BOARD FIRE PROTECTION**

- A. Calcium-Silicate Board: Rigid board containing no asbestos and consisting primarily of lime, silica, inert fillers, and cellulosic reinforcing fibers; of thickness required to produce fire-resistance rating indicated; with flame-spread and smoke-developed indexes of zero in accordance with ASTM E 84; passing ASTM E 136 for combustion characteristics.
  - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. BNZ Materials, Inc; Marinite I.
  - b. IIG (Industrial Insulation Group, LLC); Super Firetemp L.
- 2. Finish: Sanded finish on both sides.
- B. Mineral-Fiber Board: Fiberglass mat-faced rigid board produced by combining slag-wool-/rock-wool fibers with thermosetting resin binders passing ASTM E 136 for combustion characteristics; of thickness required to produce fire-resistance rating indicated.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Albi Manufacturing, Division of StanChem Inc; DriClad.
    - b. Isolatek International, Inc; Cafco-Board.
  - 2. Maximum Density: 10 lb/cu. ft..
  - 3. Surface-Burning Characteristics: Flame-spread and smoke-developed indexes of 15 zero and 5 zero, respectively, in accordance with ASTM E 84.

## 2.4 ACCESSORIES

- A. Anchorage Accessories: Provide manufacturer's standard board-anchorage components complying with related design of UL or of another testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Joint Treatment and Finishing Materials: For calcium-silicate board applications exposed to view, provide joint treatment tape and joint compounds recommended in writing by board manufacturer for finishing surfaces.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions of construction to receive fire protection, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Reject fire-protection materials that are wet, moisture damaged, or mold damaged.
- C. Examine walls, floors, and other construction for suitable conditions where fire-protection materials will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Install board fire protection on structural members after piping and other construction behind fire-resistive materials have been completed.
- B. Welded-Stud Systems: Remove rust and scale from steel substrates at welded-steel-stud anchorage locations.

### 3.3 INSTALLATION

- A. Install board fire protection in accordance with manufacturer's written instructions.
- B. Install board fire protection to comply with requirements for layer thicknesses and number, construction of joints and corners, and anchorage methods applicable to fire-resistance-rated assemblies indicated.
- C. Install enclosing or concealing construction only after board fire protection has been applied and inspected by authorities having jurisdiction.

- D. Finish calcium-silicate board exposed to view to comply with board manufacturer's written instructions and as follows:
1. At joints in calcium-silicate board, embed tape in joint compound and apply first, fill, and finish coats of joint compounds over tape, fastener heads, and accessories.
  2. Apply a thin, uniform skim coat of joint compound over entire surface.
  3. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects, tool marks, and ridges.

### **3.4 PROTECTION**

- A. Replace or repair board fire protection that has been cut away to facilitate other construction. Maintain complete coverage of full thickness on members and substrates protected by board fire protection.
1. Provide final protection and maintain conditions in a manner acceptable to Installer, manufacturer, and authorities having jurisdiction to ensure that board fire protection is without damage or deterioration at time of Substantial Completion.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 07 84 13 - PENETRATION FIRESTOPPING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Penetrations in fire-resistance-rated walls.
  - 2. Penetrations in horizontal assemblies.
  - 3. Penetrations in smoke barriers.
- B. Related Requirements:
  - 1. Section 07 84 43 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
  - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) guidelines. Obtain approval of authorities having jurisdiction prior to submittal.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Listed System Designs: For each penetration firestopping system, for tests performed by a qualified testing agency.

**1.5 CLOSEOUT SUBMITTALS**

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

**1.6 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

**1.7 COORDINATION**

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Obtain penetration firestop systems for each type of opening indicated from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics:
  - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test in accordance with testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
    - a. Penetration firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with listed system designs published by a qualified testing agency.
      - 1) UL in its online directory "Product iQ."
      - 2) Intertek Group in its "Directory of Building Products."
      - 3) FM Approvals in its "Approval Guide."

**2.3 PENETRATION FIRESTOPPING SYSTEMS**

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems are to be compatible with one another, with the substrates forming openings, and with penetrating items if any.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Fire Protection Products.
    - b. A/D Fire Protection Systems Inc.
    - c. Grabber Construction Products.
    - d. Hilti, Inc.
    - e. HOLDRITE.
    - f. NUCO Inc.
    - g. Passive Fire Protection Partners.
    - h. RectorSeal.
    - i. Specified Technologies, Inc.
    - j. Tremco, Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined in accordance with ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  - 1. F-Rating: Not less than the fire-resistance rating of the wall penetrated.



- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined in accordance with ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of the floor penetrated.
  - 2. W-Rating: Provide penetration firestopping systems with a Class 1 W-rating in accordance with UL 1479.
- D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, in accordance with ASTM E 84.
- E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
  - 1. Permanent forming/damming/backing materials.
  - 2. Substrate primers.
  - 3. Collars.
  - 4. Steel sleeves.

## 2.4 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric strips for use around combustible penetrants.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Compressible, removable, and reusable intumescent pillows encased in fire-retardant polyester or glass-fiber cloth. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.
- K. Fire-Rated Cable Sleeve Kits: Complete kits designed for new or existing cable penetrations through walls to accept standard accessories.
- L. Thermal Wrap: Flexible protective wrap tested and listed for up to 2-hour fire ratings in accordance with ASTM E 814 or UL 1479 for membrane penetrations or ASTM E 1725 or UL 1724 for thermal barrier and circuit integrity protection.

- M. Fire-Rated Cable Pathways: Single or gangable device modules composed of a steel raceway with integral intumescent material and requiring no additional action in the form of plugs, twisting closure, putty, pillows, sealant, or otherwise to achieve fire and air-leakage ratings.
- N. Retrofit Device for Cable Bundles: Factory-made, intumescent, collar-like device for firestopping existing over-filled cable sleeves and capable of being installed around projecting sleeves and cable bundles.
- O. Wall-Opening Protective Materials: Intumescent, non-curing putty pads or self-adhesive inserts for protection of electrical switch and receptacle boxes.
- P. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestop gasket for use around rectangular steel HVAC ducts without fire dampers.
- Q. Firestop Plugs: Flexible, re-enterable, intumescent, foam-rubber plug for use in blank round openings and cable sleeves.
- R. Fire-Rated Cable Grommet: Molded two-piece grommet made of plenum-grade polymer and foam inner core for sealing small cable penetrations in gypsum walls up to 1/2 inch in diameter.
- S. Closet Flange Gasket: Molded, single-component, flexible, intumescent gasket for use beneath a water closet (toilet) flange in floor applications.
- T. Endothermic Wrap: Flexible, insulating, fire-resistant, endothermic wrap for protecting membrane penetrations of utility boxes, critical electrical circuits, communications lines, and fuel lines.

## 2.5 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.

- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

### **3.3 INSTALLATION OF PENETRATION FIRESTOPPING SYSTEMS**

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### **3.4 IDENTIFICATION**

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
  - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
  - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Designation of applicable testing and inspecting agency.
  - 4. Date of installation.
  - 5. Manufacturer's name.
  - 6. Installer's name.

### **3.5 FIELD QUALITY CONTROL**

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

**3.6 CLEANING AND PROTECTION**

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION

**SECTION 07 84 43 - JOINT FIRESTOPPING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Joints in or between fire-resistance-rated construction.
  - 2. Joints at exterior curtain-wall/floor intersections.
  - 3. Joints in smoke barriers.
- B. Related Requirements:
  - 1. Section 07 84 13 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and for wall identification.
  - 2. Section 09 22 16 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
  - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) guidelines.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Listed System Designs: For each joint firestopping system, for tests performed by a qualified testing agency.

**1.5 CLOSEOUT SUBMITTALS**

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

**1.7 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

**1.8 COORDINATION**

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Obtain joint firestop systems for each type of joint opening indicated from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics:
  - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
    - a. Joint firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with Listed System Designs published by a qualified testing agency.
      - 1) UL in its "Fire Resistance Directory".
      - 2) Intertek Group in its "Directory of Building Products."
- B. Rain/Water Resistance: For perimeter fire-barrier system applications, where inclement weather or greater-than-transient water exposure is expected, use products that dry rapidly and cure in the presence of atmospheric moisture sufficient to pass ASTM D 6904 early rain-resistance test (24-hour exposure).

**2.3 JOINT FIRESTOPPING SYSTEMS**

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems must accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
  - 1. Joint firestopping systems that are compatible with one another, with the substrates forming openings, and with penetrating items, if any.
  - 2. Provide products that, upon curing, do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture.
  - 3. Provide firestop products that do not contain ethylene glycol.

- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Fire Protection Products.
    - b. A/D Fire Protection Systems Inc.
    - c. BlazeFrame Industries.
    - d. Grabber Construction Products.
    - e. Hilti, Inc.
    - f. Metal-Lite.
    - g. Nelson Firestop; a brand of Emerson Industrial Automation.
    - h. NUCO Inc.
    - i. Passive Fire Protection Partners.
    - j. RectorSeal.
    - k. Roxul Inc.
    - l. Specified Technologies, Inc.
    - m. Thermafiber, Inc.; an Owens Corning company.
    - n. Tremco, Inc.
  2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
  3. W-Rating: Water resistant joint assembly equal to or exceeding the fire-resistance rating of the floor assembly.
    - a. Locations: All floor penetrations above Electrical, AV, IDF, and Switchgear.
- C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E 2307.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Fire Protection Products.
    - b. Hilti, Inc.
    - c. Industrial Insulation Group, LLC (IIG-LLC).
    - d. Nelson Firestop; a brand of Emerson Industrial Automation.
    - e. NUCO Inc.
    - f. RectorSeal.
    - g. Roxul Inc.
    - h. Specified Technologies, Inc.
    - i. Thermafiber, Inc.; an Owens Corning company.
    - j. Tremco, Inc.
  2. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
  3. W-Rating: Water resistant joint assembly equal to or exceeding the fire-resistance rating of the floor assembly.
    - a. Locations: All floor penetrations above Electrical, AV, IDF, and Switchgear.
- D. Joints in Smoke Barriers: Provide joint firestopping systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Fire Protection Products.
    - b. A/D Fire Protection Systems Inc.
    - c. Hilti, Inc.
    - d. Nelson Firestop; a brand of Emerson Industrial Automation.
    - e. NUCO Inc.
    - f. Passive Fire Protection Partners.
    - g. RectorSeal.
    - h. Roxul Inc.
    - i. Specified Technologies, Inc.

- j. Thermafiber, Inc.; an Owens Corning company.
    - k. Tremco, Inc.
  - 2. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.
- E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

## 2.4 ACCESSORIES

- A. Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Before installing joint firestopping systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
  - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
  - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Apply a suitable bond-breaker to prevent three-sided adhesion in applications where this condition occurs, such as the intersection of a gypsum wall to floor or roof assembly where the joint is backed by a steel ceiling runner or track.

### 3.3 INSTALLATION

- A. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:



1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
  1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 ft. from end of wall and at intervals not exceeding 30 ft..
- B. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
  1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  2. Contractor's name, address, and phone number.
  3. Designation of applicable testing agency.
  4. Date of installation.
  5. Manufacturer's name.
  6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections in accordance with ASTM E 2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

### 3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 07 91 00 - PREFORMED PRECAST SEATING BOWL JOINT SEALANTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following joint sealants at the following locations:
  - 1. Two-Part Pourable Urethane: Joints in the following typical horizontal traffic surfaces:
    - a. Joints between precast seating units, vomitory walls, field walls, camera bays, floors, and miscellaneous joints between precast units including precast aisle steps.
- B. Related Sections: The following Section contains requirements that relate to this Section:
  - 1. Division 07 Section "Joint Sealants" for building and stadium joint sealants.

**1.2 PERFORMANCE REQUIREMENTS**

- A. General: Provide factory-fabricated expansion joint systems capable of withstanding the types of loads and of accommodating the kinds of movement, and the other functions for which they are designed including those specified below, without failure. Types of failure include those listed in Appendix X3 of ASTM E 1399.
  - 1. Pedestrian Traffic Joints: Support pedestrian traffic across joint.
  - 2. Joints in Fire-Resistance-Rated Assemblies: Maintain fire-resistance ratings of assemblies.

**1.3 SUBMITTALS**

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each type and color of joint sealant required. Install joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.
- E. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- G. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.
- H. Field Test Report Log: For each elastomeric sealant application. Include information specified in "Field Quality Control" Article.
- I. Compatibility and Adhesion Test Reports: From sealant manufacturer indicating the following:
  - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.

2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- J. Product Test Reports: From a qualified testing agency indicating sealants comply with requirements, based on comprehensive testing of current product formulations.
- K. Warranties: Special warranties specified in this Section.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Preconstruction Compatibility and Adhesion Testing: Submit to joint sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
  1. Use manufacturers standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
    - a. Perform tests under environmental conditions replicating those that will exist during installation.
  2. Submit not fewer than nine pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
  3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  4. For materials failing tests, obtain joint sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
  5. Testing will not be required if joint sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
  1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
  2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
  3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.
  4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
- E. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates as follows:
  1. Locate test joints where indicated or, if not indicated, as directed by Architect.
  2. Conduct field tests for each application indicated below:
    - a. Each type of elastomeric sealant and joint substrate indicated.
    - b. Each type of nonelastomeric sealant and joint substrate indicated.
  3. Notify Architect seven days in advance of dates and times when test joints will be erected.
  4. Arrange for tests to take place with joint sealant manufacturer's technical representative present.
  5. Test Method: Test joint sealants by hand-pull method described below:

- a. Install joint sealants in 60-inch-long joints using same materials and methods for joint preparation and joint-sealant installation required for the completed Work. Allow sealants to cure fully before testing.
  - b. Make knife cuts from one side of joint to the other, followed by two cuts approximately 2 inches long at sides of joint and meeting cross cut at one end. Place a mark 1 inch from cross-cut end of 2-inch piece.
  - c. Use fingers to grasp 2-inch piece of sealant between cross-cut end and 1-inch mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.
  - d. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.
6. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
  7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.
- F. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution:
1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
  1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.
  2. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 50 degrees F.
  3. When joint substrates are wet.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than or greater than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

**1.7 WARRANTY**

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- C. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: 5 years from date of Substantial Completion.
- D. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
  - 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
  - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Joint Sealants: Subject to compliance with requirement the following joint sealants are acceptable:
  - 1. Multi-part Pourable Urethane Sealant for Use T:
    - a. "Iso Flex 880 GB"; LymTal
    - b. "Vulkem 245"; Tremco
    - c. "THC 900"; Tremco
    - d. "Sika Flex 2C SL"; Sika Corporation

**2.2 REMOLDED EXPANSION JOINT**

- A. Expansion Joints: Provide expansion joint material in widths to maintain continuity of seal through all projected degrees of movement.
- B. Fixed End Joints: Provide joint material identical to the expansion joints in widths required to seal fixed joints in horizontal planes.
- C. Vertical Plane Joints: Provide joint material identical to the expansion joints, except without the bearing plate.
- D. Provide 1 hour rated assemblies where indicated.

**2.3 JOINT SEALANT MATERIALS**

- A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

- B. Colors: Provide color of exposed joint sealants to comply with the following:
  - 1. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.
- C. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920.

## **2.4 JOINT-SEALANT BACKING**

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
  - 1. Type C: Closed-cell material with a surface skin.
  - 2. Type B: Bicellular material with a surface skin.
  - 3. Type: Either material indicated above.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## **2.5 MISCELLANEOUS MATERIALS**

- A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
    - a. Concrete.
    - b. Masonry.
  3. Remove laitance and form-release agents from concrete.
  4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
    - a. Metal.
- B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  1. Do not leave gaps between ends of sealant backings.
  2. Do not stretch, twist, puncture, or tear sealant backings.
  3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.
- E. Install sealants by proven techniques to comply with the following and at the same time backings are installed:
  1. Place sealants so they directly contact and fully wet joint substrates.
  2. Completely fill recesses provided for each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  1. Remove excess sealants from surfaces adjacent to joint.
  2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.



3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint configuration, per Figure 5B in ASTM C 1193, where indicated.
5. Provide recessed joint configuration, per Figure 5C in ASTM C 1193, of recess depth and at locations indicated.
  - a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

### 3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as follows:
  1. Extent of Testing: Test completed elastomeric sealant joints as follows:
    - a. Perform 10 tests for the first 1000 feet of joint length for each type of elastomeric sealant and joint substrate.
    - b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
  2. Test Method: Test joint sealants by hand-pull method described below:
    - a. Make knife cuts from one side of joint to the other, followed by two cuts approximately 2 inches long at sides of joint and meeting cross cut at one end. Place a mark 1 inch from cross-cut end of 2-inch piece.
    - b. Use fingers to grasp 2-inch piece of sealant between cross-cut end and 1-inch mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.
    - c. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.
  3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.
  4. Inspect tested joints and report on the following:
    - a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field- adhesion hand-pull test criteria.
    - b. Whether sealants filled joint cavities and are free from voids.
    - c. Whether sealant dimensions and configurations comply with specified requirements.
  5. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
  6. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.
- B. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.5 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### **3.6 PROTECTION**

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION

**SECTION 07 92 00 - JOINT SEALANTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Silicone joint sealants.
  - 2. Nonstaining silicone joint sealants.
  - 3. Urethane joint sealants.
  - 4. Mildew-resistant joint sealants.
  - 5. Butyl joint sealants.
  - 6. Latex joint sealants.
  - 7. Joint-sealant backings.
  - 8. Miscellaneous materials.
- B. Related Requirements:
  - 1. Section 08 44 13 "Glazed Aluminum Curtain Walls" for glazing sealants used in glazed curtain walls.
  - 2. Section 08 80 00 "Glazing" for glazing sealants used and accessories.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.
  - 5. Primer requirements based on preconstruction adhesion and compatibility test.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.
- C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- D. Field Quality-Control Reports: For field-adhesion-test reports, for each sealant application tested.
- E. Sample warranties.

**1.5 CLOSEOUT SUBMITTALS**

- A. Manufacturers' special warranties.
- B. Installer's special warranties.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.
- C. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

**1.7 MOCKUPS**

- A. Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

**1.8 PRECONSTRUCTION TESTING**

- A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
  - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
  - 2. Conduct field tests for each kind of sealant and joint substrate.
  - 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
  - 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
  - 5. Test Method: Test joint sealants in accordance with Method A, Field-Applied Sealant Joint Hand Pull Tab, Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  - 6. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
  - 7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

**1.9 FIELD CONDITIONS**

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

**1.10 WARRANTY**

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Obtain joint sealants from single manufacturer.

**2.2 JOINT SEALANTS, GENERAL**

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

**2.3 SILICONE JOINT SEALANTS**

- A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. GE Construction Sealants; Momentive Performance Materials Inc.; SCS2700 SilPruf LM.
    - b. Sika Corporation; Sikasil WS-290 .
- B. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 758.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS2350.
    - c. Polymeric Systems, Inc; PSI-631.
    - d. Schnee-Morehead, Inc., an ITW company; SM5731 Poly-Glaze Plus.
    - e. Sherwin-Williams Company (The); White Lightning Silicone Ultra All Purpose Sealant.
    - f. Sika Corp; SikaSil-N Plus.

- C. Silicone, Acid Curing, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 999A.
    - b. Pecora Corporation; 860.
    - c. Polymeric Systems, Inc; PSI-601.
    - d. Tremco; Tremsil 200.
    - e. Sika Corporation; Sikasil-GP.
- D. Silicone, M, P, 100/50, T, NT: Multicomponent, pourable, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type M, Grade P, Class 100/50, Uses T and NT.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Sika Corp; SikaSil 728 RCS.

## 2.4 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C 1248.
- B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pecora Corporation; 890 NST.
    - b. Sika Corp; SikaSil WS-290, SikaSil WS-290 FPS
    - c. Tremco Incorporated; Spectrem 3.
- C. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; [756 SMS] [795].
    - b. GE Construction Sealants; Momentive Performance Materials Inc.; Silpruf NB.
    - c. Pecora Corporation; [864NST] [895NST] [898NST].
    - d. Sika Corp; SikaSil WS- 295, SikaSil WS-295 FPS
    - e. Tremco Incorporated; Spectrem 3.
- D. Silicone, Nonstaining, S, NS, 100/50, T, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Dow Corning Corporation; 790.
- E. Silicone, Nonstaining, M, NS, 50, NT: Nonstaining, multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Use NT.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Sika Corp; SikaSil WS-295, SikaSil WS-295 FPS
    - b. Tremco Incorporated; Spectrem 4-TS.

**2.5 URETHANE JOINT SEALANTS**

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Master Builders Solutions; Construction Systems.
    - b. Pecora Corporation.
    - c. Polymeric Systems, Inc.
    - d. Schnee-Morehead, Inc., an ITW company.
    - e. Sherwin-Williams Company (The).
    - f. Sika Corporation; Joint Sealants.
    - g. Tremco Incorporated.
- B. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Sika Corporation; Joint Sealants.
- C. Urethane, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Master Builders Solutions; Construction Systems.
    - b. LymTal International Inc.
    - c. Tremco; Vulkem 116.
- D. Urethane, S, P, 35, T, NT: Single-component, pourable, plus 35 percent and minus 35 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 35, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Tremco; Vulkem 45 SSL.
- E. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Master Builders Solutions; Construction Systems.
    - b. Pecora Corporation.
    - c. Polymeric Systems, Inc.
    - d. Schnee-Morehead, Inc., an ITW company.
    - e. Sherwin-Williams Company (The).
- F. Urethane, M, NS, 50, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Pecora Corporation.

- G. Urethane, M, NS, 25, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Master Builders Solutions; Construction Systems.
    - b. Sherwin-Williams Company (The).
- H. Urethane, M, NS, 50, T, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Tremco Incorporated.
- I. Urethane, M, NS, 25, T, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 25, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Master Builders Solutions; Construction Systems.
    - b. LymTal International Inc.
    - c. Sika Corporation; Joint Sealants.
- J. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 50, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. LymTal International Inc.
- K. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 25, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Master Builders Solutions; Construction Systems.
    - b. LymTal International Inc.
    - c. Pecora Corporation.
    - d. Sherwin-Williams Company (The).
    - e. Sika Corporation; Joint Sealants.
    - f. Tremco Incorporated.

## 2.6 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 786-M White.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary.
    - c. Soudal USA; RTV GP.
    - d. Sika Corp; SikaSil N Plus
    - e. Tremco Incorporated; Tremsil 200.



**2.7 BUTYL JOINT SEALANTS**

- A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Pecora Corporation, BC-158.
    - b. Tremco Incorporated, Butyl Sealant.

**2.8 LATEX JOINT SEALANTS**

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Master Builders Solutions, Construction Chemicals - Construction Systems; Sonolac.
    - b. Pecora Corporation; AC-20.
    - c. Sherwin-Williams Company (The); 850A Siliconized Acrylic Latex Caulk.
    - d. Tremco Incorporated; Tremflex 834.

**2.9 JOINT-SEALANT BACKING**

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Alcot Plastics Ltd.
    - b. Master Builders Solutions; Construction Systems.
    - c. Construction Foam Products; a division of Nomaco, Inc.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

**2.10 MISCELLANEOUS MATERIALS**

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
    - d. Exterior insulation and finish systems.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

**3.3 INSTALLATION OF JOINT SEALANTS**

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.
  3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
  2. Completely fill recesses in each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
  2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  3. Provide concave joint profile in accordance with Figure 8A in ASTM C 1193 unless otherwise indicated.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
    - a. Extent of Testing: Test completed and cured sealant joints as follows:
      - 1) Perform 10 tests for the first 1000 ft. of joint length for each kind of sealant and joint substrate.
      - 2) Perform one test for each 1000 ft. of joint length thereafter or one test per each floor per elevation.
    - b. Test Method: Test joint sealants in accordance with Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 of ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
      - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
    - c. Inspect tested joints and report on the following:
      - 1) Whether sealants filled joint cavities and are free of voids.
      - 2) Whether sealant dimensions and configurations comply with specified requirements.
      - 3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
    - d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
    - e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

2. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

C. Prepare test and inspection reports.

### 3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.1 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
  1. Joint Locations:
    - a. Control and expansion joints in brick pavers.
    - b. Isolation and contraction joints in cast-in-place concrete slabs.
    - c. Tile control and expansion joints.
    - d. Joints between different materials listed above.
    - e. Other joints as indicated on Drawings.
  2. Joint Sealant: Silicone, M, P, 50, T, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
  1. Joint Locations:
    - a. Construction joints in cast-in-place concrete.
    - b. Control and expansion joints in unit masonry.
    - c. Joints between metal panels.
    - d. Joints between different materials listed above.
    - e. Perimeter joints between materials listed above and frames of doors windows and louvers.
    - f. Control and expansion joints in ceilings and other overhead surfaces.
    - g. Other joints as indicated on Drawings.
  2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
  1. Joint Locations:
    - a. Isolation joints in cast-in-place concrete slabs.
    - b. Control and expansion joints in tile flooring.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: Silicone, S, P, 25, T, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
  1. Joint Locations:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.

- b. Tile control and expansion joints.
    - c. Vertical joints on exposed surfaces of unit masonry concrete walls and partitions.
    - d. Other joints as indicated on Drawings.
  2. Joint Sealant: Silicone, S, NS, 25, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
  1. Joint Locations:
    - a. Control joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: Acrylic latex.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
  1. Joint Locations:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Tile control and expansion joints where indicated.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. Joint-Sealant Application: Concealed mastics.
  1. Joint Locations:
    - a. Aluminum thresholds.
    - b. Sill plates.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: Silicone based.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 07 95 00 - EXPANSION CONTROL****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Interior expansion control systems.
  - 2. Exterior wall expansion control systems.
  - 3. Roof expansion control systems.
- B. Related Requirements:
  - 1. Section 07 84 43 "Joint Firestopping" for liquid-applied joint sealants in fire-resistive building joints.
  - 2. Section 07 92 00 "Joint Sealants" for liquid-applied joint sealants and for elastomeric sealants without metal frames.

**1.2 ACTION SUBMITTALS**

- A. Shop Drawings: For each expansion control system specified. Include plans, elevations, sections, details, splices, blockout requirement, attachments to other work, and line diagrams showing entire route of each expansion control system. Where expansion control systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect. Indicate joint locations, dimensions, and adjacent construction.
  - 1. Provide details for transitions in plane and direction for continuity of seal through watertight transitions from wall expansion joints to other interfacing expansion joint systems at adjacent construction.
- B. Samples for Initial Selection: For each type of expansion control system indicated.
  - 1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric seal material.
- C. Samples for Verification: For each type of expansion control system indicated, full width by 6 inches long in size.
- D. Product Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
  - 1. Manufacturer and model number for each expansion control system.
  - 2. Expansion control system location cross-referenced to Drawings.
  - 3. Nominal joint width.
  - 4. Movement capability.
  - 5. Classification as thermal or seismic.
  - 6. Materials, colors, and finishes.
  - 7. Product options.
  - 8. Fire-resistance ratings.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: For each fire barrier provided as part of an expansion control system, for tests performed by a qualified testing agency.

- B. Manufacturer's Certification: Products are capable of withstanding temperature of 150 degrees F (65 degrees C) for 3 hours while compressed to minimum of movement capability dimension without evidence of bleeding of impregnation medium from material.
  - 1. Same material after heat stability test and after cooling to room temperature will self-expand to maximum of movement capability dimension within 24 hours at 68 degrees F (20 degrees C).

#### 1.4 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference:
  - 1. Convene at Project site two (2) weeks prior to beginning work of this Section.
  - 2. Attendance: Architect, Contractor, joint seal installer, and related trades and include the expansion joint manufacturer in the design and pre-construction meetings.
  - 3. Review and discuss:
    - a. Joint seal manufacturer's requirements, project conditions, allowable structural movement at joints, and protection of completed work.
    - b. Transitions in plane and direction, and requirement for continuity of seal through watertight transitions from wall expansion joint to other interfacing expansion joint systems at adjacent construction.

### PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

- A. General: Provide expansion control systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
  - 1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.
  - 2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control systems.
- B. Coordination: Coordinate installation of exterior wall and soffit expansion control systems with roof expansion control systems to ensure that wall transitions are watertight. Roof expansion joint assemblies are specified elsewhere.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Where indicated, provide expansion control systems with fire barriers identical to those of systems tested for fire resistance per UL 2079 by a testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Hose Stream Test: Wall-to-wall and wall-to-ceiling systems shall be subjected to hose stream testing.
- B. Seismic Performance: Expansion control systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
  - 2. Component Importance Factor is 1.0.



**2.3 INTERIOR EXPANSION CONTROL SYSTEMS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products by EMSEAL Joint Systems, Ltd. or comparable product by one of the following:
  - 1. Balco, Inc.
  - 2. CS Construction Specialties.
  - 3. EMSEAL Joint Systems, Ltd.
  - 4. InPro Corporation (IPC).
  - 5. Watson Bowman Acme Corp.
- B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.

**2.4 EXTERIOR WALL EXPANSION CONTROL SYSTEMS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products by EMSEAL Joint Systems, Ltd. or comparable product by one of the following:
  - 1. Balco, Inc.
  - 2. CS Construction Specialties.
  - 3. InPro Corporation (IPC).
  - 4. Watson Bowman Acme Corp.
- B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.

**2.5 EXTERIOR ROOF JOINT SYSTEMS**

- A. Metal Cover Plate Roofing System:
  - 1. Standard Joint range applications 2-36" [50-900mm].
  - 2. Flush Mount capable of extremely wide joint widths, seismic-capable movement with 100%+- lateral shear ability.
  - 3. Flush pan cover plate system with integral IBC-listed fire-resistant composite metal panel cladding. Impact-resistant panels are specified with fluoropolymer resin paint finish available in a range of colors with 20-year finish Warranty. (650C Series).
  - 4. Joint operating range 50%+- of total nominal joint width.
  - 5. Integral flexible moisture barrier membrane available for all models. Reinforced EPDM 45 mil thick.\ membrane with nylon reinforcement standard. PVC and TPO options also exist.
  - 6. New and existing construction applications.
  - 7. Base boot, transition covers and drain fittings (optional) to discharge water intrusion to exterior.
  - 8. Basis of Design: Curb mounted: Inpro 651 Series:
    - a. Roof to Roof: 651-A01.
    - b. Roof to Wall: 651-A02.

**2.6 ACCESSORIES**

- A. Moisture Barriers: Manufacturer's standard moisture barrier consisting of a continuous, waterproof membrane within joint and attached to substrate on sides of joint below the primary cover.
  - 1. Drain-Tube Assemblies: Equip moisture barrier with drain tubes and seals to direct collected moisture to drain to exterior-wall expansion control system.
- B. Joint Sealer:
  - 1. Basis of Design: Sikasil WS-295 by Sika Corporation.
  - 2. Type: ASTM C920, Type NS, Class 50, Use NT, M, G, A, or O, one part, neutral curing.
  - 3. Color: Architect to select from manufacturer's full range of colors.

## 2.7 MATERIALS

- A. Aluminum: ASTM B 221, Alloy 6063-T5 for extrusions; ASTM B 209, Alloy 6061-T6 for sheet and plate.
  - 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304 for plates, sheet, and strips.
  - 1. Remove tool and die marks and stretch lines or blend into finish.
- C. Brass: ASTM B 36/B 36M, UNS Alloy C26000 for half hard sheet and coil.
- D. Bronze: ASTM B 455, Alloy C38500 for extrusions; Alloy C23000 red brass for plates.
- E. Elastomeric Seals: ASTM E 1783; preformed elastomeric membranes or extrusions to be installed in metal frames.
- F. Elastomeric Concrete: Modified epoxy or polyurethane extended into a prepackaged aggregate blend, specifically designed for bonding to concrete substrates. Aggregate ratio shouldn't exceed.
- G. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required fire-resistance rating.
- H. Moisture Barrier: Flexible elastomeric material, EPDM, minimum 45 mils thick.
- I. Insulated Thermal Moisture Barrier for vertical and horizontal applications:
  - 1. Reinforced EPDM 45 mil thick membranes sandwiching commercial grade batt insulation adhered and pinned together to resist slump and cyclic movement (movement must match the capabilities of the specified cover plate systems). Maintains R-value equivalent to the exterior and roof assemblies on project. Seams and directional transitions designed to ensure watertight seal and positive condensation drainage.
- J. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- K. Waterproof Foal Seals: Closed Cell Waterproof Foam.
- L. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

## 2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.9 ALUMINUM FINISHES

- A. Mill finish.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

**2.10 STAINLESS-STEEL FINISHES**

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run grain of directional finishes with long dimension of each piece.
  - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
  - 3. Directional Satin Finish: No. 4.
- C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine surfaces where expansion control systems will be installed for installation tolerances and other conditions affecting performance of work.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Prepare substrates according to expansion control system manufacturer's written instructions.
- B. Clean joints thoroughly; remove loose and foreign matter that could impair adhesion or performance
- C. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion control systems.
- D. Cast-In Frames: Coordinate and furnish frames to be cast into concrete.

**3.3 INSTALLATION**

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion control systems.
  - 1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
  - 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper expansion control system installation and performance.
  - 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
  - 4. Repair or grout blockout as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
  - 5. Install frames in continuous contact with adjacent surfaces.
    - a. Shimming is not permitted.
  - 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.
- C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
  - 1. Provide in continuous lengths for straight sections.

2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
  3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Install joint seal in accordance with Sika Emseal instructions and approved Shop Drawings.
- E. Remove joint seal from precompressed packaging, immediately insert into joint, and allow to expand.
- F. Use temporary retainers if required to maintain joint seals in position until expansion is complete.
- G. Epoxy-Bonded Seals: Pressurize seal for time period and to pressure recommended by manufacturer. Do not over pressurize.
- H. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.
- I. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion control system materials and associated work so complete assemblies comply with assembly performance requirements.
1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- J. Moisture Barrier: Provide at all exterior joints and where indicated on Drawings. Provide drainage fittings at a maximum of 50 feet or where indicated on Drawings.
- K. Roof Expansion Joint: Comply with manufacturer's written instructions for handling and installing roof expansion joints.
1. Anchor roof expansion joints securely in place, with provisions for required movement. Use fasteners, protective coatings, sealants, and miscellaneous items as required to complete roof expansion joints.
  2. Install roof expansion joints true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
  3. Provide for linear thermal expansion of roof expansion joint materials.
  4. Provide uniform profile of roof expansion joint throughout its length; do not stretch or squeeze membranes.
  5. Provide uniform, neat seams.
  6. Install roof expansion joints to fit substrates and to result in watertight performance.
  7. Torch cutting of roof expansion joints is not permitted.
  8. Do not use graphite pencils to mark aluminum surfaces.

### 3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion control systems. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION

**SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Interior hollow-metal doors and frames.
  - 2. Exterior hollow-metal doors and frames.
- B. Related Requirements:
  - 1. Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors.

**1.2 DEFINITIONS**

- A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

**1.3 COORDINATION**

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

**1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.5 ACTION SUBMITTALS**

- A. Product Data Submittals: For each product.
  - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door type.
  - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
  - 7. Details of anchorages, joints, field splices, and connections.
  - 8. Details of accessories.
  - 9. Details of moldings, removable stops, and glazing.
- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

**1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For door inspector.
  - 1. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

- B. Product Test Reports: For each type of hollow-metal door and frame assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.
- C. Field quality-control reports.

### **1.7 CLOSEOUT SUBMITTALS**

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

### **1.8 QUALITY ASSURANCE**

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies is to meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
  - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.
- B. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies is to meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
  - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
  - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

## **PART 2 - PRODUCTS**

### **2.1 HOLLOW METAL DOORS AND FRAMES**

- A. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.
- B. Manufacturers: Subject to compliance with requirements provide one of the following for Non-fire rated doors and Fire rated doors:
  - 1. Steelcraft.
  - 2. Ceco.
  - 3. Timely.
  - 4. Comparable products of other manufacturers.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
  - 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.
- C. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3, 4 for protection.
  - 1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) above grade.
  - 2. Small-Missile Test: For glazing located between 30 feet (9.1 m) above grade.
  - 3. Large-Missile Test: For all glazing, regardless of height above grade.

## 2.3 INTERIOR AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A.
  - 1. Doors:
    - a. Physical Performance: Level A according to SDI A250.4
    - b. Type: As indicated in the Door and Frame Schedule on Drawings.
    - c. Thickness: 1-3/4 inches (44.5 mm).
    - d. Face: Cold-rolled steel sheet, minimum thickness of 0.053 inch (1.3 mm) (16 gage), with minimum A60 (ZF180) coating.
    - e. Edge Construction: Model 2, Seamless.
    - f. Core: Vertical steel stiffener
    - g. Top Closures: Flush with top of faces and edges.
  - 2. Frames:
    - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch (1.7mm) (14 gage), with a minimum A60 (ZF180) coating.
    - b. Construction: Full profile welded.
  - 3. Exposed Finish: Prime

## 2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Maximum-Duty Doors and Frames: ANSI/SDI A250.8, Level 4; ANSI/SDI A250.4, Level A.
  - 1. Physical Performance: Level A according to SDI A250.4.
  - 2. Doors:
    - a. Type: As indicated in the Door and Frame Schedule on Drawings.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum A40 coating.
    - d. Edge Construction: Model 2, Seamless.

- e. Core: Manufacturer's standard steel stiffeners with Polyurethane, Polyisocyanurate, or mineral-board core at manufacturer's discretion.
  - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 4.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
- 3. Frames:
  - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum A40 coating.
  - b. Construction: Full profile welded.
  - c. Thermal properties: Minimum of 0.41 U value (2.4 R value) according to NFRC 102-2014 and ASTM.
- 4. Exposed Finish: Prime.

## 2.5 EXTERIOR WINDBORNE-DEBRIS STEEL DOORS AND FRAMES

- A. Construct windborne-debris impact resistance doors to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
  - 1. Comply with Florida Building Code (FBC) test protocols for High Velocity Hurricane Zone (HVHZ) FBC TAS 201, FBC TAS 202 and FBC TAS 203.
  - 2. Design and size door and frame components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E 330/E 330M.
    - a. Design Wind Loads: Comply with requirements of authorities having jurisdiction.
    - b. Wind-Borne Debris Resistance: Door and frame components shall have FLA (PAD) approval or Miami (APD) approval for Large and Small Missile impact and pressure cycling at design wind loads.

## 2.6 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
  - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
  - 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
  - 4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
  - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

## 2.7 MATERIALS

- A. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- B. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.



- D. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- E. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- F. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 08 80 00 "Glazing."
- H. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.8 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
  - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
  - 2. Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated.
  - 3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
  - 4. Top Edge Closures: Close top edges of doors with inverted or flush closures, except provide flush closures at exterior doors, of same material as face sheets.
  - 5. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
  - 6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
  - 7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- C. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
  - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
  - 3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor.
  - 4. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
      - 1) Three anchors per jamb up to 90 inches high.
      - 2) Four anchors per jamb from 90 to 120 inches high.
      - 3) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

- b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
          - 1) Four anchors per jamb upto 90 inches high.
          - 2) Five anchors per jamb from 90 to 96 inches high.
          - 3) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
  - 5. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
  - 6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
- 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  - 2. Reinforcement:
    - a. Hinge Reinforcement: Metallic-coated steel sheet, minimum 0.123 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
    - b. Other Surface-Mounted Hardware, Lock Face, Flush Bolts, Closers, and Concealed Holders: Metallic-coated steel sheet, minimum 0.067 inch thick.
  - 3. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  - 4. Provide welded continuous 12 gauge straps in doors and frames for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
  - 5. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

## 2.9 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
  - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## 2.10 ACCESSORIES

- A. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.3 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11 or NAAMM-HMMA 840.
  1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
    - a. Where frames are fabricated in sections because of shipping and handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - b. Install frames with removable stops located on secure side of opening.
    - c. Install door silencers in frames before grouting.
    - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
  2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
  3. Floor Anchors: Secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  4. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
    - a. Provide at walls with STC ratings over 52.
  5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
  6. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation
  7. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  8. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions
  9. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
  - 1. Non-Fire-Rated Steel Doors:
    - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
    - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
    - c. At Bottom of Door (No Threshold): 3/4 inch plus or minus 1/32 inch.
    - d. Between Bottom of Door And Threshold: 3/8 inch plus or minus 1/32 inch.
    - e. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
  - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
  - 3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.
- D. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.
  - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

### 3.4 FIELD QUALITY CONTROL

- A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
  - 1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
  - 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

### 3.5 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.

### 3.6 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.
- C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish in accordance with manufacturer's written instructions.

END OF SECTION

**SECTION 08 14 16 - FLUSH WOOD DOORS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
  - 1. Section 06 20 00 - "Finish Carpentry"
  - 2. Section 08 11 13 - "Hollow Metal Doors and Frames"
  - 3. Section 08 71 00 - "Finish Hardware"
  - 4. Section 09 90 00 - "Painting"
  - 5. Division 23 - "Mechanical" (Door Louvers and Frames)

**1.2 DESCRIPTION OF WORK**

- A. Work described in this section includes solid core flush wood doors with veneer faces and metal frames for any light openings.
- B. Unless otherwise indicated, all wood doors will receive stained "transparent" finish specified in Section 09 90 00 - "Painting".
- C. Any wood frames for wood doors will be provided under the work of Section 06400, to match species of wood doors where frames are to be stained/transparent finish, and as specified therein when they are required to be opaque finish.

**1.3 SUBMITTALS**

- A. Product Data: Submit door manufacturer's technical data for each type of door, including details of core and edge construction, and trim for openings and louvers.
- B. Shop Drawings: Submit shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, details of metal frames for light openings, location and extent of hardware blocking, fire ratings, and other pertinent data.

**1.4 QUALITY ASSURANCE**

- A. Quality Standards: Comply with the following standards:
  - 1. NWWDA Quality Standard: I.S.1 "Industry Standard for Wood Flush Doors", of National Wood Window and Door Association (NWWDA).
  - 2. AWI Quality Standard: "Architectural Woodwork Quality Standards", including Section 1300 "Architectural Flush Doors", of Architectural Woodwork Institute (AWI) for grade of door, core construction, finish and other requirements exceeding those of NWWDA quality standard.
- B. NWWDA Quality Marking:
  - 1. Mark each wood door with NWWDA Wood Flush Door Certification Hallmark certifying compliance with applicable requirements of NWWDA I.S. 1 Series.
  - 2. For manufacturers not participating in NWWDA Hallmark Program, a certification of compliance may be substituted for marking of individual doors.
- C. Fire-Rated Wood Doors: Provide wood doors which are identical in materials and construction to units tested in door and frame assemblies per ASTM E 152 and which are labeled and listed for ratings indicated by UL, Warnock Hersey or other testing and inspection agency acceptable to authorities having jurisdiction.

- D. Manufacturer:
  - 1. Obtain doors from a single manufacturer, selecting from manufacturers listed herein.
  - 2. Other manufacturers may be considered, however, approval must be requested from the Architect in writing at least ten (10) days prior to original bid date. Architect will issue only written approval, via letter and/or Addendum, and conditionally subject to compliance with specified requirements.

## 1.5 PRODUCT DELIVER, STORAGE AND HANDLING

- A. Protect wood doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Comply with requirements of referenced standards and recommendations of NWWDA pamphlet "How to Store, Handle, Finish, Install, and Maintain Wood Doors" as well as with manufacturer's instructions.
- B. Identify each door with individual opening numbers which correlate with designation system used on shop drawings for door, frames, and hardware, using temporary, removable, or concealed markings.

## 1.6 PROJECT CONDITIONS

- A. Conditioning:
  - 1. Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during remainder of construction period to comply with the following requirements applicable to project's geographical location:
  - 2. Referenced AWI quality standard including Section 100-S-3 "Moisture Content".

## 1.7 WARRANTY

- A. General: Warranties shall run concurrently with, be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents or otherwise.
- B. Door Manufacturer's Warranty:
  - 1. Submit written agreement on door manufacturer's standard form signed by Manufacturer, Installer and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup or twist), or that show telegraphing of core construction in face veneers, or do not conform to tolerance limitations of referenced quality standards.
  - 2. Warranty shall also include refinishing and reinstallation which may be required due to repair or replacement of defective doors where defect was not apparent prior to hanging.
  - 3. Warranty shall be in effect during following period to time after date of Substantial Completion.
    - a. Solid Core Interior Doors: Life of installation.
- C. Contractor's Responsibilities: Replace or refinish doors where Contractor's work contributed to rejection or to voiding of manufacturer's warranty.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, provide doors on one of the following:
  - 1. Solid Core Doors with Wood Veneer Faces:
    - a. Algoma Hardwoods, Inc.
    - b. Eggers Industries, Architectural Door Division.
    - c. Ipik Door Co., Inc.
    - d. Marshfield Door Systems, Inc.

- e. Oshkosh Architectural Door Co.
2. Metal Frames for Light Openings in Fire Rated and Other Doors: Manufacturer's standard beveled or square frame of 18-gage cold-rolled steel, factory-primed, and approved for use in door of fire-rating indicated or required, and in other doors where indicated.

## 2.2 INTERIOR FLUSH WOOD DOORS

- A. Solid Core Doors: Comply with the following requirements.
  1. Faces for Transparent Finish: Quarter sawn white oak; Consistent similar appearance on all doors.
    - a. Similar color and appearance at both sides of doors.
    - b. Transparent finish is anticipated to be a stain and transparent finish to match other transparent finished woodwork.
  2. Faces for Opaque Finish (typical unless specifically indicated otherwise): Birch, Poplar or other close-grained hardwood permitted by referenced standards; Rotary cut.
  3. AWI Grade:
    - a. Transparent Finish: Premium.
    - b. Opaque Finish: Custom.
  4. Solid Core Construction: PC-5 (Particle board core, 5-ply, hot-pressed method), except at wood doors where 30 percent or more of their area is glass use SLC-5 (Staved lumber core, 5-ply, hot-pressed method).
- B. Fire-Rated Solid Core Doors:
  1. Comply with the following requirements - Faces and AWI Grade: Provide faces and grade to match non-rated doors in same area of building, unless otherwise indicated.
  2. Construction: Manufacturer's standard core construction as required to provide fire-resistance rating indicated.
  3. Edge Construction: Provide manufacturer's standard laminated edge construction for improved screw-holding capability and split resistance as compared to edges composed of a single layer of treated lumber.
  4. Pairs: Provide fire-rated pairs with fire-retardant stiles which are labeled and listed for kinds of applications indicated without formed steel edges and astragals.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine installed door frames prior to hanging door:
  1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.
  2. Reject doors with defects.

### 3.2 INSTALLATION

- A. Hardware: For installation see Division 8 Section "Finish Hardware", of these specifications.
- B. Manufacturer's Instructions:
  1. Install wood doors to comply with manufacturer's current written instructions and recommendations, and to comply with referenced AWI standard, and as indicated.
  2. Install fire-rated doors in corresponding fire-rated frames in accordance with requirements of NFPA 80.
  3. Trim light openings with moldings of material and profile indicated.
- C. Job-Fit Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors of hardware. Seal cut surfaces after fitting and machining.
  2. Fitting Clearances for Non-Rated Doors: Provide 1/8" at jambs and heads; 1/16" per leaf at meeting stiles for pairs of doors; and 1/8" from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4" clearance from bottom of door to top of threshold.
  3. Fitting Clearances for Fire-Rated Doors: Comply with NFPA 80.
  4. Bevel non-rated doors 1/8" in 2" at lock and hinge edges.
  5. Bevel fire-rated doors 1/8" in 2" in lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Prefit Doors: Fit to frames for uniform clearance at each edge.
- E. Field-Finished Doors: Refer to Section 099000 - "Painting" for requirements for finishing wood doors, anticipated to be a cherry stain and transparent finish.

### **3.3 ADJUSTING AND PROTECTION**

- A. Operation: Rehang or replace doors which do not swing or operate freely.
- B. Protect doors as recommended by door manufacturer to ensure that wood doors will be without damage or deterioration at time of Substantial Completion.

END OF SECTION



**SECTION 08 31 13 - ACCESS DOORS AND FRAMES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Access doors and frames for walls and ceilings.
  - 2. Fire-rated access doors and frames.
- B. Related Requirements:
  - 1. Section 07 72 00 "Roof Accessories" for roof hatches.
  - 2. Section 23 33 00 "Air Duct Accessories" for heating and air-conditioning duct access doors.
- C. Scope Clarification: Assume all interior access doors are 18" x 18", unless noted otherwise on Drawings or in Specification.
  - 1. Flush Access Doors with Concealed Flanges:
    - a. Walls: 1 per room and 2 per corridor.
    - b. Ceilings: 1 per room when ceiling is gypsum board.
  - 2. Recessed Access Doors with Decorative Finish:
    - a. Walls: Provide 1 per fixture bank run in each room and 1 per suite.
    - b. Ceilings: Provide 1.5 per wet room location.
  - 3. Interior wet locations:
    - a. Walls: Provide 1 per fixture bank run in each room and 1 per suite.
    - b. Ceilings: Provide 1.5 per wet room location.
  - 4. Universal Access Doors, CMU wall:
    - a. Walls: 1 per room and 2 per corridor.
  - 5. Universal Access Doors, Back of House Wall:
    - a. Walls: 1 per room and 2 per corridor.
  - 6. Exterior Flush Access Doors:
    - a. Walls: Provide quantity as shown on Drawings.
  - 7. Fire-Rated (As Indicated):
    - a. Walls: 1 per room and 2 per corridor.
    - b. Ceilings: 1 per room when ceiling is gypsum board.

**1.2 ALLOWANCES**

- A. Access doors and frames are part of an access door and frame allowance.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Detail fabrication and installation of access doors and frames for each type of substrate.
  - 3. Coordinate and hold equipment submittals for items requiring access doors to allow for review and approval of orientation of equipment and doors concurrently.
- C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.
- D. Product Schedule: For access doors and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing and inspecting agency.
  - 1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
  - 2. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

**1.5 CLOSEOUT SUBMITTALS**

- A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

**1.6 QUALITY ASSURANCE**

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies meets the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
  - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
  - 2. NFPA 288 for fire-rated access door assemblies installed horizontally.

**2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Acudor Products, Inc., as indicated, or comparable product by one of the following:
  - 1. Access Panel Solutions.
  - 2. Alfab, Inc.
  - 3. Babcock-Davis.
  - 4. Cendrex Inc.
  - 5. Elmdor/Stoneman Manufacturing Co.; Div. of Acorn Engineering Co.
  - 6. Jensen Industries; Div. of Broan-Nutone, LLC.
  - 7. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
  - 8. Karp Associates, Inc.
  - 9. Larsen's Manufacturing Company.
  - 10. Maxam Metal Products Limited.
  - 11. Metropolitan Door Industries Corp.
  - 12. MIFAB, Inc.
  - 13. Milcor Inc.
  - 14. Nystrom, Inc.
  - 15. Williams Bros. Corporation of America (The).
- B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

- C. Interior Wet Location Access Doors:
1. Assembly Description: Fabricate door to be weatherproof and fit flush to frame. Provide manufacturer's standard 2-inch-thick fiberglass insulation and extruded door gaskets. Provide manufacturer's standard-width frame, proportional to door size.
  2. Locations: Wall and ceiling.
  3. Door Size: Provide minimal size by application or code requirement, whichever is more stringent.
  4. Frame Material: Same material, thickness, and finish as door.
  5. Hinges: Continuous hinge.
  6. Hardware: Lock.
- D. Recessed Access Doors with Decorative Finish: Acudor; AT-5020 or FB-5060-TD (Provide for Fire-Rated locations).
1. Assembly Description: Fabricate door in the form of a pan recessed for decorative finish infill. Provide frame with gypsum board bead for concealed flange plaster bead for concealed flange installation.
  2. Locations: Wall and ceiling.
  3. Door Size: Provide minimal size by application or code requirement, whichever is more stringent.
  4. Frame Material: Same material as door.
  5. Hinges: Manufacturer's standard.
  6. Hardware: Lock.
- E. Recessed Access Doors with Decorative Finish: Acudor; AT-5020 or FB-5060-TD (Provide for Fire-Rated locations).
1. Assembly Description: Fabricate door in the form of a pan recessed for decorative finish infill. Provide frame with gypsum board bead for concealed flange plaster bead for concealed flange installation.
  2. Locations: Wall and ceiling.
  3. Door Size: Provide minimal size by application or code requirement, whichever is more stringent.
  4. Frame Material: Same material as door.
  5. Hinges: Manufacturer's standard.
  6. Hardware: Lock.
- F. Flush Access Doors with Concealed Flanges: Acudor; DW-5040 or FB-5060-DW (Provide for Fire-Rated locations).
1. Assembly Description: Fabricate door to fit flush to frame.
  2. Locations: Wall and ceiling.
  3. Door Size: Provide minimal size by application or code requirement, whichever is more stringent.
  4. Frame Material: Same material as door.
  5. Hinges: Manufacturer's standard.
  6. Hardware: Lock.
- G. Universal Access Doors, CMU wall: Acudor; UF-5500 or FB-5060 (Provide for Fire-Rated locations).
1. Assembly Description: Fabricate door to fit flush to frame.
  2. Locations: Wall and ceiling.
  3. Door Size: Provide minimal size by application or code requirement, whichever is more stringent.
  4. Frame Material: Same material as door.
  5. Hinges: Manufacturer's standard.
  6. Hardware: Lock.

- H. Universal Access Doors, Back of House Wall: Acudor; ED-2002 or FB-5060 (Provide for Fire-Rated locations).
  - 1. Assembly Description: Fabricate door to fit flush to frame.
  - 2. Locations: Wall and ceiling.
  - 3. Door Size: Provide minimal size by application or code requirement, whichever is more stringent.
  - 4. Frame Material: Same material as door.
  - 5. Hinges: Manufacturer's standard.
  - 6. Hardware: Lock.
- I. Recessed Access Doors at locations in painted gypsum board or plaster walls: Acudor; DW-5058 or FB-5060-DW (Provide for Fire-Rated locations).
  - 1. Assembly Description: Fabricate door in the form of a pan recessed 5/8 inch for gypsum board or plaster infill. Provide frame with gypsum board bead for concealed flange plaster bead for concealed flange installation.
  - 2. Locations: Wall and ceiling.
  - 3. Door Size: minimum size as required to access to element or as indicated on Drawings.
  - 4. Stainless-Steel Sheet for Door: Nominal 0.062 inch, 16 gage.
  - 5. Frame Material: Same material and thickness as door.
  - 6. Hinges: Manufacturer's standard.
  - 7. Hardware: Lock.
- J. Exterior Flush Access Doors: Acudor; UF-5000 or FW-5050 (Provide for Fire-Rated locations)
  - 1. Basis-of-Design Product: Indicated on Drawings.
  - 2. Assembly Description: Fabricate door to be weatherproof and fit flush to frame. Provide manufacturer's standard 2-inch-thick fiberglass insulation and extruded door gaskets. Provide manufacturer's standard-width frame for surface mounting, proportional to door size.
  - 3. Locations: Wall.
  - 4. Door Size: as indicated on drawings or as required by to provide proper access.
  - 5. Stainless-Steel Sheet for Door: Nominal 0.062 inch, 16 gage.
    - a. Finish: No. 4.
  - 6. Frame Material: Same material, thickness, and finish as door.
  - 7. Hinges: Manufacturer's standard.
  - 8. Hardware: Lock.

### 2.3 HEAVY-DUTY FLOOR ACCESS DOORS AND FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Acudor Products, Inc.
  - 2. Babcock-Davis.
  - 3. Bilco Company.
  - 4. Karp Associates, Inc.
  - 5. Milcor Inc.
  - 6. Nystrom, Inc.
- B. Hardware: Provide the following:
  - 1. Hinges: Heavy-duty, stainless-steel type 316, butt hinges with stainless-steel pins.
  - 2. Latch: Recessed stainless-steel slam latch.
  - 3. Lock: No lock.
  - 4. Hardware Material: Stainless steel type 316, including latch and lifting mechanism assemblies, hold-open arms, and all brackets, hinges, pins, and fasteners.
- C. Lifting mechanisms: Manufacturer shall provide the required number and size of compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. The upper tube shall be the outer tube to prevent accumulation of

moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe fastened to a formed 1/4" (6mm) gusset support plate.

- D. Cover shall have a 1" (25mm) fillable pan to receive concrete or a combination of mortar and tile. All fill material to be furnished and installed by others in the field.
- E. Insulation: Urethane with liner pan.
- F. Ladder-Assist Post: Hatch manufacturer's standard device for attachment to floor-access ladder.
  - 1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
  - 2. Height: 42 inches above finished roof deck.
  - 3. Material: Steel tube.
  - 4. Finish: Manufacturer's standard baked enamel or powder coat.
    - a. Color: White.

## 2.4 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- D. Frame Anchors: Same material as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

## 2.5 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
  - 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
  - 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
  - 1. For recessed doors with plaster infill, provide self-furring expanded-metal lath attached to door panel.
- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
  - 1. For cylinder locks, furnish two keys per lock and key all locks alike.

## 2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil for topcoat.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

#### **3.3 FIELD QUALITY CONTROL**

- A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
  - 1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, Section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80 and NFPA 101.

#### **3.4 ADJUSTING**

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

**SECTION 08 33 13 - COILING COUNTER SHUTTERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Counter door.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for door-opening framing and corner guards.
  - 2. Section 09 91 23 "Interior Painting" for finish painting of factory-primed doors.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type and size of coiling counter door and accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 4. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
  - 5. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
  - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
  - 1. Curtain slats.
  - 2. Bottom bar with sensor edge.
  - 3. Guides.
  - 4. Brackets.
  - 5. Hood.
  - 6. Locking device(s).
  - 7. Include similar Samples of accessories involving color selection.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For coiling counter doors to include in maintenance manuals.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
  - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Source Limitations: Obtain coiling counter doors from single source from single manufacturer.
  - 1. Obtain operators and controls from coiling counter door manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Fire-Rated Door Assemblies: Complying with NFPA 80; listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.
  - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

**2.3 COUNTER DOOR ASSEMBLY**

- A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CHI Overhead; a Nucor Company.
    - b. Cookson Company.
    - c. Cornell Iron Works, Inc.
    - d. McKeon Rolling Steel Door Company, Inc.
    - e. Overhead Door Corporation.
    - f. Raynor.
    - g. Wayne-Dalton Corp.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
  - 1. Include tamperproof cycle counter.
- C. STC Rating: 26.
- D. Curtain R-Value: 4.5 deg F x h x sq. ft./Btu.
- E. Door Curtain Material: Galvanized steel.
- F. Door Curtain Slats: Flat profile slats of 1-1/4-inch minimum center-to-center height.
  - 1. Insulated-Slat Interior Facing: Metal.
  - 2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- G. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated hot-dip galvanized steel and finished to match door.



- H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
- I. Hood: Match curtain material and finish.
  - 1. Shape: Round.
  - 2. Mounting: Face of wall and Between jambs; see Drawings.
- J. Integral Frame, Hood, and Fascia: Galvanized steel.
  - 1. Mounting: Face of wall or Between jambs; see Drawings..
- K. Sill Configuration: No sill.
- L. Locking Devices: Equip door with slide bolt for padlock.
  - 1. Locking Slide Bolt Assembly: Interior slide bolts at both ends of bottom bar.
- M. Manual Door Operator: Manufacturer's standard crank operator.
  - 1. Provide operator with manufacturer's standard removable operating arm.
- N. Door Finish:
  - 1. Baked-Enamel or Powder-Coated Finish: Color matching Architect's sample.
  - 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

## 2.4 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.5 DOOR CURTAIN MATERIALS AND FABRICATION

- A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
  - 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A 653/A 653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
  - 2. Aluminum is not applicable to fire-rated assemblies.
  - 3. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
  - 4. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

## 2.6 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
  - 1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A 653/A 653M.

2. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
- B. Integral Frame, Hood, and Fascia: Welded sheet metal assembly of the following sheet metal(s):
1. Galvanized Steel: Hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A 653/A 653M.

## 2.7 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks ends of bottom bar to lock, located on both left and right jamb sides, operable from coil side.
- B. Locking Device Assembly: Adjustable locking bars to engage through slots in tracks suitable for locking by padlock.

## 2.8 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.9 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf.
- C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.
- D. Crank Operator: Consisting of crank and crank gearbox, steel crank drive shaft, and gear-reduction unit, of type indicated. Size gears to require not more than 25-lbf force to turn crank. Fabricate gearbox to be oiltight and to completely enclose operating mechanism. Provide manufacturer's standard crank-locking device.

**2.10 GENERAL FINISH REQUIREMENTS**

- A. Comply with NAAMM/NOMMA "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

**2.11 STEEL AND GALVANIZED-STEEL FINISHES**

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 CONSTRUCTION WASTE MANAGEMENT**

- A. Construction Waste shall be managed in accordance with provisions of Section 01 74 19 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that section.

**3.3 INSTALLATION, GENERAL**

- A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.

**3.4 FIELD QUALITY CONTROL**

- A. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections and to furnish reports to Architect.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
  - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

### **3.5 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
  - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

### **3.6 ADJUSTING**

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

### **3.7 MAINTENANCE SERVICE**

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service is to include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.
  - 1. Perform maintenance during normal working hours.
  - 2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

### **3.8 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION

**SECTION 08 33 23 - OVERHEAD COILING DOORS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Service doors.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type and size of overhead coiling door and accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
  - 3. Include description of automatic-closing device and testing and resetting instructions.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
  - 5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
  - 6. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
  - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
  - 1. Curtain slats.
  - 2. Guides.
  - 3. Brackets.
  - 4. Hood.
  - 5. Locking device(s).
  - 6. Include similar Samples of accessories involving color selection.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.
- C. Sample Warranty: For special warranty.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
  - 1. Maintenance Proximity: Not more than three hours' normal travel time from Installer's place of business to Project site.

**1.6 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
  - 1. Obtain operators and controls from overhead coiling-door manufacturer.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
  - 1. Design Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.
  - 2. Testing: According to ASTM E330/E330M or DASMA 108 for garage doors and complying with acceptance criteria of DASMA 108.
  - 3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
  - 4. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20-lbf/sq. ft. wind load, acting inward and outward.
- B. Seismic Performance: Overhead coiling doors are to withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. Component Importance Factor: 1.0.

**2.3 DOOR ASSEMBLY**

- A. Service Door and Door: Overhead coiling door formed with curtain of interlocking metal slats.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide McKeon Door Company SD3020-M-G or IS3020-M-G or comparable product by one of the following:
    - a. C.H.I. Overhead Doors, Inc.
    - b. Clopay Building Products.
    - c. Cookson Company.
    - d. Cornell Iron Works, Inc.
    - e. Overhead Door Corporation.
    - f. Raynor.

- g. Wayne-Dalton Corp.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
  - 1. Include tamperproof cycle counter.
- C. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E 283 or DASMA 105.
- D. STC Rating: 26 or as indicated on Drawings..
- E. Door Curtain Material: Galvanized steel.
- F. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.
  - 1. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- G. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished to match door.
- H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- I. Hood: Match curtain material and finish.
  - 1. Shape: As indicated on Drawings.
  - 2. Mounting: Face of wall.
- J. Locking Devices: Equip door with locking device assembly and chain lock keeper.
  - 1. Locking Device Assembly: Interior slide bolts at both ends of bottom bar, both jamb sides.
- K. Standard Manual Door Operator: Chain-hoist operator.
  - 1. Provide operator with through-wall shaft operation.
  - 2. Provide operator with manufacturer's standard removable operating arm.
- L. Electric Door Operator where required by size:
  - 1. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day.
  - 2. Operator Location: Top of hood Front of hood or As indicated on Drawings.
  - 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower.
  - 4. Motor Exposure: Interior.
  - 5. Emergency Manual Operation: Push-up or Chain type.
  - 6. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar pneumatic sensor edge on bottom bar.
    - a. Sensor Edge Bulb Color: As selected by Architect from manufacturer's full range.
  - 7. Control Station(s): As shown on Drawings.
- M. Curtain Accessories: Equip door with smoke seals and weather seals.
- N. Door Finish:
  - 1. Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
  - 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

## 2.4 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless

otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A 653/A 653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
  2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

## 2.6 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A 653/A 653M.
  2. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
  3. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

## 2.7 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
1. Lock Cylinders: As specified in Section 08 71 00 "Door Hardware" and keyed to building keying system.
  2. Keys: Two for each cylinder.
- B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

## 2.8 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
1. At door head, use 1/8-inch-thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
  2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.
- B. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches high.

## 2.9 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.



- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
  - 1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic-closing device operates.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.10 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

## 2.11 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
  - 1. Manufacturers: Subject to compliance with requirements, provide Manufacturer's Standard Operator.
  - 2. Comply with NFPA 70.
  - 3. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location(s): Operator location indicated for each door.
  - 1. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall-mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
  - 2. Through-Wall Mounted: Operator is mounted on other side of wall from coil side of door.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.
  - a. Phase: Single phase.
  - b. Volts: 208 V.
  - c. Hertz: 60.
  - 2. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
  - 3. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.

4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel. For fire-rated doors, activation delays closing.
  1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
    - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.
  2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
    - a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
  3. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.
- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
  1. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 30 lbf.
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with the accessibility standard.

## **2.12 GENERAL FINISH REQUIREMENTS**

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Retain one of two options in "Clear Anodic Finish" Paragraph below. Class II finish is standard with many manufacturers; Class I finish is heavy anodized. Verify availability with manufacturer.
- D. Retain one of two options in "Color Anodic Finish" Paragraph below. Verify availability with manufacturer.

## **2.13 STEEL AND GALVANIZED-STEEL FINISHES**

- A. Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION, GENERAL**

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.
- D. Fire-Rated Doors: Install according to NFPA 80.
- E. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.
- F. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

#### **3.3 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to furnish reports to Architect.
- B. Perform the following tests and inspections :
  - 1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
  - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

#### **3.4 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
  - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

**3.5 ADJUSTING**

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
  - 1. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

**3.6 MAINTENANCE SERVICE**

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service includes 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.
  - 2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

**3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

**SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Exterior and Interior storefront framing.
  - 2. Exterior and Interior manual-swing entrance doors and door-frame units.

**1.2 DEFINITIONS**

- A. Water Penetration:
  - 1. Uncontrolled: Infiltrated water that is not captured, controlled, or managed to drain to exterior; water that wets perimeter containment system, wall insulation, or normally exposed interior surfaces.
  - 2. Controlled: Infiltrated water that is captured, controlled, or managed by flashings, gutters, and sills to drain to exterior; water that does wet perimeter containment system, wall insulation, or normally exposed interior surfaces.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 ACTION SUBMITTALS**

- A. Product Data Submittals: For each type of product.
  - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed entrances and storefronts.
  - 1. Plans, elevations, sections, full-size details, and attachments to other work.
  - 2. Include adjoining material details and coordinate within the Shop Drawings.
  - 3. Details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  - 4. Full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrance and storefront systems, showing the following:
    - a. Joinery, including concealed welds.
    - b. Anchorage.
    - c. Expansion provisions.
    - d. Glazing.
    - e. Flashing and drainage.
  - 5. Connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
  - 6. Include thermal modeling of the curtain wall.
    - a. Thermal modeling of typical vertical and horizontal curtain wall section details.
    - b. Lawrence Berkeley Laboratory Therm and Window software shall be used to provide modeling and computation of the U-Value and to identify extreme temperature limits of the exterior and interior surfaces of the wall system components.
    - c. Submit a project specific dew point analysis and U Value analysis performed by a NFRC certified simulator demonstrating conformance with the required thermal performance criteria as specified.
    - d. Include Thermal and Window output data files and an additional color print or image of the model not including results.

- C. Calculations: Submit structural calculations, sealed by a licensed professional engineer currently registered by the AHJ. Calculations shall be prepared in compliance with referenced documents and these specifications. Where specifications and code differ, the more severe requirements shall govern. Test reports are not an acceptable substitute for calculations. Calculations shall include the following information:
  - 1. Analysis for all applicable loads on framing members.
  - 2. Analysis for all applicable loads on anchors, including anchors embedded in concrete.
  - 3. Section property computations for framing members.
  - 4. Analysis of system accommodation for building movements.
  - 5. Seal and signature of professional engineer currently registered by the AHJ on drawings and calculations.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: Actual sample of finished products for each type of exposed finish.
  - 1. Size: Manufacturers' standard size.
- F. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:
  - 1. Joinery, including concealed welds.
  - 2. Anchorage.
  - 3. Expansion provisions.
  - 4. Glazing.
  - 5. Flashing and drainage.
- G. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- H. Delegated Design Submittals: For aluminum-framed entrances and storefront systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and field testing agency.
- B. Field Quality Control Program: Submit description of procedures for this project to be reviewed and accepted prior to the submittal of field quality control reports.
- C. Field quality-control reports.
- D. Energy Performance Certificates: For aluminum-framed entrance and storefront systems, accessories, and components, from manufacturer.
  - 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront system.
- E. Product Test Reports: For aluminum-framed entrance and storefront systems, for tests performed by manufacturer and witnessed by a qualified testing agency.
  - 1. Submit engineering calculations confirming compliance with Section 2.1.C and structural code requirements.
- F. Source Quality-Control Reports: For aluminum-framed entrance and storefront systems.
- G. Field Quality-Control Reports: For aluminum-framed entrance and storefront systems.
- H. Quality-Control Program: Developed specifically for Project, including fabrication and installation, in accordance with recommendations in ASTM C 1401. Include periodic quality-control reports.
- I. Sample Warranties: For special warranties.

**1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For aluminum-framed entrance and storefront systems.
- B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

**1.7 QUALITY ASSURANCE**

- A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the state where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of aluminum-framed entrances and storefronts that are similar to those indicated for this Project in material, design, and extent.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- C. Testing Agency Qualifications: Qualified in accordance with ASTM E 699 for testing indicated and acceptable to Owner and Architect.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
- E. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation of storefront systems that include structural glazing.

**1.8 MOCKUPS**

- A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects.
  - 1. Build mockup of typical wall area as indicated on Drawings that is minimum 10 feet by 10 feet of each type..
  - 2. Testing to be performed on mockups in accordance with requirements in "Field Quality Control" Article.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

**1.9 PRECONSTRUCTION TESTING**

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on laboratory mockups.
  - 1. Build preconstruction laboratory mockups at testing agency facility; use personnel, products, and methods of construction that will be used at Project site.
  - 2. Size and Configuration: As indicated on Drawings.
  - 3. Notify Architect seven days in advance of the dates and times when preconstruction laboratory mockups will be constructed and tested.

- B. Preconstruction Laboratory Mockup Testing: Performed by a qualified testing agency on manufacturer's standard assemblies.
1. Test preconstruction laboratory mockups in accordance with requirements in "Performance Requirements" Article. Perform the following tests in the following order:
    - a. Structural, 50 Percent: ASTM E 330/E 330M at 50 percent of positive test load.
    - b. Air Leakage: ASTM E 283.
    - c. Water Penetration under Static Pressure: ASTM E 331.
    - d. Water Penetration under Dynamic Pressure: AAMA 501.1.
    - e. Thermal Cycling: AAMA 501.5. Repeat the following:
      - 1) Air Leakage: ASTM E 283.
      - 2) Water Penetration under Static Pressure: ASTM E 331.
    - f. Structural, 100 Percent: ASTM E 330/E 330M at 100 percent of positive and negative test loads. Repeat the following:
      - 1) Air Leakage: ASTM E 283.
      - 2) Water Penetration under Static Pressure: ASTM E 331.
      - 3) Water Penetration under Dynamic Pressure: AAMA 501.1.
    - g. Structural, 150 Percent: ASTM E 330/E 330M at 150 percent of positive and negative test loads.
- C. Preconstruction Adhesion and Compatibility Testing: Submit to structural glazing sealant manufacturer, for testing indicated below, Samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that is in close proximity to or is touching the structural or nonstructural sealants of a structural glazed system.
1. Compatibility: Test materials or components using ASTM C 1087.
  2. Adhesion: Test for adhesion or lack of adhesion of a structural sealant to the surface of another material or component using ASTM C 1135.
  3. Submit no fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
  4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  5. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
  6. Testing will not be required if data based on previous testing of current sealant products match those submitted.

#### 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrance and storefront systems that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Structural failures, including but not limited to, excessive deflection.
    - b. Noise or vibration created by wind and thermal and structural movements.
    - c. Deterioration of metals and other materials beyond normal weathering.
    - d. Water penetration through fixed lazing and framing area.
    - e. Failure of operating components.
  2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.



2. Warranty Period: 10 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 SOURCE LIMITATIONS**

- A. Obtain all components of aluminum-framed entrance and storefront system, including framing spandrel panels and accessories, from single manufacturer.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design aluminum-framed entrance and storefront systems.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrance and storefront systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  1. Aluminum-framed entrance and storefront systems to withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
  3. Engineering Assumptions:
    - a. Design wind pressure shall be as required for partially enclosed structure per Structural Drawings.
      - 1) Allowable stress values cannot exceed yield stress of material.
    - b. Corners and Wind Pressures:
      - 1) Corners in Typical Windload Zones: Both surfaces shall be assumed to experience inward and outward design pressures simultaneously.
      - 2) Corners in Corner Windload Zones: Simultaneous occurrence of inward design pressure on one surface, and outward design pressure on adjoining surface is not required.
    - c. A 1/3 increase in allowable stress for wind or seismic loads not allowed.
    - d. Glass, sealants and interior finishes shall not contribute to framing member strength, stiffness or lateral stability.
    - e. Compression flanges of flexural members may be assumed to receive effective lateral bracing only from anchors to building structure and horizontal glazing rails or interior trim, which are in contact with compression flange. Points of contraflexure shall not be regarded as lateral braces or as end points of an unbraced length; unbraced length shall be actual distance between effective lateral braces.
    - f. Where a framing member reaction is resisted by a continuous element, maximum assumed effective length of resisting element shall be 4 times bearing length, but not more than 12 in (300 mm).
    - g. Properly brace assembly anchors in 3 orthogonal directions (vertical, transverse, and longitudinal) to resist loads from any direction, including, but not limited to, positive and negative wind pressures.
    - h. Attachment of assembly to building structure shall not apply moments to floor slab edge, lateral loads to steel beams, or torsional loads to steel beams and columns.
    - i. Dead loads of glass and panels shall not be developed through thermal break materials.

- C. Structural Loads: As indicated on Structural Drawings, in accordance with the building code and with ASCE 7.
1. Wind Loads: As indicated on Drawings.
  2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less..
  2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
  3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
    - a. Perpendicular to Plan of Wall: No greater than 1/240 of clear span plus 1/4 inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans less than 11 feet 8-1/4 inches
  4. Sills, copings, and floor closures: Capable of returning to original profile and position without permanent set after application of a 250 lb (113.4 kg) concentrated live load. Also include exterior projections beyond the plane of glass shall be designed to resist loads from window washing personnel, snow and ice.
- E. Structural: Test in accordance with ASTM E330 as follows:
1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
    - a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft.
  2. Entrance Doors:
    - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
    - b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
- G. Water Penetration under Static Pressure: Test in accordance with ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..
- H. Energy Performance: Certified and labeled by manufacturer for energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor):
    - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.45 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100. Coordinate with the energy model or HVAC engineer.
  2. Solar Heat-Gain Coefficient (SHGC):
    - a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.40 as determined in accordance with NFRC 200.

3. Condensation Resistance Factor (CRF):
  - a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined in accordance with AAMA 1503.
- I. Noise Reduction: Test in accordance with ASTM E 90, with ratings determined by ASTM E 1332, as follows.
  1. Outdoor-Indoor Transmission Class: Minimum 26.
- J. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone as indicated on Drawings for protection.
  1. Large-Missile Test: For glazing located within 30 feet (9.1 m) above of grade.
  2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and above grade.
  3. Large-Missile Test: For all glazing, regardless of height above grade.
- K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
  1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- L. Condensation Resistance Requirements:
  1. Fabricate, assemble and erect the work to prevent excessive condensation on the indoor face of the work or internalized within the wall system that may cause degradation of any wall system component, with the heating and ventilating system in operation and under the following conditions:
    - a. Outdoor: Ambient temperature of (exterior design temperature according to ASHRAE) degrees F; 24 kph (15 mph) wind.
    - b. Indoor: Ambient of 70 degrees F; relative humidity of 30%. (Verify with HVAC Engineer).
- M. Structural-Sealant Joints:
  1. Designed to carry gravity loads of glazing.
  2. Designed to produce tensile or shear stress of less than 20 psi.
- N. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed storefront systems without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant to occur before adhesive failure.
  1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
  2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate, because sealant-to-substrate bond strength exceeds sealant's internal strength.

## 2.3 MANUFACTURERS

- A. Basis-of-Design for Entrances and Framing Members: Kawneer Trifab VersaGlaze 451T-Impact Resistant of 2" x 4-1/2" extruded or formed aluminum framing members of thickness required and reinforced as required to support imposed loads or comparable products by one of the following:
  1. EFCO Corporation.
  2. Oldcastle Building Envelope.

## 2.4 ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  1. Construction: Nonthermal broken at interiors and thermal broken at exteriors.
  2. Glazing System: Retained mechanically with gaskets on four sides.
  3. Glazing Plane: Front.
  4. Finish: High-performance organic finish.

5. Fabrication Method: Field-fabricated stick system.
  6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  7. Steel Reinforcement: As required by manufacturer.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

## 2.5 ENTRANCE DOOR SYSTEMS

- A. Basis of Design for Entrance Doors: Kawneer 350 Heavy Wall, heavy duty glazed entrance doors for manual-swing operation.
1. Door Construction: 2-inch overall thickness, with minimum 0.188-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
  2. Door Design:
    - a. Medium stile: Manufacturer's standard width.
    - b. Bottom Rail: 10 inches high or 60 degree beveled, top edge required.
    - c. Top Rail: Medium stile, Manufacturer's standard height or 10" head with closer.
    - d. Cross rail at push rails.
  3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
    - a. Provide nonremovable glazing stops on outside of door.

## 2.6 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 71 00 "Door Hardware."

## 2.7 GLAZING

- A. Glazing: Comply with Section 08 80 00 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.
- D. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L.
- E. Structural Glazing Sealants: ASTM C 1184 chemically curing silicone formulation that is compatible with system components with which it comes in contact; specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in storefront system indicated.
  1. Color: Black.
- F. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.
  1. Color: Match structural sealant.

## 2.8 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

- B. Sheet and Plate: ASTM B 209.
- C. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
- D. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M
- E. Structural Profiles: ASTM B 308/B 308M.
- F. Steel Reinforcement:
  - 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  - 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  - 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
- G. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

## 2.9 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  - 2. Reinforce members as required to receive fastener threads.
  - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
  - 4. Self-Drilling fasteners shall be stainless steel or include a protective coating equal to that manufactured by Elco.
  - 5. Wet Area Fasteners: Provide 300 series stainless steel.
  - 6. Structural, Non-stainless Fasteners: Provide minimum SAE J429 Grade 5.
  - 7. Grade 8.2 fasteners, high strength bolts of non U.S. origin, or zinc-plated high strength bolts shall not be used.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
  - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A1 23M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.
- E. Slip pads - Provide "Eel Slip", "Nylatron" washers or pads of sizes and thicknesses (minimum 1/16" except 1/8" for Eel Slip") recommended by the manufacturer to permanently prevent "freeze up" of joints. Provide high impact polystyrene shim pads for static shims.
- F. Shims - Static shims shall be aluminum or high-impact polystyrene materials capable of resisting compressive and prying loads with no displacement. Steel materials may be used only if dissimilar metals separators are included. The structural engineer shall review the adequacy of shim types, materials and bearing surfaces to be provided by the installer. This shim review and analysis shall be included in the structural calculations. U-shaped shims shall have restricted throats that prevent falling-out from the fastener at each application. Shim stack thickness shall not exceed two times the fastener diameter. Plastic storefront shims are not acceptable.
- G. Provide PVC-coated open cell reticulated urethane foam baffles at all weep holes or vent tubes. Size, length and porosity to meet water and air infiltration design requirements.

- H. Engineering and brackets shop installed for sign supports.

## 2.10 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Physical and thermal isolation of glazing from framing members.
  - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 5. Provisions for field replacement of glazing from exterior.
  - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
- F. Storefront Framing: Fabricate components for assembly using screw-spline system.
- G. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
  - 1. At interior and exterior doors, provide compression weather stripping at fixed stops.
- H. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
  - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
  - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- I. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- J. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

## 2.11 ALUMINUM FINISHES

- A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.
  - 1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 2. Color and Gloss: As selected by Architect from full range of industry colors and color densities.

## 2.12 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations, including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

**3.3 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS**

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.
- G. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Set continuous sill members and flashing in full sealant bed, as specified in Section 07 92 00 "Joint Sealants," to produce weathertight installation.
- I. Install joint filler behind sealant as recommended by sealant manufacturer.
- J. Install components plumb and true in alignment with established lines and grades.
- K. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- L. Install entrance doors to produce smooth operation and tight fit at contact points.
  - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
  - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- M. Install structural glazing as follows:
  - 1. Prepare surfaces that will contact structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
  - 2. Set glazing into framing in accordance with sealant manufacturer and framing manufacturer's written instructions and standard practice. Use a spacer or backer as recommended by manufacturer.
  - 3. Set glazing with proper orientation so that coatings face exterior or interior as specified.

4. Hold glazing in place using temporary retainers of type and spacing recommended by manufacturer, until structural sealant joint has cured.
5. Apply structural sealant to completely fill cavity, in accordance with sealant manufacturer and framing manufacturer's written instructions and in compliance with local codes.
6. Apply structural sealant at temperatures indicated by sealant manufacturer for type of sealant.
7. Allow structural sealant to cure in accordance with manufacturer's written instructions.
8. Clean and protect glass as indicated in Section 08 80 00 "Glazing."
9. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass as recommended by sealant manufacturer.
10. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.

### 3.4 ERECTION TOLERANCES

- A. Install aluminum-framed entrance and storefront systems to comply with the following maximum tolerances:
  1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
  2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
  3. Alignment:
    - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
  4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests.
- B. Tests: Perform the following tests on representative areas of aluminum-framed entrance and storefront systems.
  1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect to be tested in accordance with AAMA 501.2 and to not evidence water penetration.
    - a. Perform a minimum of three tests in areas as directed by Architect.
    - b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 20, 50, and 90 percent completion.
  2. Field Test: Perform two tests using procedure ASTM E 1105 at a test pressure of 10 PSF.
- C. Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.
  1. Test a minimum of two areas on each building facade.
  2. Repair installation areas damaged by testing.
- D. Aluminum-framed entrance and storefront systems will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.



**3.6 MAINTENANCE SERVICE**

## A. Entrance Door Hardware Maintenance:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide **six** months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 08 44 13 - GLAZED ALUMINUM CURTAIN WALLS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Hurricane-resistant glazed aluminum curtain wall systems: Conventionally glazed installed as stick assemblies.
- B. Related Requirements:
1. Section 05 12 00 "Structural Steel Framing" for steel support framing of aluminum curtainwall system.
  2. Section 07 27 26 "Fluid-Applied Membrane Air Barrier" for air barrier on sheathing above or below aluminum curtainwall system to provide a continuous air and water exterior wall envelope.
  3. Section 07 84 43 "Joint Firestopping" for firestopping required at curtainwall between floor levels as indicated on Drawings.
  4. Section 07 92 00 "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.
  5. Section 08 41 13 "Aluminum Framed Entrances and Storefronts" for doors to be installed in curtainwall systems.
  6. Section 08 80 00 "Glazing" for glazing types to be installed in curtainwall systems.

**1.2 DEFINITIONS**

- A. Water Penetration:
1. Uncontrolled: Infiltrated water that is not captured, controlled or managed to drain to exterior; water that wets perimeter containment system, wall insulation, or normally exposed interior surfaces.
  2. Controlled: Infiltrated water that is captured, controlled or managed by flashings, gutters, and sills to drain to exterior; water that does wet perimeter containment system, wall insulation, or normally exposed interior surfaces.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Shop drawings and design must be supplied by the Aluminum Framing Manufacturer, not an outside or third party source, including storefront, doors, and curtainwall framing system as a complete submittal for glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
1. Include adjoining material details and coordinate within the Shop Drawings.
  2. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  3. Include full-size isometric details of each type of vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
    - a. Joinery, including concealed welds.
    - b. Anchorage.

- c. Expansion provisions.
- d. Glazing.
- e. Flashing and drainage.
- 4. Include thermal modeling of the curtain wall.
  - a. Thermal modeling of typical vertical and horizontal curtain wall section details.
  - b. Lawrence Berkeley Laboratory Therm and Window software shall be used to provide modeling and computation of the U-Value and to identify extreme temperature limits of the exterior and interior surfaces of the wall system components.
  - c. Submit a project specific dew point analysis and U Value analysis performed by a NFRC certified simulator demonstrating conformance with the required thermal performance criteria as specified.
  - d. Include Therm and Window output data files and an additional color print or image of the model not including results.
- C. Calculations: Submit structural calculations, sealed by a licensed professional engineer currently registered by the AHJ. Calculations shall be prepared in compliance with referenced documents and these specifications. Where specifications and code differ, the more severe requirements shall govern. Test reports are not an acceptable substitute for calculations. Calculations shall include the following information:
  - 1. Analysis for all applicable loads on framing members.
  - 2. Analysis for all applicable loads on anchors, including anchors embedded in concrete.
  - 3. Section property computations for framing members.
  - 4. Analysis of system accommodation for building movements.
  - 5. Seal and signature of professional engineer currently registered by the AHJ on drawings and calculations.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation registered in the state where Project is located.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Field Quality Control Program: Submit description of procedures for this project to be reviewed and accepted prior to the submittal of field quality control reports.
- B. Field quality-control reports.
- C. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.
  - 1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.

### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating glazed aluminum curtain walls that meet or exceed energy performance requirements indicated and of documenting this performance by certification, labeling, and inclusion in lists.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the state where Project is located and who is experienced in providing engineering

services of the kind indicated. Engineering services are defined as those performed for installations of glazed aluminum curtain walls that are similar to those indicated for this Project in material, design, and extent.

- C. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project and has purchased like materials from supplying manufacturer for over 15 years.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
- E. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.

### **1.8 MOCKUPS**

- A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of assembly, including corner, soffits, supports, attachments, and accessories that is minimum 10 feet by 10 feet.
  - 2. Refer to drawings for details and scope of mockup.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

### **1.9 PROJECT CONDITIONS**

- A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements before fabrication and indicate measurements on Shop Drawings.

### **1.10 WARRANTY**

- A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Unusual noise or vibration created by wind and thermal and structural movements.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - d. Water penetration through fixed glazing and framing areas.
    - e. Failure of operating components.
  - 2. Warranty Period: Two years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. General Performance: Comply with performance requirements specified, as determined by testing of manufacturer's standard glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- B. Delegated Design: Design glazed aluminum curtain walls, including curtain wall to curtain wall connections, curtain wall to structure connection, and a comprehensive engineering analysis by a qualified professional engineer registered in the state where Project is located, using performance requirements and design criteria indicated. All calculations should include loads imposed by sunshade system, subframe and supports attached to the curtainwall system.
1. Engineering Assumptions:
    - a. Design wind pressure shall be as required for partially enclosed structure per Structural Drawings.
      - 1) Allowable stress values cannot exceed yield stress of material.
    - b. Corners and Wind Pressures:
      - 1) Corners in Typical Windload Zones: Both surfaces shall be assumed to experience inward and outward design pressures simultaneously.
        - a) Combination factor: 95% positive, 85% negative, 75% difference.
      - 2) Corners in Corner Windload Zones: Simultaneous occurrence of inward design pressure on one surface, and outward design pressure on adjoining surface is not required.
    - c. A 1/3 increase in allowable stress for wind or seismic loads not allowed.
    - d. Glass, sealants and interior finishes shall not contribute to framing member strength, stiffness or lateral stability.
    - e. Compression flanges of flexural members may be assumed to receive effective lateral bracing only from anchors to building structure and horizontal glazing rails or interior trim, which are in contact with compression flange. Points of contraflexure shall not be regarded as lateral braces or as end points of an unbraced length; unbraced length shall be actual distance between effective lateral braces. Anti-buckling clips are considered effective braces.
    - f. Where an internal framing member reaction is resisted by a continuous element, maximum assumed effective length of resisting element shall be 4 times bearing length, but not more than 12 in (300 mm).
    - g. Properly brace assembly anchors in 3 orthogonal directions (vertical, transverse, and longitudinal) to resist loads from any direction, including, but not limited to, positive and negative wind pressures.
    - h. Attachment of assembly to building structure shall not apply moments to floor slab edge, lateral loads to steel beams, or torsional loads to steel beams and columns except where noted in Construction Documents.
    - i. Dead loads of glass and panels shall not be developed through thermal break materials.

- C. Structural Loads:
1. Structural Loads: As indicated on Structural Drawings, in accordance with the building code and with ASCE 7.
  2. Wind Loads: As indicated on Structural Drawings.
    - a. Structural-Test Performance: Test according to ASTM E 330 as follows:
  3. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
  4. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
  5. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- D. Deflection of Framing Members: At design wind load, as follows:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans of greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
  2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch, whichever is smaller. Retain "Cantilever Deflection" Subparagraph below if required.
  3. Cantilever Deflection: Limited to 2L/175.
  4. Sills, copings and floor closures: Capable of returning to original profile and position without permanent set after application of a 250 lb (113.4 kg) concentrated live load; maximum length no larger than 12". Also include exterior projections beyond the plane of glass shall be designed to resist loads from snow and ice.
- E. Water Penetration under Static Pressure: Test in accordance with ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq.ft..
- F. Story Drift: Accommodate design displacement of adjacent stories indicated.
1. Design Displacement: As indicated on Drawings.
  2. Test Performance: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.4 at design displacement.
- G. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
1. Component Importance Factor is 1.5.
- H. Energy Performance: Glazed aluminum curtain walls shall have energy performance ratings in accordance with NFRC. Coordinate with the energy model or HVAC engineer.
1. Thermal Transmittance (U-factor):
    - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.45 Btu/sq. ft. x h x deg F as determined in accordance with AAMA Specification 1503.
  2. Solar Heat Gain Coefficient (SHGC):
    - a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.25 as determined in accordance with NFRC 200.
  3. Air Leakage:
    - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E 283.
  4. Condensation Resistance Factor (CRF):
    - a. Fixed glazing and framing areas shall have an condensation resistance rating of no less than 66 for framing and 60 for glazing as determined according to AAMA Specification 1503.

- I. Condensation Resistance Requirements:
  - 1. Fabricate, assemble and erect the work to prevent excessive condensation on the indoor face of the work or internalized within the wall system that may cause degradation of any wall system component, with the heating and ventilating system in operation and under the following conditions:
    - a. Outdoor: Ambient temperature of (exterior design temperature according to ASHRAE) 19.4 degrees F; 24 kph (15 mph) wind.
    - b. Indoor: Ambient of 70 degrees F; relative humidity of 30%. (Verify with HVAC Engineer).
- J. Windborne-Debris Impact Resistance: Pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone as indicated on Drawings for protection.
  - 1. Large-Missile Test: For glazing located within 30 feet (9.1 m) above of grade.
  - 2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and above grade.
  - 3. Large-Missile Test: For all glazing, regardless of height above grade.
- K. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperature changes:
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
  - 2. Test Interior Ambient-Air Temperature: 75 deg F.

## 2.2 SOURCE LIMITATIONS

- A. Obtain all components of curtain-wall system and storefront system, including framing spandrel panels and accessories, from single manufacturer.

## 2.3 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer North America; an Alcoa company; System 1 Impact Resistant (or as indicated on Drawings) or a comparable product by one of the following:
  - 1. CMI Architectural.
  - 2. EFCO Corporation.
  - 3. Wausau Window and Wall Systems.
- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  - 1. Construction: Thermally broken.
  - 2. Glazing System: Retained mechanically with gaskets at perimeter and structural silicone at all intermediate framing members.
  - 3. Glazing Plane: Front.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Framing Sealants: Manufacturer's standard sealants.
- E. Entrance Door Systems: Comply with Section 08 41 13 "Aluminum-Framed Entrances and Storefronts".

## 2.4 GLAZING

- A. Glazing and Spandrel Glazing: Comply with Section 08 80 00 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers
- C. Glazing and Air / Water Barrier Sealants: Silicone sealant as recommended by manufacturer.



- D. Glazing Sealants: Comply with Section 08 80 00 "Glazing."

## 2.5 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
- B. Sheet and Plate: ASTM B 209.
- C. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
- D. Structural Profiles: ASTM B 308/B 308M.
- E. Steel Reinforcement:
  - 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  - 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  - 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
- F. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

## 2.6 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  - 2. Reinforce members as required to receive fastener threads.
  - 3. Self-Drilling fasteners shall be stainless steel or include a protective coating equal to that manufactured by Elco.
  - 4. Wet Area Fasteners: Provide 300 series stainless steel.
  - 5. Structural, Non-stainless Fasteners: Provide minimum SAE J429 Grade 5.
  - 6. Grade 8.2 fasteners, high strength bolts of non U.S. origin, or zinc-plated high strength bolts shall not be used.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
  - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.
- E. Air and Water Barrier Tape: Basis of Design is Dow Corning 123 silicone tape in width as required to accommodate movement indicated or approved equal.
- F. Slip pads - Provide "Eel Slip", "Nylatron" washers or pads of sizes and thicknesses (minimum 1/16" except 1/8" for Eel Slip") recommended by the manufacturer to permanently prevent "freeze up" of joints. Provide high impact polystyrene shim pads for static shims.

- G. Shims - Static shims shall be aluminum or high-impact polystyrene materials capable of resisting compressive and prying loads with no displacement. Steel materials may be used only if dissimilar metals separators are included. The structural engineer shall review the adequacy of shim types, materials and bearing surfaces to be provided by the installer. This shim review and analysis shall be included in the structural calculations. U-shaped shims shall have restricted throats that prevent falling-out from the fastener at each application. Shim stack thickness shall not exceed two times the fastener diameter. Obtain approval for shim stack thicknesses that exceeds maximum.
- H. Provide PVC-coated open cell reticulated urethane foam baffles at all weep holes or vent tubes. Size, length and porosity to meet water and air infiltration design requirements.
- I. Engineering and brackets shop installed for sign supports.

## 2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Physical and thermal isolation of glazing from framing members.
  - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
  - 6. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- C. Fabricate components that, when assembled, have the following characteristics:
  - 1. Pressure-equalized system design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

## 2.8 ALUMINUM FINISHES

- A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF or FEVE resin by weight in color coat.
  - 1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 2. Color and Gloss: As selected by Architect from full range of industry colors and color densities.

## 2.9 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality-control procedures complying with ASTM C1401 recommendations, including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION, GENERAL**

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal joints watertight unless otherwise indicated.
- G. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- I. Install components plumb and true in alignment with established lines and grades.
- J. Install glazing as specified in Section 08 80 00 "Glazing."

**3.3 ERECTION TOLERANCES**

- A. Install glazed aluminum curtain walls, including shop assembled and installed materials to comply with the following maximum tolerances:
  - 1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
  - 2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
  - 3. Alignment:
    - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
  - 4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

**3.4 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Test Area: Perform tests on representative areas of glazed aluminum curtain walls.
- C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.
  - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.
    - a. Perform a minimum of three tests in areas as directed by Architect.
    - b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 20%, 50%, and 90% completion.

- D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION

**SECTION 08 51 13 - ALUMINUM WINDOWS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes aluminum-framed windows:
  - 1. Horizontal sliding windows.
- B. Related Requirements:
  - 1. Section 08 41 13 "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units.
  - 2. Section 08 80 00 "Glazing" for glazing requirements for aluminum windows, including those specified to be factory glazed.

**1.2 DEFINITIONS**

- A. AW: Architectural.
- B. HC: Heavy Commercial.
- C. Performance grade number, included as part of the AAMA/NWWDA product designation code, is actual design pressure in pounds force per square foot used to determine structural test pressure and water test pressure.
- D. Structural test pressure, for uniform load structural test, is equivalent to 150 percent of design pressure.
- E. Minimum test size is smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
  - 3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
  - 4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
  - 5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes, and operating instruction for each type for aluminum window indicated.

- B. Shop Drawings: For aluminum windows.
  1. Include plans, elevations, sections, hardware, accessories, insect screens, attachments to other Work, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
  2. Mullion details, including reinforcement and stiffeners.
  3. Joinery details.
  4. Expansion provisions.
  5. Flashing and drainage details.
  6. Thermal-break details.
  7. Glazing details.
  8. Window cleaning provisions.
  9. Window System Operators: Show locations, mounting, and details for installing operator components and controls.
  10. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation and used to determine the following:
    - a. Structural test pressures and design pressures from basic wind speeds indicated.
    - b. Deflection limitations of glass framing systems
- C. Samples for Initial Selection: For units with factory-applied finishes.
- D. Samples for Verification: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:
  1. Exposed Finishes: 2 by 4 inches.
  2. Exposed Hardware: Full-size units.
- E. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency, for each type, grade, and size of aluminum window. Test results based on use of down-sized test units will not be accepted.
- C. Field Quality-Control Test Reports: From a qualified testing and inspecting agency engaged by Contractor.
- D. Sample Warranties: For manufacturer's warranties.

### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.
- B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for aluminum windows' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance

characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

- E. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum windows and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
  - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- F. Fenestration Standard: Comply with AAMA/NWWDA 101/I.S.2, "Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors," for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
  - 1. Provide AAMA-certified aluminum windows with an attached label.
- G. Glazing Publications: Comply with published recommendations of glass manufacturers and GANA's "Glazing Manual" unless more stringent requirements are indicated.
- H. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockup of typical wall area as shown on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

## 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

## 1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure to meet performance requirements.
    - b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
    - c. Faulty operation of movable sash and hardware.
    - d. Deterioration of materials and finishes beyond normal weathering.
    - e. Failure of insulating glass.
  - 2. Warranty Period:
    - a. Window: 10 years from date of Substantial Completion.
    - b. Glazing Units: 10 years from date of Substantial Completion.
    - c. Aluminum Finish: 20 years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. All Seasons Window & Door Mfg., Inc.; All Seasons Commercial Division, Inc.
  - 2. EFCO Corporation; a Pella company.
  - 3. EXTECH Exterior Technologies, Inc.
  - 4. Graham Architectural Products Corp.
  - 5. Kawneer North America; an Alcoa company.
  - 6. Peerless Products Inc.
  - 7. TRACO.
  - 8. YKK AP America Inc.
- C. Glazing: Insulated glass, as specified in Division 08 Section "Glazing".
- D. Window Type: Horizontal Sliding Windows.
  - 1. Basis-of-Design Product: The design is based on Kawneer "8470TL Thermal Window (Horizontal Slider)." Subject to compliance with mullion dimensions, operational design, and performance characteristics of the specified product, a comparable product may be proposed by other manufacturers of aluminum window systems. Comparable products are subject to review and approval through the submittal process specified.
  - 2. Glazing: Laminated glass, as specified in Division 08 Section "Glazing".
  - 3. Accessories:
    - a. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator.
    - b. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
    - c. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.

**2.2 WINDOW PERFORMANCE REQUIREMENTS**

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
  - 1. Window Certification: AAMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
  - 1. Minimum Performance Class: AW.
  - 2. Minimum Performance Grade: 50.
- C. Structural Performance: Provide aluminum windows capable of withstanding the following, including wind loads based on passing AAMA/NWWDA 101/I.S.2, Uniform Load Structural Test, at basic wind speed indicated:
  - 1. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch (19 mm), whichever is less, at design pressure based on structural computations.
  - 2. Basic Wind Speed: As indicated in miles per hour (meters per second) at 33 feet (10 m) above grade. Determine wind loads and resulting design pressures applicable to Project according to the following, based on mean roof heights above grade as indicated on Drawings:
    - a. ASCE 7, "Minimum Design Loads for Buildings and Other Structures," Section 6.4.2, "Analytic Procedure."



- D. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/NWWDA 101/I.S.2, Air Infiltration Test.
  1. Maximum Rate: 0.3 cfm/sq. ft. (5 cu. m/h x sq. m) of area at an inward test pressure of 6.24 lbf/sq. ft. (300 Pa).
- E. Water Resistance: No water leakage as defined in AAMA/NWWDA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/NWWDA 101/I.S.2, Water Resistance Test.
  1. Test Pressure: 15 percent of positive design pressure, but not less than 2.86 lbf/sq. ft. (140 Pa) or more than 12 lbf/sq. ft. (580 Pa).
  2. Test Pressure: 20 percent of positive design pressure, but not more than 12 lbf/sq. ft. (580 Pa).
- F. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.30.
- G. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.
- H. Thermal Transmittance: Provide aluminum windows with a whole-window U-value maximum indicated at 15-mph (24-km/h) exterior wind velocity and winter condition temperatures when tested according to AAMA 1503.
  1. U-Value: Based on 0.55 Btu/sq. ft. x h x deg F (W/sq. m x K).
- I. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  1. Temperature Change: 120 deg F ambient; 180 deg F material surfaces.
- J. Sound Transmission Class (STC): Rated for not less than STC when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413.
- K. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone as indicated on Drawings for protection.
  1. Large-Missile Test: For glazing located within 30 feet of grade.
  2. Small-Missile Test: For glazing located between 30 feet and above grade.

### 2.3 MATERIALS, GENERAL

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi (150-MPa) ultimate tensile strength, not less than 16,000-psi (110-MPa) minimum yield strength, and not less than 0.062-inch (1.6-mm) thickness at any location for the main frame and sash members.
- B. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components. Cadmium-plated steel fasteners are not permitted.
  1. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.125 inch (3.2 mm) thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, splined grommet nuts.
  2. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.
- C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient

strength to withstand design pressure indicated. Cadmium-plated steel anchors, clips, and accessories are not permitted.

- D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated. Cadmium-plated steel reinforcing members are not permitted.
- E. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

## 2.4 ACCESSORIES

- A. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.
- B. Column Covers: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- C. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- D. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- E. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

## 2.5 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Glaze aluminum windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.
- F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- G. Window Assemblies: Provide operating and fixed units in configuration indicated. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:
  - 1. Angled mullion posts with interior and exterior trim.
  - 2. Angled interior and exterior extension and trim.
  - 3. Exterior head and sill casings and trim.
- H. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.

- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.7 ALUMINUM FINISHES

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. High-Performance Organic Finish (Three-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coatings; Organic Coating: manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
  - 1. Color and Gloss: Match Aluminum-Framed Entrances and Storefronts: As selected by Architect from full range of industry colors and color densities.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
  - 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
  - 2. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
- D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

- E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- F. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in "Dissimilar Materials" Paragraph in Appendix B in AAMA/NWWDA 101/I.S.2.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
  - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
  - 1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
  - 2. Air-Infiltration Testing:
    - a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
    - b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.
  - 3. Water-Resistance Testing:
    - a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
    - b. Allowable Water Infiltration: No water penetration.
  - 4. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
  - 5. Test Reports: Prepared according to AAMA 502.
- C. Windows will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- B. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.
- C. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
  - 1. Keep protective films and coverings in place until final cleaning.
- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- E. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain window operating system. Refer to Division 01 Section "Closeout Procedures."

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

## **SECTION 08 56 53 - SECURITY WINDOWS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Vision security windows.
  - 2. Fixed, transaction security windows.
- B. Related Requirements:
  - 1. Section 08 88 53 "Security Glazing" for ballistic-resistant glass for security windows.

#### **1.2 COORDINATION**

- A. Coordinate installation of anchorages for security windows. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in adjacent construction.

#### **1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, weights and finishes for window units.
- B. Shop Drawings: For security windows.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Full-size section details of framing members, including internal armoring, reinforcement, and stiffeners.
  - 3. Location of weep holes.
  - 4. Glazing details.
  - 5. Details of deal tray transaction drawer and speaking aperture.
- C. Samples for Initial Selection: For frame members with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:
  - 1. Framing: 12-inch-long sections of frame members.
- E. Delegated Design Submittal: For security windows indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Product Test Reports: For each type of security window and accessory indicated as ballistics resistant, for tests performed by a qualified testing agency.
- D. Configuration Disclosure Drawing: For each type of forced-entry-resistant security window, complying with ASTM F 1233.

- E. Examination reports documenting inspections of substrates, areas, and conditions.
- F. Anchor inspection reports documenting inspections of built-in and cast-in anchors.
- G. Sample Warranty: For special warranty.

## **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
  - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 2. AWS D1.6, "Structural Welding Code - Stainless Steel."

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Pack security windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.
- B. Label security window packaging with drawing designation.
- C. Store crated security windows on raised blocks to prevent moisture damage.

## **1.8 FIELD CONDITIONS**

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## **1.9 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace security windows that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including deflections exceeding 1/4 inch.
    - b. Failure of welds.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  - 2. Warranty Period: Three years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Attack Resistance: Provide units identical to those tested for compliance with requirements indicated, and as follows:
  - 1. Ballistics Resistance, UL 752: Listed and labeled as Level 3 in accordance with UL 752.
- B. Structural Loads: Security windows withstand the effects of wind loads, with no permanent deformation or breakage of components within window assembly when tested in accordance with ASTM E 330.
  - 1. Structural Loads: As indicated on Structural Drawings, in accordance with the building code and with ASCE 7.
  - 2. Wind Loads: As indicated on Structural Drawings.
- C. Air Leakage, Fixed Glazing and Framing: Provide windows with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested in accordance with ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft..



- D. Water Penetration under Static Pressure, Fixed Glazing and Framing: Provide windows that do not evidence water penetration through fixed glazing and framing areas when tested in accordance with ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
- E. Windborne-Debris Impact Resistance: Passes ASTM E 1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone as indicated on Drawings for protection.
  - 1. Large-Missile Test: For glazing located within 30 feet of grade.
  - 2. Small-Missile Test: For glazing located between 30 feet and above grade.

## 2.2 VISION SECURITY WINDOWS

- A. Provide vision security windows with framing on four sides and no operable sash or ventilator.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide CR Laurence Transparent Bullet-Resistance Assemblies or comparable product by one of the following:
    - a. Creative Industries, Inc.
    - b. National Bullet Proof, Inc.
    - c. SABIC Innovative Plastics IP BV; Insulgard Security Products.
- B. Framing: Fabricate top and bottom channel framing, mullions, and glazing stops from aluminum as follows:
  - 1. Profile: Narrow, with minimum face dimension indicated.
    - a. Minimum Face Dimension: 2 inches.
  - 2. Depth: Manufacturer's standard.
  - 3. Glass Orientation: Vertical.
- C. Head and Jamb Framing: Designed for sealant glazing.
- D. Glazing and Glazing Materials: Comply with requirements in Section 08 88 53 "Security Glazing."
- E. Materials:
  - 1. Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666 or ASTM A 240/A 240M, austenitic stainless steel, Type 304.
  - 2. Aluminum Extrusions: ASTM B 221. Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength.
  - 3. Aluminum Sheet and Plate: ASTM B 209.

## 2.3 FABRICATION

- A. General: Fabricate security windows to provide a complete system for assembly of components and anchorage of window units.
  - 1. Provide units that are reglazable from the secure side without dismantling the attack side of framing.
  - 2. Prepare security windows for field glazing unless preglazing at the factory is indicated.
- B. Provide weep holes and internal water passages for exterior security windows to conduct infiltrating water to the exterior.
- C. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.
  - 1. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required for security windows to comply with ballistics-resistance performance indicated.
- D. Glazing Stops: Finish glazing stops to match security window framing.
  - 1. Attack-Side (Exterior) Glazing Stops: Welded or integral to framing.
  - 2. Secure-Side (Interior) Glazing Stops: Removable, coordinated with glazing indicated.

- E. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- F. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- G. Factory-cut openings in glazing for speaking apertures.
- H. Weather Stripping: Factory applied.

## **2.4 GENERAL FINISH REQUIREMENTS**

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## **2.5 ALUMINUM FINISHES**

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.
- B. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF or FEVE resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 1. Color and Gloss: Match ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS; To be selected by Architect from full range of industry colors and color densities.

## **2.6 STAINLESS STEEL FINISHES**

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run grain of directional finishes with long dimension of each piece.
  - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
  - 3. Directional Satin Finish: ASTM A 480/A 480M, No. 4.

## **2.7 ACCESSORIES**

- A. Recessed Deal Trays: Formed from stainless steel; fabricated in curved shape with exposed flanges for recessed installation into horizontal surface.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Creative Industries, Inc.; 1611-S3 deal tray, or comparable product by another manufacturer.
  - 2. Size: 16 inches wide by 11 inches deep by 1-1/2 inches high.
  - 3. Opening Size: 14-1/2 inches wide by 9-1/2 inches deep.
  - 4. Custom Cover: Stainless steel with felt weatherstripping.
  - 5. Custom Drainage: Provide weep hole and drainage tube.
  - 6. Ballistics Resistance: UL Level 3.
  - 7. Listed and labeled as bullet resisting in accordance with UL 752.

- B. Amplified Speaking Apertures: Fabricate from aluminum, designed to allow passage of speech at normal speaking volume without distortion.
  - 1. Shape: Circular, 5 inches diameter.
  - 2. Hole Size: 3-1/2 inches diameter.
  - 3. Provide manufacturer's spacer or extender if required for glass thickness.
  - 4. Ballistics Resistance: UL Level 3.
  - 5. Listed and labeled as bullet resisting in accordance with UL 752.
  - 6. Power Supply: 120V AC, 60 Hz.
  - 7. Microphone: Gooseneck, removable.
  - 8. Finish: Clear anodized.
  - 9. Basis-of-Design Product: Norcon Communications; TTU-AJB.
- C. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.
- D. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum 3/16 inch thick; with minimum 1/2-inch-diameter, headed studs welded to back of plate.
- E. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
- F. Glazing Strips and Weather Stripping: Manufacturer's standard replaceable components unless otherwise indicated, provide the following:
  - 1. Compression Type: Molded EPDM or neoprene gaskets complying with ASTM D 2000, Designations 2BC415 to 3BC620; molded PVC gaskets complying with ASTM D 2287; or molded, expanded EPDM or neoprene gaskets complying with ASTM C 509, Grade 4.
  - 2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric backing.
- G. Compression-Type Glazing Strips and Weather Stripping: Unless otherwise indicated, provide compressible stripping for glazing and weather stripping, such as molded EPDM or neoprene gaskets complying with ASTM D 2000, Designations 2BC415 to 3BC620; molded PVC gaskets complying with ASTM D 2287; or molded, expanded EPDM or neoprene gaskets complying with ASTM C 509, Grade 4.
- H. Miscellaneous Glazing Materials: Provide material, size, and shape complying with requirements of glass manufacturers and with a proven record of compatibility with surfaces contacted in installation.
  - 1. Cleaners, Primers, and Sealers: Type recommended by sealant or gasket manufacturer.
  - 2. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.
  - 3. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
  - 4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- I. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B 633; provide sufficient strength to withstand design pressures indicated.
- J. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- K. Sealants: For sealants required within fabricated security windows, provide type recommended by manufacturer for joint size and movement. Sealant remains permanently elastic, nonshrinking, and nonmigrating.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of security windows.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of security window connections before security window installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of security windows.
- D. Inspect built-in and cast-in anchor installations, before installing security windows, to verify that anchor installations comply with requirements. Prepare inspection reports.
  - 1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
  - 2. Perform additional inspections to determine compliance of replaced or additional work. Prepare anchor inspection reports.
- E. For glazing materials whose orientation is critical for performance, verify installation orientation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other security window anchors whose installation is specified in other Sections.
  - 1. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.

### **3.3 INSTALLATION**

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing security windows to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.
  - 1. Install an attached or integral flange to secure side of security windows extending over rough-in opening gap so that gap has same ballistics-resistance performance as security window.
- B. Voice-Communication-Type Framing: Attach removable glass spacers to jambs and head of glazing, located not more than 6 inches from each corner and spaced not more than 12 inches o.c.
- C. Glazed Framing: Provide sealant -glazed framing. Comply with installation requirements in Section 08 88 53 "Security Glazing."
- D. Removable Glazing Stops and Trim: Fasten components with security fasteners.
- E. Fasteners: Install security windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials. Provide stainless steel fasteners in stainless steel materials.
- F. Sealants: Comply with requirements in Section 07 92 00 "Joint Sealants" for installing sealants, fillers, and gaskets.
  - 1. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
  - 2. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.

- G. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

### **3.4 FIELD QUALITY CONTROL**

- A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
- B. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.
- C. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

### **3.5 ADJUSTING**

- A. Adjust horizontal-sliding, transaction security windows to provide a tight fit at contact points for smooth operation and a secure enclosure.
- B. Adjust transaction drawers to provide a tight fit at contact points and weather stripping for smooth operation and weathertight and secure enclosure.
- C. Remove and replace defective work, including security windows that are warped, bowed, or otherwise unacceptable.

### **3.6 CLEANING AND PROTECTION**

- A. Clean surfaces promptly after installation of security windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.
  - 1. Lubricate sliding security window hardware.
  - 2. Lubricate transaction drawer hardware.
- B. Clean glass of preglazed security windows promptly after installation. Comply with requirements in Section 08 88 53 "Security Glazing" for cleaning and maintenance.
- C. Provide temporary protection to ensure that security windows are without damage at time of Substantial Completion.

### **3.7 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain operable security windows and security windows with transaction drawers.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**PROJECT MANUAL  
VOLUME 2**

**FOR**

**MOBILE ARENA  
401 Civic Center Drive  
Mobile, Alabama 36602**

**Project No. AMOB230117**

**BID SET**

December 13, 2024



**City of Mobile  
Architectural Engineering Department  
Government Plaza  
205 Government Street, South Tower, 5th Floor  
Mobile, Alabama 36602**

**Bid Date:** \_\_\_\_\_

**Set Number:** \_\_\_\_\_

## **OWNERSHIP OF DOCUMENTS AND DISCLAIMER**

The Project Manual, Technical Specifications, Drawings, and all other documents relating to this project have been prepared for this individual and particular project, and for the exclusive use of the original Owner, developer or other party so indicated.

Actual project conditions and as-built conditions may vary significantly. Changes made during bidding, negotiations, construction, due to additions or deletions of portions of this project, and/or for other reasons, may not be indicated in these documents.

These documents may not be used or relied upon as a certification of information indicated, or used for any other project, by any third parties or other parties, for any purpose whatsoever, without the prior written consent of Goodwyn Mills Cawood, LLC, or prior to receipt of mutually agreed to compensation paid to Goodwyn Mills Cawood, LLC, therefore.

The ownership, copyrights, and all other rights to these documents, are reserved by Goodwyn Mills Cawood, LLC, including in part, all copies thereof in any form or media. Reproduction of the material contained in these documents or substantial quotation of their provisions without prior written permission of Goodwyn Mills Cawood, LLC, violates the copyright and common laws of the United States and will subject the violator to legal prosecution.

**Goodwyn Mills Cawood, LLC**

11 N. Water Street

Suite 15250

Mobile, AL 36602



**SECTION 00 01 05 – PROJECT DIRECTORY**

**PROJECT DIRECTORY**

**OWNER:** **City of Mobile Architectural Engineering Department**  
Government Plaza 205 Government Street, South Tower, 5th  
Floor  
Mobile, Alabama 36602  
Phone: (251) 208-7492  
**Carleen Stout, Deputy Director, Real Estate  
and Asset Manager**

**ARCHITECT:** **GOODWYN MILLS CAWOOD, LLC**  
11 North Water Street  
Mobile, Alabama 36602  
Phone: (251) 460-4006  
**James R. Walker, AIA, Project Architect**  
**George Keith Parker, AIA, Project Manager**

**ARCHITECT:** **POPULOUS**  
4800 Main Street, Suite 300  
Kansas City, Missouri 64112  
Phone: (816) 221-1500  
**Aaron Bruckerhoff, AIA, Project Architect**

**CONSTRUCTION  
MANAGER:** **VOLKERT, INC**  
11 N Water Street, Suite 18290  
Mobile, AL 36602  
Phone: (864) 245-1917  
**Sam Matheny, Program Manager**

**STRUCTURAL  
ENGINEERS:** **WALTER P MOORE**  
1301 McKinney Drive, Suite 1100  
Houston, TX 77010  
Phone: (713) 630-7300  
**Erin Kueht, P.E., Structural**

**MECHANICAL/ELECTRICAL  
PLUMBING/ FP ENGINEERS:** **HENDERSON ENGINEERS**  
1801 Main Street, Suite 300  
Kansas City, MO 64108  
Phone: (816) 663-8700  
**Tyler Johnson, P.E., Project Manager**  
**Evan O'Brien, P.E., Lead Mechanical**  
**Mike Fiser, P.E., Lead Electrical**

**CIVIL  
ENGINEERS:**

**DRIVEN ENGINEERING**  
805 Morris Hill Road  
Semmes, AL 36575-6445  
Phone: (251) 649-4011  
**Avalisha Fisher, P.E., Civil**

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

## VOLUME 1

### SECTION 00 01 10 – TABLE OF CONTENTS

#### DIVISION 00 – PROCUREMENT & CONTRACTING REQUIREMENTS

00 01 00	COVER
00 01 05	DIRECTORY
00 01 07	PROFESSIONAL SEALS
00 01 10	TABLE OF CONTENTS
00 10 00	INVITATION TO BID
00 20 00	INSTRUCTIONS TO BIDDERS
00 22 00	SUPPLEMENTARY INSTRUCTIONS TO BIDDERS
00 24 00	PROPOSAL FORM
00 25 00	ATTACHMENT A TO PROPOSAL FORM
00 50 00	STANDARD FORM OF AGREEMENT OWNER/CONTRACTOR AIA A101-2017
00 72 00	GENERAL CONDITIONS OF THE CONTRACT AIA A201-2017
00 73 00	SUPPLEMENTARY PROJECT CONDITIONS

#### DIVISION 01 – GENERAL REQUIREMENTS

01 10 00	SUMMARY
01 23 00	ALTERNATES
01 25 00	SUBSTITUTION PROCEDURES
01 26 00	CONTRACT MODIFICATION PROCEDURES
01 29 00	PAYMENT PROCEDURES
01 31 00	PROJECT MANAGEMENT AND COORDINATION
01 32 00	CONSTRUCTION PROGRESS DOCUMENTATION
01 33 00	SUBMITTAL PROCEDURES
01 35 16	ALTERATION PROJECT PROCEDURES
01 40 00	QUALITY REQUIREMENTS
01 42 00	REFERENCES
01 43 39	MOCKUPS
01 45 29	STRUCTURAL TESTING AND INSPECTIONS
01 50 00	TEMPORARY FACILITIES AND CONTROLS
01 60 00	PRODUCT REQUIREMENTS
01 73 00	EXECUTION
01 77 00	CLOSEOUT PROCEDURES
01 78 23	OPERATION AND MAINTENANCE DATA
01 78 39	PROJECT RECORD DOCUMENTS
01 79 00	DEMONSTRATION AND TRAINING

#### DIVISION 02 – EXISTING CONDITIONS

NOT ISSUED

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 03 – CONCRETE**

03 10 00	CONCRETE FORMING AND ACCESSORIES		
03 20 00	CONCRETE REINFORCING		
03 30 00	CAST IN PLACE CONCRETE		
03 35 43	POLISHED CONCRETE FINISHING		
03 41 34	PRECAST PRETENSIONED CONCRETE SEATING UNITS		
03 45 00	PRECAST ARCHITECTURAL CONCRETE		

**DIVISION 04 – MASONRY**

04 20 00	UNIT MASONRY		
04 21 13.23	ADHERED BRICK VENEER		

**DIVISION 05 – METALS**

05 12 00	STRUCTURAL STEEL FRAMING		
05 31 00	STEEL DECKING		
05 40 00	COLD-FORMED METAL FRAMING		
05 45 00	METAL SUPPORT ASSEMBLIES		
05 50 00	METAL FABRICATIONS		
05 51 13	METAL PAN STAIRS		
05 51 16	METAL FLOOR PLATE STAIRS		
05 51 19	METAL GRATING STAIRS		
05 52 13	PIPE AND TUBE RAILINGS		
05 53 13	BAR GRATINGS		
05 70 00	DECORATIVE METAL		
05 70 10	VISION BARRIERS		
05 73 13	GLAZED DECORATIVE METAL RAILINGS		
05 75 00	DECORATIVE FORMED METAL		

**DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES**

06 10 00	ROUGH CARPENTRY		
06 20 00	FINISH CARPENTRY		
06 40 00	ARCHITECTURAL WOODWORK		
06 42 16	FLUSH WOOD PANELING		
06 65 00	SOLID SURFACE FABRICATIONS		

**DIVISION 07 – MOISTURE PROTECTION**

07 11 13	BITUMINOUS DAMPROOFING		
07 13 26	SHEET WATERPROOFING		
07 18 00	TRAFFIC COATINGS		
07 21 00	THERMAL INSULATION		
07 26 16	BELOW-GRADE VAPOR RETARDERS		
07 27 26	FLUID-APPLIED MEMBRANE AIR BARRIERS		

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
07 42 13	INSULATED METAL WALL PANELS		
07 42 93	SOFFIT PANELS		
07 46 46	FIBER-CEMENT SIDING		
07 54 19	PVC MEMBRANE ROOFING		
07 62 00	SHEET METAL FLASHING AND TRIM		
07 71 00	ROOF SPECIALTIES		
07 72 00	ROOF ACCESSORIES		
07 76 00	ROOF PAVER AND PEDESTAL SYSTEM		
07 81 00	APPLIED FIRE PROTECTION		
07 81 23	INTUMESCENT FIRE PROTECTION		
07 82 00	BOARD FIRE PROTECTION		
07 84 13	PENETRATION FIRESTOPPING		
07 84 43	JOINT FIRESTOPPING		
07 91 00	PREFORMED PRECAST SEATING BOWL JOINT TREATMENTS		
07 92 00	JOINT SEALANTS		
07 95 00	EXPANSION CONTROL		

**DIVISION 08 – OPENINGS**

08 11 13	HOLLOW METAL DOORS AND FRAMES
08 14 16	FLUSH WOOD DOORS
08 31 13	ACCESS DOORS AND FRAMES
08 33 13	COILING COUNTER SHUTTERS
08 33 23	OVERHEAD COILING DOORS
08 41 13	ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
08 44 13	GLAZED ALUMINUM CURTAIN WALLS
08 51 13	ALUMINUM WINDOWS
08 56 53	SECURITY WINDOWS

**VOLUME 2**

08 71 00	DOOR HARDWARE
08 80 00	GLAZING
08 81 13	DECORATIVE GLASS GLAZING
08 83 00	MIRRORS
08 88 53	SECURITY GLAZING
08 91 19	FIXED LOUVERS

**DIVISION 09 – FINISHES**

09 21 16.23	GYPSUM BOARD SHAFT WALL ASSEMBLIES
09 22 16	NON-STRUCTURAL METAL FRAMING
09 29 00	GYPSUM BOARD
09 30 13	TILE
09 51 00	SUSPENDED CEILING SYSTEMS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
09 61 13	FLOOR SEALERS		
09 61 23	HAZARD STRIPING		
09 65 13	RESILIENT BASE AND ACCESSORIES		
09 65 16	RESILIENT SHEET FLOORING		
09 65 19	RESILIENT TILE FLOORING		
09 66 23	RESINOUS MATRIX TERRAZZO FLOORING		
09 67 23	RESINOUS FLOORING		
09 68 00	CARPETING		
09 69 00	ACCESS FLOORING		
09 72 00	WALL COVERINGS		
09 72 19	GRAPHICS WALL COVERINGS		
09 84 33	SOUND-ABSORBING WALL UNITS		
09 84 36	SOUND-ABSORBING CEILING UNITS		
09 91 13	EXTERIOR PAINTING		
09 91 23	INTERIOR PAINTING		
09 93 00	STAINING AND TRANSPARENT FINISHING		
09 96 00	HIGH-PERFORMANCE COATINGS		

**DIVISION 10 – SPECIALTIES**

10 11 00	VISUAL DISPLAY UNITS
10 12 00	DISPLAY CASES
10 14 00	SIGNAGE
10 21 13.14	STAINLESS STEEL TOILET COMPARTMENTS
10 21 16	SHOWER AND DRESSING COMPARTMENTS
10 22 26.13	ACCORDION FOLDING PARTITIONS
10 22 29	UPFOLDING PANEL PARTITIONS
10 22 39	FOLDING PANEL PARTITIONS
10 26 00	WALL AND DOOR PROTECTION
10 28 00	TOILET, BATH, AND LAUNDRY ACCESSORIES
10 28 19	TUB AND SHOWER ENCLOSURES
10 35 00	FLAGPOLES
10 43 13	DEFIBRILLATOR CABINETS
10 43 14	AUTOMATED EXTERNAL DEFIBRILLATORS
10 44 13	FIRE PROTECTION CABINETS
10 44 16	FIRE EXTINGUISHERS
10 51 13	METAL LOCKERS
10 51 19	PHENOLIC LOCKERS
10 51 20	CUSTOM WOOD LOCKERS
10 53 00	WALKWAY COVERS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 11 – EQUIPMENT**

11 13 13	LOADING DOCK BUMPERS
11 13 16	LOADING DOCK SEALS AND SHELTERS
11 13 19	STATIONARY LOADING DOCK EQUIPMENT
11 23 00	COMMERCIAL LAUNDRY EQUIPMENT
11 31 00	RESIDENTIAL APPLIANCES
11 40 00	FOOD SERVICE EQUIPMENT
11 47 00	ICE MACHINES
11 61 00	THEATER AND STAGE EQUIPMENT
11 61 43	STAGE CURTAINS
11 61 44	HALF-HOUSE CURTAINS
11 61 53	ARENA CURTAINS
11 82 26	FACILITY WASTE COMPACTORS

**DIVISION 12 – FURNISHINGS**

12 22 00	CURTAINS AND DRAPES
12 36 16	METAL COUNTERTOPS
12 48 13	ENTRANCE FLOOR MATS AND FRAMES
12 63 26	ARENA SEATS
12 66 00	TELESCOPING STANDS
12 66 23	PORTABLE PLATFORMS

**DIVISION 13 – SPECIAL CONSTRUCTION**

13 17 00	HYDROTHERAPY EQUIPMENT, POOLS, AND TUBS
13 18 11	ICE RINK GENERAL REQUIREMENTS
13 18 12	ICE RINK REFRIGERATION SYSTEM
13 18 13	ICE RINK FLOOR SYSTEM
13 18 14	ICE RINK PIPING, VALVES, AND ACCESSORIES
13 18 15	ICE RINK WASTE HEAT RECOVERY SYSTEM
13 18 16	ICE RINK DASHER BOARD SYSTEM AND ACCESSORIES

**VOLUME 3**

13 18 17	ICE RINK CENTRAL CONTROL SYSTEM
13 18 19	ICE RINK WATER TREATMENT SYSTEM
13 28 16	HOCKEY SAFETY NETTING SYSTEM

**DIVISION 14 – CONVEYING SYSTEMS**

14 21 00	GEARLESS MACHINE ROOM LESS TRACTION ELEVATORS
14 22 00	ELECTRIC TRACTION FREIGHT ELEVATORS
14 31 00	ESCALATORS
14 42 00	WHEELCHAIR LIFTS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 21 – FIRE SUPPRESSION**

21 00 00	TABLE OF CONTENTS AND SEAL		
21 00 10	GENERAL FIRE SUPPRESSION REQUIREMENTS		
21 05 00	COMMON WORK RESULTS FOR FIRE SUPPRESSION		
21 05 15	BASIC FIRE SUPPRESSION PIPING METHODS AND MATERIALS		
21 05 53	IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT		
21 11 00	FIRE SUPPRESSION WATER SERVICE PIPING		
21 12 00	FIRE SUPPRESSION STANDPIPES		
21 13 13	WATER BASED FIRE SUPPRESSION SYSTEMS		
21 31 13	ELECTRIC DRIVE CENTRIFUGAL PUMPS		

**DIVISION 22 – PLUMBING**

22 00 00	TABLE OF CONTENTS AND SEAL		
22 00 10	GENERAL PLUMBING REQUIREMENTS		
22 00 15	COORDINATION		
22 05 10	COMMON WORK RESULTS FOR PLUMBING		
22 05 13	COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT		
22 05 15	BASIC PIPING MATERIALS AND METHODS		
22 05 19	METERS AND GAUGES FOR PLUMBING PIPING		
22 05 23	GENERAL DUTY VALVES FOR PLUMBING PIPING		
22 05 29	HANGERS AND SUPPORTS FOR PLUMBING PIPING		
22 05 33	HEAT TRACING FOR PLUMBING PIPING		
22 05 50	VIBRATION ISOLATION FOR PLUMBING PIPING AND EQUIPMENT		
22 05 53	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT		
22 07 00	PLUMBING INSULATION		
22 11 00	WATER DISTRIBUTION PIPING AND SPECIALTIES		
22 11 11	MECHANICALLY JOINED PLUMBING PIPING SYSTEMS		
22 11 14	STAINLESS STEEL WATER DISTRIBUTION PIPING & SPECIALTIES		
22 11 23	DOMESTIC WATER PUMPS		
22 13 00	SANITARY DRAINAGE AND VENT PIPING & SPECIALTIES		
22 13 28	CONDENSATE PUMPS FOR HVAC EQUIPMENT		
22 14 00	STORM DRAINAGE PIPING AND SPECIALTIES		
22 14 89	SUMP PUMPS		
22 34 00	FUEL FIRED DOMESTIC WATER HEATERS		
22 40 00	PLUMBING FIXTURES		
22 70 00	NATURAL GAS SYSTEMS		

**DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING**

23 00 00	TABLE OF CONTENTS AND SEAL		
23 00 10	GENERAL MECHANICAL REQUIREMENTS		
23 00 15	ELECTRICAL COORDINATION FOR MECHANICAL EQUIPMENT		

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------



23 05 00	COMMON WORK RESULTS FOR HVAC
23 05 10	BASIC PIPING MATERIALS AND METHODS
23 05 13	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
23 05 14	VARIABLE FREQUENCY DRIVES
23 05 16	EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING
23 05 19	METERS AND GAUGES FOR HVAC PIPING
23 05 23	GENERAL DUTY VALVES FOR HVAC PIPING
23 05 29	HANGERS AND SUPPORTS FOR HVAC PIPING & EQUIPMENT
23 05 50	VIBRATION ISOLATION FOR HVAC
23 05 53	IDENTIFICATION FOR HVAC PIPING & EQUIPMENT
23 05 93	TESTING, ADJUSTING AND BALANCING FOR HVAC
23 07 00	HVAC INSULATION
23 08 00	COMMISSIONING OF HVAC SYSTEMS
23 09 13	INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
23 09 14	REFRIGERANT MONITORING SYSTEMS
23 09 23	DIRECT-DIGITAL CONTROL FOR HVAC
23 21 13	HYDRONIC PIPING
23 21 13.13	BURIED HYDRONIC AND STEAM PIPING
23 21 13.23	MECHANICALLY JOINED HYDRONIC PIPING SYSTEMS
23 21 14	HYDRONIC SPECIALTIES
23 21 23	HYDRONIC PUMPS
23 25 00	HVAC WATER TREATMENT
23 31 13	METAL DUCTS
23 33 00	AIR DUCT ACCESSORIES
23 34 23	HVAC POWER VENTILATORS
23 34 33	AIR CURTAINS
23 36 00	AIR TERMINAL UNITS
23 37 13	DIFFUSERS, REGISTERS AND GRILLES
23 51 00	BREECHES, CHIMNEYS AND STACKS
23 51 13	DRAFT CONTROL DEVICES
23 52 16	CONDENSING BOILERS
23 53 23	BOILER ACCESSORIES
23 64 16	CENTRIFUGAL WATER CHILLERS
23 65 00	COOLING TOWERS
23 72 00	AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

#### **VOLUME 4**

23 73 13	CENTRAL STATION AIR HANDLING UNITS
23 82 00	TERMINAL HEATING AND COOLING UNITS
23 84 14	SELF CONTAINED HUMIDIFIERS
23 84 17	DESICCANT WHEEL UNITS
23 84 19	HYDROTHERAPY AIR HANDLING UNITS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 26 – ELECTRICAL**

26 00 00	TABLE OF CONTENTS AND SEAL		
26 00 10	GENERAL ELECTRICAL REQUIREMENTS		
26 05 00	COMMON WORK RESULTS FOR ELECTRICAL		
26 05 02	EQUIPMENT WIRING SYSTEMS		
26 05 04	PROVISIONS FOR ELECTRIC UTILITY SERVICE		
26 05 19	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES		
26 05 26	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS		
26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS		
26 05 33	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS		
26 05 43	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS		
26 05 53	IDENTIFICATION FOR ELECTRICAL SYSTEMS		
26 05 73	POWER SYSTEM STUDIES		
26 09 10	CENTRALIZED DIMMING SYSTEM		
26 09 23	LIGHTING CONTROL DEVICES		
26 22 00	LOW-VOLTAGE TRANSFORMERS		
26 24 13	SWITCHBOARDS		
26 24 16	PANELBOARDS		
26 27 26	WIRING DEVICES		
26 28 13	FUSES		
26 28 16	ENCLOSED SWITCHES AND CIRCUIT BREAKERS		
26 32 13	PACKAGED ENGINE-DRIVEN GENERATORS		
26 33 53	STATIC UNINTERRUPTIBLE POWER SUPPLIES		
26 36 00	TRANSFER SWITCHES		
26 41 13	LIGHTNING PROTECTION FOR STRUCTURES		
26 43 13	SURGE PROTECTIVE DEVICES		
26 51 00	INTERIOR LIGHTING		
26 53 00	INDOOR ARENA LIGHTING		
26 56 00	EXTERIOR AREA LIGHTING		

**DIVISION 27 – COMMUNICATIONS (TECHNOLOGY)**

27 00 00	TABLE OF CONTENTS - COMMUNICATIONS		
27 05 00	COMMONWORK RESULTS FOR COMMUNICATIONS		
27 05 26	GROUNDING AND BONDING FOR COMMUNICATIONS		
27 05 28	PATHWAYS FOR COMMUNICATIONS		
27 05 43	UNDERGROUND PATHWAYS & STRUCTURES FOR COMMUNICATIONS SYSTEMS		
27 05 53	IDENTIFICATIONS FOR COMMUNICATIONS		
27 11 00	COMMUNICATIONS EQUIPMENT ROOM FITTINGS		
27 13 00	COMMUNICATIONS BACKBONE CABLING		
27 15 00	COMMUNICATIONS HORIZONTAL CABLING		
27 31 24	IP TELEPHONE SYSTEM		
27 32 44	EMERGENCY RESPONDER TESTING		

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
27 35 23	EMERGENCY RESPONDER RADIO COVERAGE		
27 60 00	NETWORK ELECTRONICS		
27 62 00	WIRELESS NETWORK SYSTEMS		

**DIVISION 27 – COMMUNICATIONS (AUDIO – VIDEO)**

27 00 01	TABLE OF CONTENTS AND SEAL – AUDIO-VIDEO
27 00 11	GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO - VIDEO
27 05 01	COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO - VIDEO
27 41 00	AUDIO VIDEO SYSTEMS
27 41 16	AUDIO VIDEO SYSTEMS EQUIPMENT
27 41 22	LARGE FORMAT DISPLAY SYSTEMS
27 41 33	TELEVISION DISTRIBUTION SYSTEM
27 41 51	BROADCAST SYSTEMS PRE-WIRE

**DIVISION 28 – ELECTRONIC SAFETY AND SECURITY**

28 00 00	TABLE OF CONTENTS (SECURITY)
28 05 00	BASIC SECURITY REQUIREMENTS
28 05 20	BASIC SECURITY MATERIALS AND METHODS
28 05 26	GROUNDING AND BONDING FOR SECURITY SYSTEMS
28 05 28	SECURITY SYSTEMS PATHWAYS AND SUPPORT EQUIPMENT
28 13 00	ACCESS CONTROL SOFTWARE AND DATABASE MANAGEMENT
28 15 00	ACCESS CONTROL HARDWARE DEVICES
28 15 23	INTERCOM ENTRY SYSTEM
28 23 00	VIDEO SURVEILLANCE CAMERA SYSTEMS
28 41 10	SECURITY CONTROL ROOM EQUIPMENT
28 45 00	TABLE OF CONTENTS AND SEAL (FIRE ALARM)
28 46 00	FIRE DETECTION AND ALARM

**VOLUME 5****DIVISION 31 – EARTHWORK**

02 06 13	GEOTECHNICAL REPORT - SEE APPENDIX
31 00 00	TABLE OF CONTENTS AND SEAL
31 00 00	EARTHWORK
31 11 00	CLEARING, GRUBBING AND DEMOLITION
31 22 00	SITE GRADING
31 23 23 23	SOIL COMPACTION CONTROL
31 40 00	SHORING AND UNDERPINNING
31 63 29	DRILL DISPLACEMENT CAST-IN-PLACE PILES
32 12 16	ASPHALT PAVING
32 13 13	CONCRETE PAVING, CURBS, AND WALKS
32 90 00	PLANTING
33 14 11	WATER SERVICE PIPING
33 30 00	SANITARY SEWERAGE

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
33 31 00	SANITARY SEWER COLLECTION SYSTEM		
33 40 00	STORMWATER UTILITIES		

**DIVISION 32 – EXTERIOR IMPROVEMENTS**

32 00 00	TABLE OF CONTENTS AND SEAL
32 13 13	CONCRETE PAVING
32 13 16	DECORATIVE CONCRETE PAVING
32 13 73	CONCRETE PAVING JOINT SEALANTS
32 14 00	UNIT PAVING
32 17 26	TACTILE WARNING SURFACING
32 31 16	WELDED WIRE FENCES AND GATES
32 31 19	DECORATIVE METAL FENCES AND GATES
32 31 19.53	DECORATIVE METAL SECURITY FENCES AND GATES
32 32 23	SEGMENTAL RETAINING WALLS
32 33 00	SITE FURNISHINGS
32 84 00	PLANTING IRRIGATION
32 84 23	IRRIGATION WORK
32 90 00	PLANTING (LANDSCAPE WORK)
32 90 05	LANDSCAPE MAINTENANCE
32 91 13	SOIL PREPARATION
32 92 00	TURF AND GRASSES
32 92 23	SODDING
32 93 00	PLANTS

**DIVISION 33 – UTILITIES**

REFER TO DIVISION 31 ABOVE

**APPENDIX**

GEOTECHNICAL REPORT DATED AUGUST 16, 2024 (from Geotechnical Engineering Testing, Inc.)  
AVAILABLE UPON REQUEST

END OF SECTION

**SECTION 08 71 00 - DOOR HARDWARE****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes commercial door hardware for the following:
1. Swinging doors.
  2. Sliding doors.
  3. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
1. Mechanical door hardware.
  2. Electromechanical door hardware.
  3. Cylinders specified for doors in other sections.
- C. Related Sections:
1. Division 08 Section "Hollow Metal Doors and Frames".
  2. Division 08 Section "Flush Wood Doors".
  3. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
  4. Division 28 Section "Access Control Hardware Devices".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  2. ICC/IBC - International Building Code.
  3. NFPA 70 - National Electrical Code.
  4. NFPA 80 - Fire Doors and Windows.
  5. NFPA 101 - Life Safety Code.
  6. NFPA 105 - Installation of Smoke Door Assemblies.
  7. TAS-201-94 - Impact Test Procedures.
  8. TAS-202-94 - Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components using Uniform Static Air Pressure.
  9. TAS-203-94 - Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.
  10. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
1. ANSI/BHMA Certified Product Standards - A156 Series.
  2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
  3. ANSI/UL 294 - Access Control System Units.
  4. UL 305 - Panic Hardware.

### 1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
  - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
  - 3. Content: Include the following information:
    - a. Type, style, function, size, label, hand, and finish of each door hardware item.
    - b. Manufacturer of each item.
    - c. Fastenings and other pertinent information.
    - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    - e. Explanation of abbreviations, symbols, and codes contained in schedule.
    - f. Mounting locations for door hardware.
    - g. Door and frame sizes and materials.
    - h. Warranty information for each product.
    - i. Operational narratives for electrified hardware.
  - 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
  - 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
    - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
  - 2. Point to Point Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
    - a. Complete (risers, point-to-point) access control system block wiring diagrams.
    - b. Wiring instructions for each electronic component scheduled herein.
  - 3. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
  - 4. Provide engineered diagrams specific to each opening. Individual wiring instructions shipped with devices are not considered a complete diagram.

- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
  - 1. Hurricane Resistant Openings: Exterior hurricane opening assemblies to be tested according to ASTM E330, ASTM E1886, ASTM E1996, TAS 201, TAS 202, TAS 203 standards, and certified by a qualified independent third party agency acceptable to authority having jurisdiction, with labeling indicating compliance with the design pressure and debris impact resistance level requirements specified for the Project.
  - 2. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.
- B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
  - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
  - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Hurricane Resistant Exterior Openings: Provide exterior door hardware as complete and tested assemblies, or component assemblies, including approved doors and frames specified under

Section 081113 "Hollow Metal Doors and Frames", to meet the design pressures, debris impact resistance, and glass and glazing requirements applicable to the Project.

1. Test units according to ASTM E330, ASTM E1886, ASTM E1996, TAS 201, TAS 202, and TAS 203 standards, certified by a qualified independent third party listing agency acceptable to authority having jurisdiction, and bearing a third party certification agency permanent label indicating windstorm approved product.
- G. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- H. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
1. Function of building, purpose of each area and degree of security required.
  2. Plans for existing and future key system expansion.
  3. Requirements for key control storage and software.
  4. Installation of permanent keys, cylinder cores and software.
  5. Address and requirements for delivery of keys.
- I. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
  2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
  3. Review sequence of operation narratives for each unique access controlled opening.
  4. Review and finalize construction schedule and verify availability of materials.
  5. Review the required inspecting, testing, commissioning, and demonstration procedures
- J. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

## **1.6 DELIVERY, STORAGE AND HANDLING**

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".



## 1.7 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

## 1.8 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
  - 1. Structural failures including excessive deflection, cracking, or breakage.
  - 2. Faulty operation of the hardware.
  - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: One year from date of Substantial Completion unless otherwise indicated.
- D. Special Warranty Periods:
  - 1. Ten years for mortise locks and latches.
  - 2. Five years for exit hardware.
  - 3. Twenty-five years for manual surface and overhead door closer bodies.
  - 4. Five years for motorized electric latch retraction exit devices.
  - 5. Two years for electromechanical door hardware and accessories.
  - 6. Two years for automatic power door operators.

## PART 2 - PRODUCTS

### 2.1 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
  - 1. Quantity: Provide the following hinge quantity:
    - a. Two Hinges: For doors with heights up to 60 inches.
    - b. Three Hinges: For doors with heights 61 to 90 inches.
    - c. Four Hinges: For doors with heights 91 to 120 inches.
    - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
  - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
  - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
  - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
  - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following:
  - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.
5. Manufacturers:
  - a. Hager Companies (HA)
  - b. dormakaba Stanley (ST).
  - c. McKinney (MK).

## 2.2 CONTINUOUS HINGES

- A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
  1. Manufacturers:
    - a. Hager Companies (HA).
    - b. Select Hinge (SL).
    - c. Pemko (PE).

## 2.3 SLIDING AND FOLDING HARDWARE

- A. Sliding and Folding Door Hardware: Hardware is to be of type and design as specified and should conform with ANSI/BHMA A156.14.
  1. Sliding Bi-Passing Pocket Door Hardware: Provide complete sets consisting of track, hangers, stops, bumpers, floor channel, guides, and accessories indicated.
  2. Manufacturers:
    - a. Hafele Manufacturing (HF).
    - b. Pemko (PE).
    - c. KN Crowder (KN).

## 2.4 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
  1. Manufacturers:

- a. Architectural Builders Hardware (AH) - PT1000-EZ Series.
  - b. Pemko (PE) - EL-CEPT Series.
  - c. Securitron (SU) - EL-CEPT Series.
- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
1. Provide one each of the following tools as part of the base bid contract:
    - a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
    - b. McKinney (MK) - Connector Hand Tool: QC-R003.
  2. Manufacturers:
    - a. McKinney (MK) - QC-C Series.

## 2.5 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.
1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
  2. Furnish dust proof strikes for bottom bolts.
  3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
  4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
  5. Manufacturers:
    - a. Burns Manufacturing (BU).
    - b. Rockwood (RO).
    - c. Trimco (TC).
- B. Coordinators: ANSI/BHMA A156.3 door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.
1. Manufacturers:
    - a. Burns Manufacturing (BU).
    - b. Rockwood (RO).
    - c. Trimco (TC).
- C. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
  2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
  3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
  4. Pulls, where applicable, shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.

5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
  6. Manufacturers:
    - a. Burns Manufacturing (BU).
    - b. Rockwood (RO).
    - c. Trimco (TC).
- D. Locking Pull System: Post-mount style door pulls with integrated deadbolt locking system in type and design as specified in the Hardware Sets. Pulls available in multiple head, floor, or combination locking options, with outside keyed rim cylinder operation and inside turn piece activation. Mounting applications for aluminum, glass, steel and wood doors, with customized sizing and configuration options. Locking pulls shall be provided with a 10" clearance from the finished floor on the cylinder side to accommodate wheelchair accessibility.
1. Manufacturers:
    - a. Blumcraft (BL).
    - b. dormakaba (DO).
    - c. Rockwood (RO).

## 2.6 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
1. Threaded mortise cylinders with rings and cams to suit hardware application.
  2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
  3. Tubular deadlocks and other auxiliary locks.
  4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
  5. Keyway: New Patented and Restricted Keyway.
- C. Large Format Interchangeable Cores: Provide removable cores (LFIC) as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.
- D. Security Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed security cylinders and keys able to be used together under the same facility master or grandmaster key system. Cylinders to be factory keyed.
1. New security key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
  2. Manufacturers:
    - a. Corbin Russwin (RU) - Access 3 AS.
    - b. Medeco (MC) - X4.
    - c. Sargent (SA) - Degree DG2.
    - d. Schlage (SC) - Everest 29 SL.
- E. Keying System: Each type of lock and cylinders to be factory keyed.
1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
  2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
  3. New System: Key locks to a new key system as directed by the Owner.

- F. Key Quantity: Provide the following minimum number of keys:
  - 1. Change Keys per Cylinder: Three (3).
  - 2. Master Keys (per Master Key Level/Group): Five (5).
  - 3. Construction Keys (where required): Ten (10).
  - 4. Construction Control Keys (where required): Two (2).
  - 5. Permanent Control Keys (where required): Two (2).
- G. Construction Keying: Provide temporary keyed construction cores.
- H. Key Registration List (Bitting List):
  - 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
  - 2. Provide transcript list in writing or electronic file as directed by the Owner.

## 2.7 KEY CONTROL

- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
  - 1. Manufacturers:
    - a. Lund Equipment (LU).
    - b. MMF Industries (MM).
    - c. Telkee (TK).

## 2.8 MORTISE LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.
  - 1. Manufacturers (Full Mortise Case):
    - a. Corbin Russwin Hardware (RU) - ML2000 Series.
    - b. Sargent Manufacturing (SA) - 8200 Series.
    - c. Schlage (SC) - L9000 Series.
  - 2. Manufacturers (Narrow Mortise Case):
    - a. Accurate Lock - 1700/M8700 Series.

## 2.9 MULTI-POINT LOCKS AND LATCHING DEVICES

- A. Multi-Point Locksets: Vertical rod locking devices designed for openings requiring multiple latching points within one locking mechanism. Listed manufacturers shall meet all functions and features as specified herein.
  - 1. Provide locksets with functions and features as follows:
    - a. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
    - b. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
    - c. Meets Florida Building Code FL2998 and UL Certification Directory ZHEM.R21744 for latching hardware for hurricane requirements.
  - 2. Manufacturers:
    - a. Corbin Russwin Hardware (RU) - MP9800 Series.
    - b. Sargent Manufacturing (SA) - 7000 Series.

**2.10 DEADLOCKS AND LATCHES**

- A. Mortise Deadlocks, Small Case: ANSI/BHMA A156.36, Grade 1, small case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. Steel or stainless steel bolts with a 1" throw and hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other specified locksets.
1. Manufacturers:
    - a. Corbin Russwin Hardware (RU) - DL4000 Series.
    - b. Sargent Manufacturing (SA) - 4870 Series.
    - c. Schlage (SC) - L460 Series.
  - B. Narrow Case Deadlocks and Deadlatches: ANSI/BHMA 156.13 Series 1000 Grade 1 narrow case deadlocks and deadlatches for swinging or sliding door applications. All functions shall be manufactured in a single sized case formed from 12 gauge minimum, corrosion resistant steel (option for fully stainless steel case and components). Provide minimum 2 7/8" throw laminated stainless steel bolt. Bottom rail deadlocks to have 3/8" diameter bolts.
    1. Manufacturers:
      - a. Adams Rite Manufacturing (AD) - MS1850S Series.

**2.11 LOCK AND LATCH STRIKES**

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  2. Custom Lip Strikes: For locks used on doors with overlapping astragals and frames with wood casing trim.
  3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
- B. Standards: Comply with the following:
1. Strikes for Mortise Locks and Latches: BHMA A156.13.
  2. Strikes for Auxiliary Deadlocks: BHMA A156.36.
  3. Dustproof Strikes: BHMA A156.16.

**2.12 CONVENTIONAL EXIT DEVICES**

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
1. Exit devices shall have a five-year warranty.
  2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
  3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
  4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
  5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
    - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    - b. Where function of exit device requires a cylinder (Rim or Mortise) as specified in Hardware Sets.
  7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
  8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
  9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
  10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
  11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
  12. Hurricane and Storm Shelter Compliance: Devices to be U.L. listed for windstorm assemblies where applicable. Provide the appropriate hurricane or storm shelter products that have been independently third party tested, certified, and labeled to meet state and local windstorm building codes applicable to project.
    - a. Meets Florida Building Code FL2998 and UL Certification Directory ZHEM.R21744 for latching hardware for hurricane requirements.
- B. Electromechanical Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.
1. Electromechanical exit devices shall have the following functions and features:
    - a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12VDC to 24VDC regulated.
    - b. Wire routing for all non-access control electromechanical functions.
    - c. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar
  1. Manufacturers:
    - a. Corbin Russwin Hardware (RU) - PED4000 / PED5000 Series.
    - b. Sargent Manufacturing (SA) - PE80 Series.
    - c. Von Duprin (VD) - 35A/98 XP Series.
- C. Steel Removable Mullions: ANSI/BHMA A156.3 steel removable mullions with options for fire rating, locking, through-wire electrification and hurricane compliance as specified.
1. Provide mullions with functions and features as follows:
    - a. At openings designed for severe wind load conditions due to hurricanes or tornadoes, provide manufacturer's certified mullion and accessories to meet applicable state and local windstorm codes.
    - b. Provide keyed removable feature where specified in the Hardware Sets.
    - c. Provide stabilizers and mounting brackets as required.
  2. Manufacturers:
    - a. Same as exit device manufacturer.

## 2.13 SURFACE DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
  3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
  4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
  5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
  6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Heavy duty surface mounted door closers shall have a 30-year warranty.
  2. Manufacturers:
    - a. Corbin Russwin Hardware (RU) - DC6000 Series.
    - b. LCN Closers (LC) - 4040XP Series.
    - c. Sargent Manufacturing (SA) - 351 Series.

## 2.14 ELECTROMECHANICAL DOOR OPERATORS

- A. General: Provide low energy operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.
1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
- B. Standard: Certified ANSI/BHMA A156.19.
- C. Performance Requirements:
1. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
  2. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.
- D. Configuration: Surface mounted. Door operators to control single swinging and pair of swinging doors.
- E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline.
1. Normal Close Operation: Door can be used as a manual door with no damage to the operator. Closing provided by means of a spring and adjustable tension provided by means of a single screw.
  2. Power Assist Operation: Operator can be adjusted to lower the open forces when used manually. Power Assist will be active only while pushing or pulling the door and will allow the door to close when an opening force is no longer applied to the door.



3. Push-Pull-to-Activate programmable feature. Push or pull the door open from any position, and the door will gently power open, time out and slowly close.
- F. The swing door package consists of operator housing, swing power operator, electronic control, wire harnesses and connecting hardware.
- G. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.
- H. Provide on board modules and relays to allow for coordination of exit device latch retraction and blow open operator activation upon signal from the smoke evacuation system.
- I. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.
- J. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.
- K. Signage: Provide signage in accordance with ANSI/BHMA A156.19.
- L. Manufacturers (Surface/Overhead Concealed Operators): Subject to compliance with requirements, provide products by one of the following:
  1. Besam Automated Entrance Systems (BE) - SW200i Series.
  2. Horton Automatics (HO) - S4100LE Series.
  3. Norton Rixon (NO) - 6000 Series.
- M. Manufacturers (Actuator Switches and Bollards): Subject to compliance with requirements, provide products by one of the following:
  1. Wikk Industries (WK).
  2. BEA Security (BEA).

## 2.15 ARCHITECTURAL TRIM

- A. Door Protective Trim
  1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
  2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
  3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
  4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
    - a. Stainless Steel: 300 grade, 050-inch thick.
  5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
  6. Manufacturers:
    - a. Burns Manufacturing (BU).
    - b. Rockwood (RO).
    - c. Trimco (TC).

**2.16 DOOR STOPS AND HOLDERS**

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
  - 1. Manufacturers:
    - a. Burns Manufacturing (BU).
    - b. Rockwood (RO).
    - c. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
  - 1. Manufacturers:
    - a. Architectural Builders Hardware (AH).
    - b. Norton Rixson (RF).
    - c. Sargent (SA).

**2.17 ARCHITECTURAL SEALS**

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
  - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
  - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
  - 1. Pemko (PE).
  - 2. Reese Enterprises, Inc. (RE).
  - 3. Zero (ZE).

**2.18 ELECTRONIC ACCESSORIES**

- A. Door Position Switches (By Security System Provider with Prep by Door Hardware Provider): Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide DPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
- B. Door Position Switches (By Door Hardware Provider): Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide DPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
  - 1. Manufacturers:
    - a. Bosch (BH) - 1076D Series.
- C. Linear Power Supplies (By Door Hardware Provider): Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide capability for power distribution, direct locking control, and Fire Alarm Interface (FAI) through add on modules.
  - 1. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware.
  - 2. Manufacturers:
    - a. Altronix (AX) - Maximal 3 Series.
    - b. Securitron (SU) - AQD Series.

**2.19 FABRICATION**

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

**2.20 FINISHES**

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

### 3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

### 3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
  - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  - 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
  - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
  - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Power Operator products and accessories are required to be installed through by supplier of operator products.
- D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

### 3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
  - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

**3.5 ADJUSTING**

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

**3.6 CLEANING AND PROTECTION**

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

**3.7 DEMONSTRATION**

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

**3.8 DOOR HARDWARE SETS**

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- B. The door hardware sets are based on described door and hardware applications and may apply to multiple types of doors and locations. The hardware sets should be applied in conjunction with the door schedule, floor plans, and technology drawings for verification of quantities, sizes, materials, types, and applications.
  - 1. The supplier is responsible for verifying product quantities, handing, sizing, and custom options at each pair or single door application.
    - a. Hinges: Comply with Section 2.2(A) Hanging Devices for hinge quantities and sizes.
  - 2. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
  - 3. Fire Rated Hardware: If required, revise hardware sets to include the manufacturer's listed fire door hardware and comply with NFPA 80 standards at fire rated openings shown on life safety plans and door schedules.
  - 4. Manufacturer Abbreviations:
    - 1. MK - McKinney
    - 2. PE - Pemko
    - 3. SU - Securitron

4. RO - Rockwood
5. SA - SARGENT
6. AT - Accurate Lock
7. AD - Adams Rite
8. KA - Kaba Ilco
9. RF - Rixson
10. BM - Besam
11. ZE - Zero International
12. BH - Bosch
12. OT - Other

### Hardware Sets

#### **Set: 1.0**

Doors: 01.03.06A, 01.31.03A

Description: Pair ALUM - Grand Hall Vestibule - Panic/ELR (CR, DPS, Smoke Evac)

2 Elec Continuous Hinge	CFMxxSLF-HD1 PT	ALUM	PE
2 Electric Power Transfer	EL-CEPT	630	SU
1 ELR CVR Exit, Exit Only (rex)	55 56 ADPE8410 EO	US32D	SA
1 ELR CVR Exit, Nightlatch (rex)	DG264 55 56 ADPE8410 P106	US32D	SA
1 Perm Core	DG264 6300	US15	SA
2 Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US32D	RO
2 Auto Operator - Outswing	SW200i - Smoke Evac - Full Header	ALUM	BM
2 Wiring Harness (transfer/door)	QC-Cxxx		MK
2 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
2 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT
1 Power Supply - Smoke Evac	AQD Series x Battery Backup (amps, relays, as req'd)		OT
1 Power Supply	By Security Provider (ACS devices)		SU

Notes: Perimeter seal and astragal by aluminum door provider.

Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system.
2. Authorized access by card reader retracting exit device latch for predetermined time limit.
3. Request to exit switch in the push pad to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.
5. Keyed cylinder override for emergency access.

Smoke Evacuation Operation: Combine and provide least number of low voltage power supplies across the entire bank of Smoke Evac openings.

1. Door position switches to signal door open/closed to the smoke evacuation system.
2. Upon signal from smoke evacuation system exit device latches are electrically retracted and auto door operators activated to power open doors.
3. Door to remain open until smoke evacuation system is reset.
4. Smoke Evac power supply battery backup provides emergency power for low voltage electrified hardware during power loss.
5. Auto door operators (120V) require backup UPS for activation during power loss.

#### **Set: 2.0**

Doors: 01.27.13B, 01.ST-3C

Description: Ext Pair HM - Exit Stair - Panic/ELR (CR, DPS)

2 Elec Continuous Hinge	CFMxxHD1 PT	ALUM	PE
2 Electric Power Transfer	EL-CEPT	630	SU
1 Mullion	HCL980	PC	SA
1 Fail Secure Exit Device	DG264 HC 55 PE8876- NEMD	US32D	SA
1 Elec Rim Exit, Exit Only	HC 55 PE8810 EO	US32D	SA
1 Mullion Cylinder	DG264 980C1	US26D	SA
2 Perm Core	DG264 6300	US15	SA
2 Surf Overhead Stop	9-x36	630	RF
2 Surface Closer (OHS arm)	351 PD10	EN	SA
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
2 Astragal	18061CNB (both leaves)		PE
1 Mullion Gasketing	5110BL		PE
1 Gasketing (head)	2891APK		PE
2 Gasketing (jambs)	290APK		PE
2 Sweep	315CN		PE
1 Threshold	2005AV		PE
2 Wiring Harness (transfer/door)	QC-Cxxx		MK
2 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
2 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Install perimeter seal prior to closer, stops, and strikes. Special templating required.

Operation:

1. Doors normally closed and secure.
2. Authorized access by card reader releasing lever trim for predetermined time limit.
3. Request to exit switch in the push pad to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.
5. Exit device trim remains locked (fail secure) in event of power loss. Keyed cylinder override for emergency access.

**Set: 3.0**

Doors: 01.12.14A, 01.14.05A

Description: Ext Pair ALUM - Player/VIP, Staff Entry - Panic/ELR (CR, DPS)

2 Elec Continuous Hinge	CFMxxSLF-HD1 PT	ALUM	PE
2 Electric Power Transfer	EL-CEPT	630	SU
1 ELR CVR Exit, Exit Only (rex)	55 56 ADPE8410 EO	US32D	SA
1 ELR CVR Exit, Nightlatch (rex)	DG264 55 56 ADPE8410 P106	US32D	SA
1 Perm Core	DG264 6300	US15	SA
2 Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US32D	RO
2 Conc Overhead Stop	1ADJ-x36	630	RF
2 Surface Closer	351 P10	EN	SA
2 Drop Plate	351D	EN	SA
2 Blade Stop Kit	581-2	EN	SA
2 Sweep	315CN		PE
1 Threshold	2005AV		PE

2 Wiring Harness (transfer/door)	QC-Cxxx	MK
2 Wiring Harness (trasfer/jbox)	QC-CxxxxP	MK
1 Card Reader	By Security Provider	OT
2 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)	SU
1 Power Supply - Low Voltage	By Security Provider	OT

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Perimeter seal and astragal by aluminum door provider.

Operation:

1. Doors normally closed and secure.
2. Authorized access by card reader retracting exit device latch for predetermined time limit. Exit device latch can be electrically held retracted for open access.
3. Request to exit switch in the push pad to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.
5. Exit device latch releases (fail secure) in event of power loss. Keyed cylinder override for emergency access.

**Set: 4.0 (NOT USED)**

**Set: 5.0**

Doors: 01.22.02C

Description: Ext Sgl HM - Loading Dock Exit - Panic/FSE (CR, IC, DPS)

1 Elec Continuous Hinge	CFMxxHD1 PT	ALUM	PE
1 Electric Power Transfer	EL-CEPT	630	SU
1 Fail Secure Exit Device	DG264 HC 55 PE8876- NEMD	US32D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surf Overhead Stop	9-x36	630	RF
1 Surface Closer (OHS arm)	351 PD10	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Rain Guard	346C		PE
1 Gasketing (head / jambs)	2891APK		PE
1 Sweep	315CN		PE
1 Threshold	2005AV		PE
1 Wiring Harness (transfer/door)	QC-Cxxx		MK
1 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Intercom Unit	By Security Provider		OT
1 Power Supply - Low Voltage	By Security Provider		OT

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Install perimeter seal prior to closer, stops, and strike. Special templating required.

Operation:

1. Door electrically unlocked or locked during established time zones as programmed by the access control system. When outside lever is locked the card reader grants access upon presentation of a valid credential. Lever locked during power failure with a mechanical key override entry.



2. Egress always free from inside by depressing inside push bar.
3. Request to exit switch in push bar to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 6.0**

Doors: 01.23.05A

Description: Ext Sgl HM - Security Office - Elec Lock DL/FSE (CR)

1 Elec Continuous Hinge	CFMxxHD1 PT	ALUM	PE
1 Electric Power Transfer	EL-CEPT	630	SU
1 Fail Secure Lock/DL	DG264 NAC-82280- LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 CPS	EN	SA
1 Gasketing (head)	2891APK		PE
2 Gasketing (jambs)	290APK		PE
1 Sweep	315CN		PE
1 Threshold	2005AV		PE
1 Wiring Harness (transfer/door)	QC-Cxxx		MK
1 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Install perimeter seal prior to closer. Special templating required.

Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When outside lever is locked the card reader grants access upon presentation of a valid credential. Lockset lock during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside lever.
3. Request to exit switch in lever to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 6.5**

Doors: 01.04.11A

Description: Ext Sgl ALUM - Staff Entry - Push/Pull/DL (DPS)

1 Continuous Hinge	CFMxxSLF-HD1	ALUM	PE
1 Header Bolt	4085-0x-IB	US2G	AD
1 Threshold Bolt	4015-18-IB	603	AD
1 Mortise Deadlock	MS1850S 4089	628	AD
1 Mortise Cylinder	DG264 41 (length, cam, collar as req'd)	US32D	SA
1 Perm Core	DG264 6300	US15	SA
1 Thumbturn Cylinder	ADA7201	26D	KA
1 Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US32D	RO
1 Push Bar	RM3112 Mtg-Type 6HD	US32D	RO
1 Surface Closer	351 P10	EN	SA
1 Drop Plate	351D	EN	SA
1 Blade Stop Kit	581-2	EN	SA
1 Floor Stop	481(H)	US26D	RO

1 Sweep	315CN	PE
1 Threshold	2005AV	PE
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)	SU

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Perimeter seal by aluminum door provider.

Operation:

1. Door position switch to signal door open/closed to the access control system.

**Set: 7.0**

Doors: 01.03.06F, 01.03.06G, 01.03.06H, 01.15.05E, 01.15.05F, 01.15.05H, 01.15.05L, 01.31.03G, 01.31.03H

Description: Ext Pair ALUM - Grand Hall Entrance - Panic/EO (DPS - Smoke Evac)

2 Elec Continuous Hinge	CFMxxSLF-HD1 PT	ALUM	PE
2 Electric Power Transfer	EL-CEPT	630	SU
2 ELR CVR Exit, Exit Only	56 ADPE8410 EO	US32D	SA
2 Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US32D	RO
2 Auto Operator - Outswing	SW200i - Smoke Evac - Full Header	ALUM	BM
2 Sweep	315CN		PE
1 Threshold	2005AV		PE
2 Wiring Harness (transfer/door)	QC-Cxxx		MK
2 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
2 Door Position Switch	1076D		BH
1 Power Supply - Smoke Evac	AQD Series x Battery Backup (amps, relays, as req'd)		OT

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Perimeter seal and astragal by aluminum door provider.

Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system.

Smoke Evacuation Operation: Combine and provide least number of low voltage power supplies across the entire bank of Smoke Evac openings.

1. Door position switches to signal door open/closed to the smoke evacuation system.
2. Upon signal from smoke evacuation system exit device latches are electrically retracted and auto door operators activated to power open doors.
3. Door to remain open until smoke evacuation system is reset.
4. Smoke Evac power supply battery backup provides emergency power for low voltage electrified hardware during power loss.
5. Auto door operators (120V) require backup UPS for activation during power loss.

**Set: 7.1**

Doors: 01.07.01A, 01.09.01A, 01.09.01B, 01.10.01A, N/A - 5651512

Description: Ext Pair ALUM - Ballroom Exit - Panic/EO (DPS)

2 Continuous Hinge	CFMxxSLF-HD1	ALUM	PE
--------------------	--------------	------	----

2	CVR Exit, Exit Only	DG264 16 ADPE8410 EO	US32D	SA
2	Perm Core	DG264 6300	US15	SA
2	Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US32D	RO
2	Conc Overhead Stop	1ADJ-x36	630	RF
2	Surface Closer	351 P10	EN	SA
2	Drop Plate	351D	EN	SA
2	Blade Stop Kit	581-2	EN	SA
2	Sweep	315CN		PE
1	Threshold	2005AV		PE
2	Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Perimeter seal and astragal by aluminum door provider.

Operation:

1. Door position switch to signal door open/closed to the access control system.

**Set: 8.0**

Doors: 01.03.06E, 01.31.03F

Description: Ext Pair ALUM - Grand Hall Entrance - Panic/NL (DPS, Smoke Evac)

2	Elec Continuous Hinge	CFMxxSLF-HD1 PT	ALUM	PE
2	Electric Power Transfer	EL-CEPT	630	SU
1	ELR CVR Exit, Exit Only	56 ADPE8410 EO	US32D	SA
1	ELR CVR Exit, Nightlatch	DG264 56 ADPE8410 P106	US32D	SA
1	Perm Core	DG264 6300	US15	SA
2	Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US32D	RO
2	Auto Operator - Outswing	SW200i - Smoke Evac - Full Header	ALUM	BM
2	Sweep	315CN		PE
1	Threshold	2005AV		PE
2	Wiring Harness (transfer/door)	QC-Cxxx		MK
2	Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
2	Door Position Switch	1076D		BH
1	Power Supply - Smoke Evac	AQD Series x Battery Backup (amps, relays, as req'd)		OT

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Perimeter seal and astragal by aluminum door provider.

Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system.
2. Keyed cylinder override for emergency access.

Smoke Evacuation Operation: Combine and provide least number of low voltage power supplies across the entire bank of Smoke Evac openings.

1. Door position switches to signal door open/closed to the smoke evacuation system.
2. Upon signal from smoke evacuation system exit device latches are electrically retracted and auto door operators activated to power open doors.
3. Door to remain open until smoke evacuation system is reset.

4. Smoke Evac power supply battery backup provides emergency power for low voltage electrified hardware during power loss.
5. Auto door operators (120V) require backup UPS for activation during power loss.

**Set: 9.0**

Doors: 02.04.04B, 02.12.03B, 02.27.06B, 02.29.05B

Description: Ext Pair ALUM - Roof Top Terrace Exit - Panic/Passage (Inswing DPS)

2	Continuous Hinge	CFMxxSLF-HD1	ALUM	PE
2	CVR Exit, Passage	ADPE8415 NEMD	US32D	SA
2	Conc Overhead Stop	1ADJ-x36	630	RF
2	Surface Closer	351 O	EN	SA
2	Sweep	315CN		PE
1	Threshold (6" solid flat)	2716A		PE
2	Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Perimeter seal and astragal by aluminum door provider. Install door sweep on interior side of door flush with threshold.

Operation:

1. Door position switch to signal door open/closed to the access control system.

**Set: 10.0**

Doors: 01.28.10

Description: Ext Pair ALUM - Box Office/Ticket Vestibule - Push/Pull/DL (DPS)

2	Continuous Hinge	CFMxxSLF-HD1	ALUM	PE
1	Header Bolt	4085-0x-IB	US2G	AD
1	Threshold Bolt	4015-18-IB	603	AD
1	Flush Bolt	MS2180	119	AD
1	Lever	4550-xx	130	AD
1	Mortise Deadlock	MS1850S 4089	628	AD
1	Mortise Cylinder	DG264 41 (length, cam, collar as req'd)	US32D	SA
1	Perm Core	DG264 6300	US15	SA
2	Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US32D	RO
2	Push Bar	RM3112 Mtg-Type 6HD	US32D	RO
2	Conc Overhead Stop	1ADJ-x36	630	RF
2	Surface Closer	351 P10	EN	SA
2	Drop Plate	351D	EN	SA
2	Blade Stop Kit	581-2	EN	SA
2	Sweep	315CN		PE
1	Threshold	2005AV		PE
2	Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Perimeter seal and astragal by aluminum door provider.

Operation:

1. Door position switch to signal door open/closed to the access control system.

**Set: 11.0**

Doors: 01.07.03A

Description: Ext Sgl ALUM - Ballroom Exit - Panic/EO (DPS)

1	Continuous Hinge	CFMxxSLF-HD1	ALUM	PE
1	CVR Exit, Exit Only	DG264 16 ADPE8410 EO	US32D	SA
1	Perm Core	DG264 6300	US15	SA
1	Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US32D	RO
1	Conc Overhead Stop	1ADJ-x36	630	RF
1	Surface Closer	351 P10	EN	SA
1	Drop Plate	351D	EN	SA
1	Blade Stop Kit	581-2	EN	SA
1	Sweep	315CN		PE
1	Threshold	2005AV		PE
1	Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Perimeter seal by aluminum door provider.

Operation:

1. Door position switch to signal door open/closed to the access control system.

**Set: 12.0**

Doors: 02.10.03B

Description: Ext Sgl ALUM - Roof Top Terrace Exit - Panic/Passage (Inswing DPS)

1	Continuous Hinge	CFMxxSLF-HD1	ALUM	PE
1	CVR Exit, Passage	ADPE8415 NEMD	US32D	SA
1	Conc Overhead Stop	1ADJ-x36	630	RF
1	Surface Closer	351 O	EN	SA
1	Sweep	315CN		PE
1	Threshold (6" solid flat)	2716A		PE
1	Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Perimeter seal by aluminum door provider.

Operation:

1. Door position switch to signal door open/closed to the access control system.

**Set: 13.0**

Doors: 01.03.06B, 01.03.06C, 01.03.06D, 01.31.03B, 01.31.03E, N/A - 10617092, N/A - 5651672

Description: Pair ALUM - Grand Hall Vestibule - Panic/ELR (REX, DPS, Smoke Evac)

2	Elec Continuous Hinge	CFMxxSLF-HD1 PT	ALUM	PE
2	Electric Power Transfer	EL-CEPT	630	SU

2	ELR CVR Exit, Exit Only (rex)	55 56 ADPE8410 EO	US32D	SA
2	Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US32D	RO
2	Auto Operator - Outswing	SW200i - Smoke Evac - Full Header	ALUM	BM
2	Wiring Harness (transfer/door)	QC-Cxxx		MK
2	Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
2	Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1	Power Supply - Smoke Evac	AQD Series x Battery Backup (amps, relays, as req'd)		OT

Notes: Perimeter seal and astragal by aluminum door provider.

Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system.
2. Request to exit switch in push bar to signal authorized egress to the access control system.
3. Door position switches monitor open/closed status to the access control system.

Smoke Evacuation Operation: Combine and provide least number of low voltage power supplies across the entire bank of Smoke Evac openings.

1. Door position switches to signal door open/closed to the smoke evacuation system.
2. Upon signal from smoke evacuation system exit device latches are electrically retracted and auto door operators activated to power open doors.
3. Door to remain open until smoke evacuation system is reset.
4. Smoke Evac power supply battery backup provides emergency power for low voltage electrified hardware during power loss.
5. Auto door operators (120V) require backup UPS for activation during power loss.

**Set: 14.0**

Doors: 02.04.04A, 02.12.03A, 02.27.06A, 02.29.05A

Description: Pair ALUM - Roof Top Terrace Vestibule - Panic/Class

2	Continuous Hinge	CFMxxSLF-HD1	ALUM	PE
2	CVR Exit, Classroom	DG264 ADPE8613 NEMD	US32D	SA
2	Perm Core	DG264 6300	US15	SA
2	Conc Overhead Stop	1ADJ-x36	630	RF
2	Surface Closer	351 P10	EN	SA
2	Drop Plate	351D	EN	SA
2	Blade Stop Kit	581-2	EN	SA
2	Sweep	315CN		PE

Notes: Perimeter seal and astragal by aluminum door provider.

**Set: 15.0**

Doors: 01.27.10, 01.ST-1C, 01.ST-2A, 01.ST-2B, 01.ST-3D, 01-ST1D

Description: Ext Pair HM - Stair Core - Panic/EO (REX, DPS)

2	Elec Continuous Hinge	CFMxxHD1 PT	ALUM	PE
2	Electric Power Transfer	EL-CEPT	630	SU
1	Mullion	HCL980	PC	SA
2	Elec Rim Exit, Exit Only	HC 55 PE8810 EO	US32D	SA
1	Mullion Cylinder	DG264 980C1	US26D	SA
1	Perm Core	DG264 6300	US15	SA
1	Surf Overhead Stop	9-x36	630	RF
2	Surface Closer (OHS arm)	351 PD10	EN	SA
2	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO

2	Astragal	18041CNB (both leaves)	PE
1	Rain Guard	346C	PE
1	Mullion Gasketing	5110BL	PE
1	Gasketing (head)	2891APK	PE
2	Gasketing (jambs)	290APK	PE
2	Sweep	315CN	PE
1	Threshold	2005AV	PE
1	Wiring Harness (transfer/door)	QC-Cxxx	MK
1	Wiring Harness (trasfer/jbox)	QC-CxxxxP	MK
2	Door Position Switch	By Security Provider (prep by Dr/Frm mfr)	SU

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Install perimeter seal prior to closer, stops, and strikes. Special templating required.

Operation:

1. Door position switch to signal door open/closed to the access control system.
2. Request to exit switch in push bar to signal authorized egress to the access control system.

**Set: 16.0**

Doors: 01.01.03M

Description: Ext Pair HM - Refrigeration Rm - Panic/Store (DPS)

2	Continuous Hinge	CFMxxHD1	ALUM	PE
1	Mullion	HCL980	PC	SA
1	Rim Exit, Exit Only	HC PE8810 EO	US32D	SA
1	Rim Exit, Storeroom	DG264 HC PE8804 NEMD	US32D	SA
1	Mullion Cylinder	DG264 980C1	US26D	SA
2	Perm Core	DG264 6300	US15	SA
2	Surf Overhead Hold Open	9-x26	630	RF
2	Surface Closer (OHS arm)	351 PD10	EN	SA
2	Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
2	Astragal	18061CNB (both leaves)		PE
1	Rain Guard	346C		PE
1	Mullion Gasketing	5110BL		PE
1	Gasketing (head)	2891APK		PE
2	Gasketing (jambs)	290APK		PE
2	Sweep	315CN		PE
1	Threshold	2005AV		PE
2	Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Install perimeter seal prior to closer and strikes. Special templating required.

Operation:

1. Door position switch to signal door open/closed to the access control system.

**Set: 17.0**

Doors: 02.01.04, 04.21.01A, 04.21.01B

Description: Ext Pair HM - Roof Access - Storeroom (DPS)

2	Continuous Hinge	CFMxxSLF-HD1	ALUM	PE
2	Surface Bolt	988		SA
1	Storeroom Lock	DG264 7/8" Lip Length 8204 LNMD	US26D	SA
1	Perm Core	DG264 6300	US15	SA
2	Surface Closer	351 CPS	EN	SA
2	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1	Astragal	43SP (paint to match door)		ZE
1	Rain Guard	346C		PE
1	Gasketing (head)	2891APK		PE
2	Gasketing (jambs)	290APK		PE
2	Sweep	315CN		PE
1	Threshold	2005AV		PE
2	Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Install keyed cylinder on interior side of opening. Install perimeter seal prior to closer. Special templating required. Mount astragal on pull side of active leaf and size doors for 1/8" clearance between leaves.

Operation:

1. Door position switch to signal door open/closed to the access control system.

**Set: 18.0**

Doors: 01.06.06, 01.27.12

Description: Ext Pair HM - Fire Water Entry - Dormitory (DPS)

2	Continuous Hinge	CFMxxHD1	ALUM	PE
2	Surface Bolt	988		SA
1	Dormitory/Exit Lock	LB DG264 7/8" Lip Length 8245 LNMD	US26D	SA
1	Perm Core	DG264 6300	US15	SA
2	Surf Overhead Hold Open	9-x26	630	RF
2	Surface Closer (OHS arm)	351 PD10	EN	SA
2	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1	Astragal	43SP (paint to match door)		ZE
1	Rain Guard	346C		PE
1	Gasketing (head)	2891APK		PE
2	Gasketing (jambs)	290APK		PE
2	Sweep	315CN		PE
1	Threshold	2005AV		PE
2	Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Install perimeter seal prior to closer. Special templating required. Install astragal on pull side of active leaf and size doors for no more than 1/8" gap clearance between doors.

Operation:

1. Door position switch to signal door open/closed to the access control system



**Set: 19.0**

Doors: 01.22.02

Description: Ext Sgl HM - Loading Dock - Panic/FSE (CR, DPS)

1 Elec Continuous Hinge	CFMxxHD1 PT	ALUM	PE
1 Electric Power Transfer	EL-CEPT	630	SU
1 Fail Secure Exit Device	DG264 HC 55 PE8876- NEMD	US32D	SA
1 Surf Overhead Stop	9-x36	630	RF
1 Surface Closer (OHS arm)	351 PD10	EN	SA
1 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1 Rain Guard	346C		PE
1 Gasketing (head / jambs)	2891APK		PE
1 Sweep	315CN		PE
1 Threshold	2005AV		PE
1 Wiring Harness (transfer/door)	QC-Cxxx		MK
1 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Install perimeter seal at head and jamb prior to closer, stop, and strike. Special templating required.

Operation:

1. Door electrically unlocked or locked during established time zones as programmed by the access control system. When outside lever is locked the card reader grants access upon presentation of a valid credential. Lever mechanically locked during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing push pad.
3. Request to exit switch in push pad to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 20.0**

Doors: 01.28.07B

Description: Ext Sgl HM - Chiller - Panic/Storeroom (DPS)

1 Continuous Hinge	CFMxxHD1	ALUM	PE
1 Rim Exit, Storeroom	DG264 HC PE8804 NEMD	US32D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surf Overhead Stop	9-x36	630	RF
1 Surface Closer (OHS arm)	351 PD10	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Rain Guard	346C		PE
1 Gasketing (head / jambs)	2891APK		PE
1 Sweep	315CN		PE
1 Threshold	2005AV		PE
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Install perimeter seal prior to closer and strike. Special templating required.

Operation:

1. Door position switch to signal door open/closed to the access control system.

**Set: 21.0**

Doors: 02.12.03C, 03.01.05, 04.00.00A, 04.00.00B

Description: Ext Sgl HM - Roof Access - Storeroom (DPS)

1	Continuous Hinge	CFMxxSLF-HD1	ALUM	PE
1	Storeroom Lock	DG264 8204 LNMD	US26D	SA
1	Perm Core	DG264 6300	US15	SA
1	Surface Closer	351 CPS	EN	SA
1	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1	Rain Guard	346C		PE
1	Gasketing (head)	2891APK		PE
1	Gasketing (jambs)	290APK		PE
1	Sweep	315CN		PE
1	Threshold	2005AV		PE
1	Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU

Notes: Exterior doors are required to meet applicable standards for windstorm. The hardware set listed is a basis of design guideline. Supplier to verify hardware is compliant with an approved manufacturer's frame and door assembly listing.

Install keyed cylinder on interior side of opening. Install perimeter seal prior to closer. Special templating required.

Operation:

1. Door position switch to signal door open/closed to the access control system.

**Set: 22.0**

Doors: 01.28.09, 01.29.04A

Description: Sgl ALUM - Box Office, Team Store - FSE Lock (CR, DPS)

1	Elec Continuous Hinge	CFMxxSLF-HD1 PT	ALUM	PE
1	Electric Power Transfer	EL-CEPT	630	SU
1	Fail Secure Lock	M8759E-AE-21L-1R WBS (size stk as req'd)	US26D	AT
1	Mortise Cylinder	DG264 41 (length, cam, collar as req'd)	US32D	SA
1	Perm Core	DG264 6300	US15	SA
1	Conc Overhead Stop	1ADJ-x36	630	RF
1	Surface Closer	351 P10	EN	SA
1	Drop Plate	351D	EN	SA
1	Blade Stop Kit	581-2	EN	SA
1	Wiring Harness (transfer/door)	QC-Cxxx		MK
1	Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1	Card Reader	By Security Provider		OT
1	Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1	Power Supply - Low Voltage	By Security Provider		OT

Notes: Perimeter seal by aluminum door provider.

Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When outside lever is locked the card reader grants access upon presentation of a valid credential. Locksets mechanically lock during power failure with a mechanical key override entry.

2. Egress always free from inside by depressing inside lever.
3. Request to exit switch in lever to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 23.0**

Doors: 01.05.10, 01.28.05

Description: Sgl Rated HM - Main Elec Rm - Panic/FSE (CR, DPS)

2 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 5" x 4-1/2"	US26D	MK
1 Electric Power Transfer	EL-CEPT	630	SU
1 Fail Secure Exit Device	DG264 12 55 PE8876- NEMD	US32D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 CPS	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88BL		PE
1 Wiring Harness (transfer/door)	QC-Cxxx		MK
1 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

## Notes: Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When outside lever is locked the card reader grants access upon presentation of a valid credential. Lever mechanically locked during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing push pad.
3. Request to exit switch in push pad to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 24.0**

Doors: 01.29.02

Description: Sgl Rated HM - MDF - FSE Lock (Inswing CR, DPS)

2 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Hinge, Full Mortise, Hvy Wt	T4A3786 QCxx 4-1/2" x 4-1/2"	US26D	MK
1 Fail Secure Lock	DG264 RX 8271- LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE
1 Wiring Harness (transfer/door)	QC-Cxxx		MK
1 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

## Notes: Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When outside lever is locked the card reader grants access upon presentation of a valid credential. Locksets mechanically locked during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside lever.
3. Request to exit switch in lever to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 25.0**

Doors: 01.27.13A

Description: Sgl Rated HM - Utility Vestibule - FSE Lock (Outswing CR, DPS)

2 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 5" x 4-1/2"	US26D	MK
1 Hinge, Full Mortise, Hvy Wt	T4A3786 QCxx 5" x 4-1/2"	US26D	MK
1 Fail Secure Lock	DG264 RX 8271- LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 CPS	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88BL		PE
1 Wiring Harness (transfer/door)	QC-Cxxx		MK
1 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

## Notes: Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When outside lever is locked the card reader grants access upon presentation of a valid credential. Locksets mechanically locked during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside lever.
3. Request to exit switch in lever to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 26.0**

Doors: 01.13.06C, 01.20.05

Description: Pair HM - Service/Team Corridor - Panic/ELR (CR, DPS)

2 Elec Continuous Hinge	BSPFMxxHD1 PT	BSP	PE
2 Electric Power Transfer	EL-CEPT	BSP	SU
1 ELR CVR Exit, Exit Only	NB 55 56 MDPE8610 EO	BSP	SA
1 ELR CVR Exit, Nightlatch	DG264 NB 55 56 MDPE8610 P106	BSP	SA
1 Perm Core	DG2 6300	BSP	SA
2 Offset Door Pull	RM3311-36 Mtg-Type 12XHD	BSP	RO
2 Surf Overhead Stop	9-x36	BSP	RF
2 Surface Closer (OHS arm)	351 PD10	BSP	SA
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
2 Astragal	18041BSPNB (both leaves)		PE
1 Gasketing	S88BL		PE
2 Wiring Harness (transfer/door)	QC-Cxxx		MK
2 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
2 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

## Notes: Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When devices are locked the card reader grants access upon presentation of a valid credential. Exit devices mechanically locked during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside push bar.
3. Request to exit switch in push bar to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 27.0**

Doors: 01.22.02A, 01.22.02B

Description: Pair HM - Service Corridor - Panic/Class

2	Continuous Hinge	CFMxxHD1	ALUM	PE
2	Concealed Vert Rod Exit, Classroom	DG264 NB MDPE8613 NEMD	US32D	SA
2	Perm Core	DG264 6300	US15	SA
2	Surf Overhead Hold Open	9-x26	630	RF
2	Surface Closer (OHS arm)	351 PD10	EN	SA
2	Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
2	Astragal	18041CNB (both leaves)		PE
1	Gasketing	S88BL		PE

**Set: 28.0**

Doors: 01.26.01, 01.26.02C

Description: Pair HM - Main Kitchen, Service Corridor - Panic/ELR (CR, DPS)

2	Elec Continuous Hinge	CFMxxHD1 PT	ALUM	PE
2	Electric Power Transfer	EL-CEPT	630	SU
1	ELR CVR Exit, Exit Only	NB 55 56 MDPE8610 EO	US32D	SA
1	ELR CVR Exit, Nightlatch	DG264 NB 55 56 MDPE8610 P106	US32D	SA
1	Perm Core	DG264 6300	US15	SA
2	Surf Overhead Hold Open	9-x26	630	RF
2	Surface Closer (OHS arm)	351 PD10	EN	SA
2	Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
2	Astragal	18041CNB (both leaves)		PE
1	Gasketing	S88BL		PE
2	Sweep	315CN		PE
2	Wiring Harness (transfer/door)	QC-Cxxx		MK
2	Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1	Card Reader	By Security Provider		OT
2	Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1	Power Supply - Low Voltage	By Security Provider		OT

## Notes: Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When devices are locked the card reader grants access upon presentation of a valid credential. Exit devices mechanically locked during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside push bar.
3. Request to exit switch in push bar to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 29.0**

Doors: 01.15.06C

Description: Sgl HM - Home Locker Rm Corridor - Panic/ELR (CR, DPS)

4	Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	BSP	MK
1	Electric Power Transfer	EL-CEPT	BSP	SU
1	ELR Rim Exit, Nightlatch	DG264 55 56 PE8804 Less Pull	BSP	SA
1	Perm Core	DG2 6300	BSP	SA
1	Offset Door Pull	RM3311-36 Mtg-Type 12XHD	BSP	RO
1	Surface Closer	351 P10	BSP	SA
1	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO

1 Wall/Door Stop	406/481(H) as req'd	BSP	RO
1 Gasketing	S88BL		PE
1 Wiring Harness (transfer/door)	QC-Cxxx		MK
1 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

**Notes: Operation:**

1. Doors normally closed and secure.
2. Authorized access by card reader retracting exit device latch for predetermined time limit. Exit device latch can be electrically held retracted for open access.
3. Request to exit switch in the push pad to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.
5. Exit device latch releases (fail secure) in event of power loss. Keyed cylinder override for emergency access.

**Set: 30.0**

Doors: 01.28.02B

Description: Sgl HM - Box Office - FSE Lock (Outswing CR, DPS)

2 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 Hinge, Full Mortise, Hvy Wt	T4A3786 QCxx 4-1/2" x 4-1/2"	US26D	MK
1 Fail Secure Lock	DG264 RX 8271- LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 P10	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE
1 Wiring Harness (transfer/door)	QC-Cxxx		MK
1 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

**Notes: Operation:**

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When outside lever is locked the card reader grants access upon presentation of a valid credential. Locksets mechanically locked during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside lever.
3. Request to exit switch in lever to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 31.0**

Doors: 01.20.02B

Description: Sgl HM - Officals Meeting Rm - FSE Lock (Outswing CR, DPS)

2 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	BSP	MK
1 Hinge, Full Mortise, Hvy Wt	T4A3786 QCxx 4-1/2" x 4-1/2"	BSP	MK
1 Fail Secure Lock	DG264 RX 8271- LNMD	BSP	SA
1 Perm Core	DG2 6300	BSP	SA
1 Surface Closer	351 P10	BSP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO

1 Wall/Door Stop	406/481(H) as req'd	BSP	RO
1 Gasketing	S88BL		PE
1 Wiring Harness (transfer/door)	QC-Cxxx		MK
1 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

**Notes:****Operation:**

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When outside lever is locked the card reader grants access upon presentation of a valid credential. Locksets mechanically locked during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside lever.
3. Request to exit switch in lever to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 32.0**

Doors: 01.31.01B

Description: Sgl Rated HM - Video Production - FSE Lock (Outswing CR, DPS, Seals)

2 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 Hinge, Full Mortise, Hvy Wt	T4A3786 QCxx 4-1/2" x 4-1/2"	US26D	MK
1 Fail Secure Lock	DG264 RX 8271- LNMD	US26D	SA
1 Surface Closer	351 P10	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S44BL		PE
1 Sound Gasketing	870AA (head x jambs)		ZE
1 Closer Bracket	870SPB		ZE
1 Auto Door Bottom	369AA Z49-PL		ZE
1 Wiring Harness (transfer/door)	QC-Cxxx		MK
1 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

**Notes:****Operation:**

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When outside lever is locked the card reader grants access upon presentation of a valid credential. Locksets mechanically locked during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside lever.
3. Request to exit switch in lever to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 33.0**

Doors: 01.04.04

Description: Sgl WD - Reception - FSE Lock (Inswing CR, DPS)

2 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Hinge, Full Mortise, Hvy Wt	T4A3786 QCxx 4-1/2" x 4-1/2"	US26D	MK
1 Fail Secure Lock	DG264 RX 8271 E3MD	US32D	SA

1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall Stop	RM867	US15	RO
1 Gasketing	S88BL		PE
1 Wiring Harness (transfer/door)	QC-Cxxx		MK
1 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

**Notes: Operation:**

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When outside lever is locked the card reader grants access upon presentation of a valid credential. Locksets mechanically lock during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside lever.
3. Request to exit switch in lever to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 33.1**

Doors: 01.28.08

Description: Sgl WD\_HM - Reception, Box Office - FSE Lock (Inswing CR, DPS)

2 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Hinge, Full Mortise, Hvy Wt	T4A3786 QCxx 4-1/2" x 4-1/2"	US26D	MK
1 Fail Secure Lock	DG264 RX 8271- LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE
1 Wiring Harness (transfer/door)	QC-Cxxx		MK
1 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

**Notes: Operation:**

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When outside lever is locked the card reader grants access upon presentation of a valid credential. Locksets mechanically lock during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside lever.
3. Request to exit switch in lever to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 34.0**

Doors: 01.26.02A

Description: Sgl HM - Main Kitchen - FSE Lock (Inswing CR, DPS)

1 Elec Continuous Hinge	CFMxxHD1 PT	ALUM	PE
1 Electric Power Transfer	EL-CEPT	630	SU
1 Fail Secure Lock	DG264 RX 8271- LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA



1	Surface Closer	351 O	EN	SA
1	Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1	Wall/Door Stop	406/481(H) as req'd	US32D	RO
1	Gasketing	S88BL		PE
1	Sweep	315CN		PE
1	Wiring Harness (transfer/door)	QC-Cxxx		MK
1	Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1	Card Reader	By Security Provider		OT
1	Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1	Power Supply - Low Voltage	By Security Provider		OT

Notes: Install sweep on interior side of opening.

Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When outside lever is locked the card reader grants access upon presentation of a valid credential. Locksets mechanically locked during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside lever.
3. Request to exit switch in lever to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 36.0**

Doors: 01.29.04

Description: Pair ALUM - Team Store - Push/Pull/DL (Inswing)

2	Continuous Hinge	CFMxxSLF-HD1	ALUM	PE
1	Dust Proof Strike	570	US26D	RO
1	Header Bolt	4085-0x-IB	US2G	AD
1	Threshold Bolt	4015-18-IB	603	AD
1	Lever	4550-xx	130	AD
1	Mortise Deadlock	MS1850S 4089	628	AD
1	Mortise Cylinder	DG264 41 (length, cam, collar as req'd)	US32D	SA
1	Perm Core	DG264 6300	US15	SA
2	Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US32D	RO
2	Push Bar	RM3112 Mtg-Type 6HD	US32D	RO
2	Conc Overhead Stop	1ADJ-x36	630	RF
2	Surface Closer	351 O	EN	SA

Notes: Perimeter seal and astragal by door provider.

**Set: 37.0 (NOT USED)**

**Set: 38.0**

Doors: 01.31.01A

Description: Sgl ALUM - Production Rack Rm - Class (Outswing CPS, Seals)

1	Continuous Hinge	CFMxxSLF-HD1	ALUM	PE
1	Classroom Lock	1745-21L-1R WBS (size stk as req'd)	US26D	AT
1	Mortise Cylinder	DG264 41 (length, cam, collar as req'd)	US32D	SA
1	Perm Core	DG264 6300	US15	SA
1	Surface Closer	351 CPS	EN	SA
1	Drop Plate	351D	EN	SA
1	Blade Stop Kit	581-2	EN	SA
1	Auto Door Bottom	3551		ZE

Notes: Perimeter sound seal by door manufacturer.

**Set: 39.0**

Doors: 01.31.03G

Description: Pair WD - Grand Hall Corridor - Panic/EO (ELR, DPS, Smoke Evac)

8 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
2 Electric Power Transfer	EL-CEPT	630	SU
2 ELR SVR Exit, Exit Only	55 56 NBPE8710 EO	US32D	SA
2 Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US32D	RO
2 Auto Operator - Outswing	SW200i - Smoke Evac - Full Header	ALUM	BM
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
2 Astragal	18041CNB (both leaves)		PE
1 Gasketing	S88BL		PE
2 Wiring Harness (transfer/door)	QC-Cxxx		MK
2 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
2 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Smoke Evac	AQD Series x Battery Backup (amps, relays, as req'd)		OT

Notes: Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system.
2. Request to exit switch in push bar to signal authorized egress to the access control system.
3. Door position switches monitor open/closed status to the access control system.

Smoke Evacuation Operation:

1. Door position switches to signal door open/closed to the smoke evacuation system.
2. Upon signal from smoke evacuation system exit device latches are electrically retracted and auto door operators activated to power open doors.
3. Door to remain open until smoke evacuation system is reset.
4. Smoke Evac power supply battery backup provides emergency power for low voltage electrified hardware during power loss.
5. Auto door operators (120V) require backup UPS for activation during power loss.

**Set: 40.0**

Doors: 01.31.03H

Description: Pair WD - Grand Hall Corridor - Panic/ELR (CR, DPS, Smoke Evac)

8 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
2 Electric Power Transfer	EL-CEPT	630	SU
1 ELR SVR Exit, Nightlatch	DG264 55 56 NBPE8710 P306	US32D	SA
1 ELR SVR Exit, Exit Only	55 56 NBPE8710 EO	US32D	SA
1 Perm Core	DG264 6300	US15	SA
2 Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US32D	RO
2 Auto Operator - Outswing	SW200i - Smoke Evac - Full Header	ALUM	BM
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
2 Astragal	18041CNB (both leaves)		PE
1 Gasketing	S88BL		PE
2 Wiring Harness (transfer/door)	QC-Cxxx		MK
2 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
2 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU

1 Power Supply - Low Voltage	By Security Provider	OT
1 Power Supply - Smoke Evac	AQD Series x Battery Backup (amps, relays, as req'd)	OT
1 Power Supply	By Security Provider (ACS devices)	SU

**Notes: Operation:**

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system.
2. Authorized access by card reader retracting exit device latch for predetermined time limit.
3. Request to exit switch in the push pad to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.
5. Keyed cylinder override for emergency access.

**Smoke Evacuation Operation:**

1. Door position switches to signal door open/closed to the smoke evacuation system.
2. Upon signal from smoke evacuation system exit device latches are electrically retracted and auto door operators activated to power open doors.
3. Door to remain open until smoke evacuation system is reset.
4. Smoke Evac power supply battery backup provides emergency power for low voltage electrified hardware during power loss.
5. Auto door operators (120V) require backup UPS for activation during power loss.

**Set: 41.0**

Doors: 01.21.08

Description: Pair Rated HM Emerg Elec - Panic/Store

8 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 Mullion	12-L980	PC	SA
1 Rated Rim Exit, Exit Only	12 PE8810 EO	US32D	SA
1 Rated Rim Exit, Storeroom	DG264 12 PE8804 NEMD	US32D	SA
1 Mullion Cylinder	DG264 980C1	US26D	SA
2 Perm Core	DG264 6300	US15	SA
2 Surface Closer	351 CPS	EN	SA
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Astragal	18041CNB (both leaves)		PE
1 Mullion Gasketing	5110BL		PE
1 Gasketing	S88BL		PE

**Set: 42.0**

Doors: 01.ST-1A, 01.ST-1B, 01.ST-2C, 01.ST-2D, 02.01.04A, 02.01.04B, 02.ST-1A, 02.ST-1B, 02.ST-2A, 02.ST-2B, 02.ST-4A, 02.ST-4B

Description: Pair Rated WD - Stair Core - Panic/Passage (WIDE, OHS)

8 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US26D	MK
2 Rated SVR Exit, Passage	12 NBPE8715 NEMD	US32D	SA
2 Surf Overhead Stop	9-x36	630	RF
2 Surface Closer (OHS arm)	351 PD10	EN	SA
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
2 Floor Stop	481(H)	US26D	RO
1 Astragal	18041CNB (both leaves)		PE
1 Gasketing	S88BL		PE

**Set: 43.0**

Doors: 01.ST-3B, 01.ST-4A, 01.ST-4B, 03.01.03B, 03.01.03C, 03.14.02C

Description: Pair Rated WD - Stair Core - Panic/Passage (OHS)

8 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US26D	MK
2 Rated SVR Exit, Passage	12 NBPE8715 NEMD	US32D	SA
2 Surf Overhead Stop	9-x36	630	RF
2 Surface Closer (OHS arm)	351 PD10	EN	SA
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
2 Floor Stop	481(H)	US26D	RO
1 Astragal	18041CNB (both leaves)		PE
1 Gasketing	S88BL		PE

**Set: 44.0**

Doors: 03.03.02C, 03.03.02D, 03.03.02E, 03.03.02F

Description: Pair Rated WD - Loge Stair Core - Panic/Passage

8 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US10	MK
2 Rated SVR Exit, Passage	12 NBPE8715 NEMD	US10	SA
2 Surf Overhead Hold Open	9-x26	691	RF
2 Surface Closer	351 O	EP	SA
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US10	RO
1 Meeting Stile	369GP		PE
1 Gasketing	S88BL		PE

**Set: 45.0**

Doors: 01.12.08A, 01.21.10

Description: Sgl Rated HM - Emerg Elec - Panic/Store

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 5" x 4-1/2"	US26D	MK
1 Rated Rim Exit, Storeroom	DG264 12 PE8804 NEMD	US32D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 P10	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Floor Stop	481(H)	US26D	RO
1 Gasketing	S88BL		PE

**Set: 46.0**

Doors: 01.23.01, 01.26.05A, 01.27.09, 01.29.01

Description: Sgl Rated HM - Show Power, Refrigeration, - Panic/Store (WIDE, OHS)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 5" x 4-1/2"	US26D	MK
1 Rated Rim Exit, Storeroom	DG264 12 PE8804 NEMD	US32D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surf Overhead Stop	9-x36	630	RF
1 Surface Closer (OHS arm)	351 PD10	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88BL		PE

**Set: 47.0**

Doors: 01.12.08B

Description: Sgl Rated HM - Main Elec Rm - Panic/Store (WIDE)

4 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 5" x 4-1/2"	US26D	MK
1 Rated Rim Exit, Storeroom	DG264 12 PE8804 NEMD	US32D	SA

1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 P10	BSP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 48.0 (NOT USED)****Set: 49.0**

Doors: 01.26.06A

Description: Sgl Rated HM - Maintenance/OPS - Storeroom (Inswing)

1 Continuous Hinge	CFMxxHD1	ALUM	PE
1 Storeroom Lock	DG264 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 O	EN	SA
1 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE
1 Sweep	315CN		PE
1 Threshold (6" solid flat)	2716A		PE

Notes: Install sweep on interior side of opening flush with threshold.

**Set: 50.0**

Doors: 01.21.09, 01.27.08, 02.21.02, 02.27.03, 03.12.01, 03.21.05

Description: Sgl Rated HM - TR , Elev Control - Storeroom (WIDE Inswing)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US26D	MK
1 Storeroom Lock	DG264 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 51.0**

Doors: 01.27.11, 03.27.01

Description: Sgl Rated - TR - Storeroom (WIDE Inswing)

4 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US26D	MK
1 Storeroom Lock	DG264 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 52.0**

Doors: 02.11.03, 04.22.01

Description: Sgl Rated HM - TR, Elev Control - Storeroom (WIDE Inswing OHS)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US26D	MK
-------------------------------	---------------------	-------	----

1	Storeroom Lock	DG264 8204 LNMD	US26D	SA
1	Perm Core	DG264 6300	US15	SA
1	Surf Overhead Stop	9-x36	630	RF
1	Surface Closer	351 O	EN	SA
1	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1	Gasketing	S88BL		PE

**Set: 53.0**

Doors: 04.ST-3

Description: Sgl Rated HM - Catwalk Access - Storeroom (WIDE Outswing)

3	Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 5" x 4-1/2"	US26D	MK
1	Storeroom Lock	DG264 8204 LNMD	US26D	SA
1	Perm Core	DG264 6300	US15	SA
1	Surface Closer	351 CPS	EN	SA
1	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1	Gasketing	S88BL		PE
1	Sweep	315CN		PE

Notes: Install keyed cylinder on stair side of opening.

**Set: 54.0**

Doors: 02.06.03, 02.11.02, 02.21.01, 02.28.01, 03.06.01, 03.11.01, 03.28.01

Description: Sgl Rated HM - TR, QE - Storeroom (WIDE Outswing)

3	Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 5" x 4-1/2"	US26D	MK
1	Storeroom Lock	DG264 8204 LNMD	US26D	SA
1	Perm Core	DG264 6300	US15	SA
1	Surface Closer	351 P10	EN	SA
1	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1	Wall/Door Stop	406/481(H) as req'd	US32D	RO
1	Gasketing	S88BL		PE

**Set: 55.0**

Doors: 01.06.03, 01.30.01

Description: Sgl Rated HM - TR, DAS - Storeroom (Outswing CPS)

3	Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Storeroom Lock	DG264 8204 LNMD	US26D	SA
1	Perm Core	DG264 6300	US15	SA
1	Surface Closer	351 CPS	EN	SA
1	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1	Gasketing	S88BL		PE

**Set: 56.0**

Doors: 01.22.05, 02.05.02, 03.05.02, 03.21.04

Description: Sgl Rated HM - Elev Control, QE - Storeroom (WIDE Outswing CPS)

4	Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 5" x 4-1/2"	US26D	MK
1	Storeroom Lock	DG264 8204 LNMD	US26D	SA
1	Perm Core	DG264 6300	US15	SA
1	Surface Closer	351 CPS	EN	SA
1	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO

1 Gasketing S88BL PE

**Set: 57.0**

Doors: 01.12.09

Description: Sgl Rated HM - TR - Storeroom (WIDE Inswing OHS)

4 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US26D	MK
1 Storeroom Lock	DG264 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surf Overhead Stop	9-x36	630	RF
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88BL		PE

**Set: 58.0**

Doors: 01.15.07B, 01.16.04B

Description: Pair HM - Aux Locker - Panic/NL (CR, DPS)

2 Elec Continuous Hinge	BSPFMxxHD1 PT	BSP	PE
2 Electric Power Transfer	EL-CEPT	BSP	SU
1 ELR CVR Exit, Exit Only	NB 55 56 MDPE8610 EO	BSP	SA
1 ELR CVR Exit, Nightlatch	DG264 NB 55 56 MDPE8610 P106	BSP	SA
1 Perm Core	DG2 6300	BSP	SA
2 Offset Door Pull	RM3311-36 Mtg-Type 12XHD	BSP	RO
2 Surface Closer	351 P10	BSP	SA
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
2 Wall/Door Stop	406/481(H) as req'd	BSP	RO
1 Astragal	18041BSPNB (both leaves)		PE
1 Gasketing	S88BL		PE
1 Card Reader	By Security Provider		OT
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

## Notes: Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When devices are locked the card reader grants access upon presentation of a valid credential. Exit devices mechanically lock during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside push bar.
3. Request to exit switch in push bar to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 59.0**

Doors: 01.07.01B, 01.07.03B, 01.09.01C, 01.09.01D

Description: Pair WD - Ballroom Entry - Panic/NL (OHSH)

8 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 SVR Exit, Exit Only	DG264 16 NBPE8710 EO	US32D	SA
1 SVR Exit, Nightlatch	DG264 16 NBPE8710 P306	US32D	SA
3 Perm Core	DG264 6300	US15	SA
2 Offset Door Pull	RM3311-12 Mtg-Type 12XHD	US32D	RO
2 Surf Overhead Hold Open	9-x26	630	RF
2 Surface Closer (OHS arm)	351 PD10	EN	SA
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO

2 Astragal	18041CNB (both leaves)	PE
1 Gasketing	S88BL	PE

**Set: 60.0**

Doors: 02.01.01B, 02.01.01E

Description: Pair WD - Sideline Club Entry - Panic/NL

6 Hinge, Full Mortise, Hvy Wt	T4A3786xNRP 4-1/2" x 4-1/2"	US4	MK
1 SVR Exit, Exit Only	DG264 16 NBPE8710 EO	US4	SA
1 SVR Exit, Nightlatch	DG264 16 NBPE8710 P306	US4	SA
3 Perm Core	DG2 6300	US4	SA
2 Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US4	RO
2 Surf Overhead Hold Open	9-x26	633	RF
2 Surface Closer (OHS arm)	351 PD10	US4 Cover	SA
2 Kick Plate	K1050(F) 10" x 2" LDW CSK BEV	US4	RO
1 Meeting Stile	369GP		PE
1 Gasketing	S88BL		PE

**Set: 61.0**

Doors: 01.02.07A, 01.02.07B, 01.32.02D

Description: Pair WD - Service Corridor - Panic/Class (OHS)

8 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 5" x 4-1/2"	US26D	MK
2 SVR Exit, Classroom	DG264 16 NBPE8713 NEMD	US32D	SA
2 Perm Core	DG264 6300	US15	SA
2 Surf Overhead Hold Open	9-x26	630	RF
2 Surface Closer (OHS arm)	351 PD10	EN	SA
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
2 Astragal	18041CNB (both leaves)		PE
1 Gasketing	S88BL		PE

**Set: 62.0**

Doors: 01.13.05A, 01.28.04

Description: Pair HM - Equipment, Jet Ice - Storeroom (Outswing OHS)

2 Continuous Hinge	CFMxxHD1	ALUM	PE
1 Flush Bolt - Self Latch	2805 - Top Only	US32D	RO
1 Storeroom Lock	DG264 7/8" Lip Length 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Coordinator	1700	Black	RO
2 Surf Overhead Hold Open	9-x26	630	RF
2 Surface Closer (OHS arm)	351 PD10	EN	SA
2 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1 Astragal	357 (paint to match door)		PE
2 Silencer - Metal Frame	608		RO

Notes: Install astragal on pull side of active leaf and size doors for 1/8" clearance between leaves.

**Set: 63.0**

Doors: 01.06.04, 01.08.03, 01.09.03, 01.15.05D

Description: Pair HM - Storage - Storage, Water Entry (Outswing OHS)

2 Continuous Hinge	CFMxxHD1	ALUM	PE
--------------------	----------	------	----



1	Flush Bolt	555	US26D	RO
1	Flush Bolt	555-18	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom Lock	DG264 7/8" Lip Length 8204 LNMD	US26D	SA
1	Perm Core	DG264 6300	US15	SA
1	Coordinator	1700	Black	RO
2	Surf Overhead Hold Open	9-x26	630	RF
2	Surface Closer (OHS arm)	351 PD10	EN	SA
2	Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1	Astragal	357 (paint to match door)		PE
2	Silencer - Metal Frame	608		RO

Notes: Install astragal on pull side of active leaf and size doors for 1/8" clearance between leaves.

**Set: 63.5**

Doors: 01.22.06

Description: Pair Rated HM - Freight Elev Control - Storeroom (Outswing CPS)

6	Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Flush Bolt - Self Latch	2805 - Top Only	US32D	RO
1	Storeroom Lock	DG264 7/8" Lip Length 8204 LNMD	US26D	SA
1	Perm Core	DG264 6300	US15	SA
1	Coordinator	1700	Black	RO
2	Surface Closer	351 CPS	EN	SA
2	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1	Astragal	357 (paint to match door)		PE
1	Gasketing	S88BL		PE

Notes: Install astragal on pull side of active leaf and size doors for 1/8" clearance between leaves.

**Set: 64.0**

Doors: 01.10.04

Description: Pair HM - Ballroom Storage - Storeroom (Outswing)

6	Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Flush Bolt	555	BSP	RO
1	Flush Bolt	555-18	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom Lock	DG264 7/8" Lip Length 8204 LNMD	US26D	SA
1	Perm Core	DG264 6300	US15	SA
2	Surf Overhead Hold Open	9-x26	630	RF
1	Surface Closer (OHS arm)	351 PD10	EN	SA
2	Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1	Astragal	357 (paint to match door)		PE
2	Silencer - Metal Frame	608		RO

Notes: Install closer on active leaf. Install astragal on pull side of active leaf and size doors for 1/8" clearance between leaves.

**Set: 64.1**

Doors: 02.01.03

Description: Pair HM - Storage - Storeroom (Outswing)

6 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
2 Flush Bolt	555	BSP	RO
1 Dust Proof Strike	570	US26D	RO
1 Storeroom Lock	DG264 7/8" Lip Length 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
2 Surf Overhead Hold Open	9-x26	630	RF
1 Surface Closer	351 P10	EN	SA
2 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1 Astragal	357 (paint to match door)		PE
2 Silencer - Metal Frame	608		RO

Notes: Install closer on active leaf. Install astragal on pull side of active leaf and size doors for 1/8" clearance between leaves.

**Set: 65.0**

Doors: 01.03.01A

Description: Pair Rated HM - Chair Storage (Outswing Store)

2 Continuous Hinge	CFMxxHD1	ALUM	PE
1 Flush Bolt - Self Latch	2805 - Top Only	US32D	RO
1 Storeroom Lock	DG264 7/8" Lip Length 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Coordinator	1700	Black	RO
2 Surface Closer	351 P10	EN	SA
2 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
2 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Astragal	357 (paint to match door)		PE
1 Gasketing	S88BL		PE

Notes: Install astragal on pull side of active leaf and size doors for 1/8" clearance between leaves.

**Set: 66.0**

Doors: 01.13.06B

Description: Pair HM - Staff Office Lobby - Multipoint/Class (OHS)

8 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
2 Multi-Point Lock	DG264 NB 701315 ETMD	US26D	SA
2 Perm Core	DG264 6300	US15	SA
2 Surf Overhead Stop	9-x36	630	RF
2 Surface Closer (OHS arm)	351 PD10	EN	SA
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
2 Astragal	18041CNB (both leaves)		PE
1 Gasketing	S88BL		PE

**Set: 67.0**

Doors: 01.19.02C

Description: Pair WD - Green/Family Lounge - Panic/NL (CR, DPS)

8 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	BSP	MK
2 Electric Power Transfer	EL-CEPT	BSP	SU
1 ELR SVR Exit, Exit Only	55 56 NBPE8710 EO	BSP	SA
1 ELR SVR Exit, Nightlatch	DG264 55 56 NBPE8710 P306	BSP	SA
1 Perm Core	DG2 6300	BSP	SA

2	Offset Door Pull	RM3311-36 Mtg-Type 12XHD	BSP	RO
2	Surface Closer	351 P10	BSP	SA
2	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
2	Wall Stop	RM867	BSP	RO
2	Astragal	18041BSPNB (both leaves)		PE
1	Gasketing	S88BL		PE

**Set: 68.0**

Doors: 02.04.03

Description: Sgl WD - Guest Services - Classroom (Inswing)

3	Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Classroom Lock	DG264 8237 E3MD	US32D	SA
1	Perm Core	DG264 6300	US15	SA
1	Surface Closer	351 O	EN	SA
1	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1	Wall Stop	RM867	US15	RO
1	Gasketing	S88BL		PE

**Set: 68.1**

Doors: 01.12.15B, 02.29.04

Description: Sgl WD\_HM- Staff Lounge, First Aid - Classroom (Inswing)

3	Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Classroom Lock	DG264 8237 LNMD	US26D	SA
1	Perm Core	DG264 6300	US15	SA
1	Surface Closer	351 O	EN	SA
1	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1	Wall/Door Stop	406/481(H) as req'd	US32D	RO
1	Gasketing	S88BL		PE

**Set: 69.0**

Doors: 01.20.01B, 01.20.03

Description: Sgl WD - Officials Dressing - Classroom (Inswing)

4	Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	BSP	MK
1	Classroom Lock	DG264 8237 E3MD	BSP	SA
1	Perm Core	DG2 6300	BSP	SA
1	Surface Closer	351 O	BSP	SA
1	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
1	Wall Stop	RM867	BSP	RO
1	Gasketing	S88BL		PE

**Set: 70.0**

Doors: 01.20.07B

Description: Sgl HM - Crew/Media Lounge - Classroom (WIDE)

3	Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US26D	MK
1	Classroom Lock	DG264 8237 LNMD	US26D	SA
1	Perm Core	DG264 6300	US15	SA
1	Surface Closer	351 O	EN	SA
1	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1	Wall/Door Stop	406/481(H) as req'd	US32D	RO

1 Gasketing S88BL PE

**Set: 71.0**

Doors: 01.19.05, 02.17.02, 02.20.02, 03.12.02

Description: Sgl HM - Pantry, Market Prep - Classroom (WIDE Inswing HO)

1 Continuous Hinge	CFMxxHD1	ALUM	PE
1 Classroom Lock	DG264 8237 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surf Overhead Hold Open	9-x26	630	RF
1 Surface Closer	351 O	EN	SA
1 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88BL		PE
1 Sweep	315CN		PE

Notes: Install sweep on interior side of opening.

**Set: 71.1**

Doors: 01.13.08

Description: Sgl Rated HM - Laundry - Classroom (Inswing)

1 Continuous Hinge	CFMxxHD1	ALUM	PE
1 Classroom Lock	DG264 8237 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 O	EN	SA
1 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	BSP	RO
1 Gasketing	S88BL		PE

Notes: Install sweep on interior side of opening.

**Set: 71.2**

Doors: 01.26.02E, 03.27.02C

Description: Sgl HM - Kitchen/Pantry Dutch - Classroom/DL

4 Hinge, Spring	1502 4-1/2" x 4-1/2"	US26D	MK
1 Dutch Door Bolt	630-4	US26D	RO
1 Passage Latch	8215 LNMD	US26D	SA
1 Deadbolt	DG264 485	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surf Overhead Hold Open	9-x26	630	RF
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Floor Stop	481(H)	US26D	RO
3 Silencer - Metal Frame	608		RO

Notes: Dutch door shelf by door provider. Install passage latch on lower leaf and deadbolt and overhead stop on upper leaf. Install dutch door bolt on upper leaf with bolt strike on lower leaf shelf.

**Set: 72.0**

Doors: 01.14.02

Description: Sgl WD - Stick/Skate Wrk Rm - Classroom (WIDE Inswing)

4 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	BSP	MK
-------------------------------	---------------------	-----	----

1 Classroom Lock	DG264 8237 E3MD	BSP	SA
1 Perm Core	DG2 6300	BSP	SA
1 Surf Overhead Hold Open	9-x26	BSP	RF
1 Surface Closer	351 O	BSP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
3 Silencer - Metal Frame	608		RO

**Set: 73.0**

Doors: 03.20.03A, 03.27.02A

Description: Pair HM - Suite Servery - Multipoint Class (WIDE Outswing OHS)

2 Continuous Hinge	CFMxxHD1	ALUM	PE
2 Multi-Point Lock	DG264 NB 701315 ETMD	US26D	SA
2 Perm Core	DG264 6300	US15	SA
2 Surf Overhead Hold Open	9-x26	630	RF
2 Surface Closer (OHS arm)	351 PD10	EN	SA
2 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
2 Astragal	18041CNB (both leaves)		PE
1 Gasketing	S88BL		PE
2 Sweep	315CN		PE

**Set: 74.0**

Doors: 01.26.02B

Description: Pair HM - Kitchen Commissary - Multipoint Class (OHS)

2 Continuous Hinge	CFMxxHD1	ALUM	PE
2 Multi-Point Lock	DG264 NB 701315 ETMD	US26D	SA
2 Perm Core	DG264 6300	US15	SA
2 Surf Overhead Hold Open	9-x26	630	RF
2 Surface Closer (OHS arm)	351 PD10	EN	SA
2 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
2 Astragal	18041CNB (both leaves)		PE
1 Gasketing	S88BL		PE
2 Sweep	315CN		PE
1 Threshold (6" solid flat)	2716A		PE

**Set: 75.0**

Doors: 01.31.03K

Description: Pair WD - Event Concourse - Panic/Class (DPS, Smoke Evac)

8 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
2 Electric Power Transfer	EL-CEPT	630	SU
1 ELR SVR Exit, Nightlatch	DG264 55 56 NBPE8710 P306	US32D	SA
1 ELR SVR Exit, Exit Only	55 56 NBPE8710 EO	US32D	SA
1 Perm Core	DG264 6300	US15	SA
2 Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US32D	RO
2 Auto Operator - Outswing	SW200i - Smoke Evac - Full Header	ALUM	BM
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
2 Astragal	18041CNB (both leaves)		PE
1 Gasketing	S88BL		PE
2 Wiring Harness (transfer/door)	QC-Cxxx		MK
2 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
2 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU

1 Power Supply - Smoke Evac      AQD Series x Battery Backup (amps, relays, as req'd)      OT

**Notes: Operation:**

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system.
2. Request to exit switch in push bar to signal authorized egress to the access control system.
3. Door position switches monitor open/closed status to the access control system.

**Smoke Evacuation Operation:**

1. Door position switches to signal door open/closed to the smoke evacuation system.
2. Upon signal from smoke evacuation system exit device latches are electrically retracted and auto door operators activated to power open doors.
3. Door to remain open until smoke evacuation system is reset.
4. Smoke Evac power supply battery backup provides emergency power for low voltage electrified hardware during power loss.
5. Auto door operators (120V) require backup UPS for activation during power loss.

**Set: 76.0**

Doors: 01.18.07A

Description: Pair HM - Visitor Locker Rm - Panic/NL (CR, DPS)

6 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
2 Electric Power Transfer	EL-CEPT	630	SU
1 ELR CVR Exit, Exit Only	NB 55 56 MDPE8610 EO	US32D	SA
1 ELR CVR Exit, Nightlatch	DG264 NB 55 56 MDPE8610 P106	US32D	SA
1 Perm Core	DG264 6300	US15	SA
2 Door Pull	BF168 Mtg-Type 12XHD	32D-316	RO
2 Surf Overhead Hold Open	9-x26	630	RF
2 Surface Closer (OHS arm)	351 PD10	EN	SA
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
2 Astragal	18061CNB (both leaves)		PE
1 Gasketing	S88BL		PE

**Notes: Operation:**

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When devices are locked the card reader grants access upon presentation of a valid credential. Exit devices mechanically lock during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside push bar.
3. Request to exit switch in push bar to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 77.0**

Doors: 01.15.07A, 01.16.04A

Description: Pair HM - Aux Locker Vestibule - Push/Pull

2 Continuous Hinge	BSPFMxxHD1	BSP	PE
2 Push Plate	73F	BSP	RO
2 Straight Door Pull	RM3301-36 Mtg-Type 12XHD	BSP	RO
2 Surface Closer	351 P10	BSP	SA
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
2 Wall/Door Stop	406/481(H) as req'd	BSP	RO
1 Gasketing	S88BL		PE

**Set: 78.0**

Doors: 01.12.14B

Description: Pair HM - Staff Entry Vestibule - Push/Pull (OHS)

8 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
2 Push Plate	73F	32D-316	RO
2 Door Pull	BF168 Mtg-Type 12XHD	US32D-316	
RO			
2 Surf Overhead Stop	9-x36	630	RF
2 Surface Closer (OHS arm)	351 PD10	EN	SA
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
2 Astragal	18041CNB (both leaves)		PE
1 Gasketing	S88BL		PE

Notes: Conceal pull fasteners behind push plate.

**Set: 78.1**

Doors: 01.14.05B

Description: Pair WD/FG - Player Entry Vestibule - Push/Pull (OHS)

8 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
2 Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US32D	RO
2 Push Bar	RM3112 Mtg-Type 6HD	US32D	RO
2 Surface Closer	351 P10	EN	SA
2 Wall Stop	RM867	US15	RO
2 Astragal	18041CNB (both leaves)		PE
1 Gasketing	S88BL		PE

**Set: 79.0**

Doors: 01.32.02C

Description: Pair HM - Penalty Box Corridor - Push/Pull

2 Continuous Hinge	CFMxxHD1	ALUM	PE
2 Push Plate	73F	32D-316	RO
2 Push Pull	BF 111x73C	32D-316	RO
2 Surf Overhead Hold Open	9-x26	630	RF
2 Surface Closer (OHS arm)	351 PD10	EN	SA
2 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
2 Astragal	18061CNB (both leaves)		PE
1 Gasketing	S88BL		PE
2 Sweep	315CN		PE

**Set: 80.0**

Doors: 01.15.06

Description: Pair WD - Home Team Locker - Panic/NL (CR, DPS, OHS)

2 Continuous Hinge	BSPFMxxHD1	BSP	PE
2 Electric Power Transfer	EL-CEPT	BSP	SU
1 ELR SVR Exit, Exit Only	55 56 NBPE8710 EO	BSP	SA
1 ELR SVR Exit, Nightlatch	DG264 55 56 NBPE8710 P306	BSP	SA
1 Perm Core	DG2 6300	BSP	SA
2 Offset Door Pull	RM3311-36 Mtg-Type 12XHD	BSP	RO
2 Surf Overhead Hold Open	9-x26	BSP	RF

2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
2 Astragal	18041BSPNB (both leaves)		PE
1 Gasketing	S88BL		PE
2 Wiring Harness (transfer/door)	QC-Cxxx		MK
2 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
2 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

**Notes: Operation:**

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When devices are locked the card reader grants access upon presentation of a valid credential. Exit devices mechanically lock during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside push bar.
3. Request to exit switch in push bar to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 80.1**

Doors: 01.17.01

Description: Pair WD - Bunker Club - Panic/NL (CR, DPS)

6 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	BSP	MK
2 Electric Power Transfer	EL-CEPT	BSP	SU
1 ELR SVR Exit, Exit Only	55 56 NBPE8710 EO	BSP	SA
1 ELR SVR Exit, Nightlatch	DG264 55 56 NBPE8710 P306	BSP	SA
1 Perm Core	DG2 6300	BSP	SA
2 Offset Door Pull	RM3311-36 Mtg-Type 12XHD	BSP	RO
2 Surf Overhead Hold Open	9-x26	BSP	RF
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
1 Meeting Stile	369DP		PE
1 Gasketing	S88BL		PE
2 Wiring Harness (transfer/door)	QC-Cxxx		MK
2 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
2 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

**Notes: Operation:**

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When devices are locked the card reader grants access upon presentation of a valid credential. Exit devices mechanically lock during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside push bar.
3. Request to exit switch in push bar to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 81.0**

Doors: 03.03.02A, 03.03.02B

Description: Pair Dbl Egress WD - Suite Corridor - Pull/BTB Non Locking

8 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	BSP	MK
4 Straight Door Pull BTB	RM3301-36 Mtg-Type 11XHD	BSP	RO
2 Surface Closer	351 CPS	BSP	SA
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO



1 Gasketing	S88BL		PE
1 Push Sign	RM1120H	BSP	RO
1 Pull Sign	RM1120L	BSP	RO

Notes: Door Pulls mounted BTB.

**Set: 81.1**

Doors: 03.01.03A, 03.14.04

Description: Pair Dbl Egress HM - Service Corridor - Push Non Locking

8 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	BSP	MK
2 Push Plate	70G	BSP	RO
2 Surface Closer	351 CPS	BSP	SA
2 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
1 Gasketing	S88BL		PE

**Set: 82.0**

Doors: 01.01.02C, 01.02.03B, 01.31.03J

Description: Sgl WD - Ballroom Entry - Panic/NL (CR)

4 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 5" x 4-1/2"	US26D	MK
1 Electric Power Transfer	EL-CEPT	630	SU
1 Fail Secure Exit Device	DG264 55 PE8876-24v NEMD	US32D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer (hold open)	351 CPSH	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE
1 Wiring Harness (transfer/door)	QC-Cxxx		MK
1 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

Notes: Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When devices are locked the card reader grants access upon presentation of a valid credential. Exit devices mechanically lock during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside push bar.
3. Request to exit switch in push bar to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 82.1**

Doors: 01.10.01B, 01.10.02

Description: Sgl WD - Ballroom Entry - Panic/Class

1 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 5" x 4-1/2"	US26D	MK
1 Rim Exit, Classroom	DG264 PE8813 NEMD	US32D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer (hold open)	351 CPSH	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 83.0**

Doors: 01.28.07A

Description: Sgl HM - Chiller - Panic Storeroom

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 Rim Exit, Nightlatch	DG264 PE8804 NEMD	US32D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 P10	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 84.0**

Doors: 01.01.02A, 01.02.03A, 01.28.02A, 01.31.02A, 01.31.02B, 01.31.02C

Description: Sgl HM - Ballroom Service - Panic/Class (WIDE Viewer)

1 Continuous Hinge	CFMxxHD1	ALUM	PE
1 Rim Exit, Classroom	DG264 PE8813 NEMD	US32D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer (hold open)	351 CPSH	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88BL		PE
1 Viewer	620	CRM	RO

**Set: 85.0**

Doors: 01.31.05

Description: Sgl HM - Grand Hall FS Storeroom - Storeroom (WIDE Inswing)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US26D	MK
2 Storeroom Lock	DG264 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 O	EP	SA
1 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
3 Silencer - Metal Frame	608		RO

**Set: 86.0 (NOT USED)****Set: 87.0**

Doors: 01.06.02, 01.21.11, 02.06.01, 03.22.02

Description: Sgl HM - House Keeping, Janitor - Storeroom (Inswing HO)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US26D	MK
1 Storeroom Lock	DG264 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer (hold open)	351 H	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
3 Silencer - Metal Frame	608		RO

**Set: 88.0**

Doors: 01.14.19

Description: Sgl HM - Storeroom- Storeroom (Outswing HO)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lock	DG264 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer (hold open)	351 CPSH	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
3 Silencer - Metal Frame	608		RO

**Set: 89.0**

Doors: 01.13.05B

Description: Sgl HM - Equip Rm - Equipment (Inswing OSHH)

1 Continuous Hinge	CFMxxHD1	ALUM	PE
1 Storeroom Lock	DG264 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surf Overhead Hold Open	9-x26	630	RF
1 Surface Closer	351 O	EN	SA
1 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
3 Silencer - Metal Frame	608		RO

**Set: 90.0**

Doors: 02.30.01

Description: Sgl - Sideline Club Pantry - Storeroom (Inswing)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US4	MK
1 Storeroom Lock	DG264 8204 E3MD	US4	SA
1 Perm Core	DG2 6300	US4	SA
1 Surface Closer	351 O	EN	SA
1 Armor Plate	K1050(F) 34" x 2" LDW CSK BEV	US4	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
3 Silencer - Metal Frame	608		RO

**Set: 91.0**

Doors: 01.12.11B, 01.13.10, 01.20.06B

Description: Sgl HM - Storage- Storeroom (Outswing No Closer)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lock	DG264 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
3 Silencer - Metal Frame	608		RO

**Set: 92.0**

Doors: 01.03.01D

Description: Sgl Rated HM - Chair Storage - Storeroom (Inswing HO)

1 Continuous Hinge	CFMxxSLF-HD1	ALUM	PE
1 Storeroom Lock	DG264 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 P10	EN	SA
1 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 93.0**

Doors: 03.22.01

Description: Sgl HM - Storage - Storeroom (WIDE Outswing HO)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 5" x 4-1/2"	US26D	MK
1 Storeroom Lock	DG264 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer (hold open)	351 CPSH	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
3 Silencer - Metal Frame	608		RO

**Set: 94.0**

Doors: 01.06.01A, 01.06.26, 01.21.01A, 01.28.06B, 01.29.05A

Description: Sgl HM - Pump Rm, Storage - Storeroom (Outswing CPS)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lock	DG264 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 CPS	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
3 Silencer - Metal Frame	608		RO

**Set: 95.0**

Doors: 01.15.06B

Description: Sgl HM - Team Storage - Storeroom (Outswing)

4 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	BSP	MK
1 Storeroom Lock	DG264 8204 E3MD	BSP	SA
1 Perm Core	DG2 6300	BSP	SA
1 Surface Closer	351 CPS	BSP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
3 Silencer - Metal Frame	608		RO

**Set: 96.0**

Doors: 01.02.05A, 01.12.07, 01.13.04B, 02.01.32, 02.14.01

Description: Sgl HM - Janitor - Storeroom (Outswing HO)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lock	DG264 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer (hold open)	351 CPSH	BSP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
3 Silencer - Metal Frame	608		RO

**Set: 97.0**

Doors: 03.04.01

Description: Sgl HM - Janitor - Storeroom (Outswing HO)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	BSP	MK
1 Storeroom Lock	DG264 8204 LNMD	BSP	SA
1 Perm Core	DG2 6300	BSP	SA

1 Surface Closer (hold open)	351 CPSH	BSP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
3 Silencer - Metal Frame	608		RO

**Set: 98.0**

Doors: 01.26.04A, 01.28.06A

Description: Sgl HM - Water Entry, Pump Room- Storeroom (WIDE Outswing)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 5" x 4-1/2"	US26D	MK
1 Storeroom Lock	DG264 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 P10	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 99.0**

Doors: 01.21.07A

Description: Sgl HM - Zamboni Room - Storeroom (Inswing OHS)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lock	DG264 8204 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surf Overhead Stop	9-x36	630	RF
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88BL		PE

**Set: 100.0**

Doors: 01.01.02B, 01.31.02D

Description: Sgl HM - Ballroom Connecting - Dbl Keyed

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 Store Door Lock	DG264 8226 LNMD	US26D	SA
2 Perm Core	DG264 6300	US15	SA
1 Surface Closer (hold open)	351 CPSH	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88BL		PE
1 Auto Door Bottom	369AA Z49-PL		ZE

**Set: 101.0**

Doors: 03.21.01

Description: Sgl HM - Audio Production - Office (Inswing Seals)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Office/Entry Lock	LB DG264 8205 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S44BL		PE
1 Sound Gasketing	870AA (head x jambs)		ZE
1 Auto Door Bottom	369AA Z49-PL		ZE

**Set: 102.0**

Doors: 01.21.03

Description: Sgl HM - Production Open - Office (Outswing)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 Office/Entry Lock	LB DG264 8205 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 P10	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 102.1**

Doors: 01.15.05G

Description: Sgl HM - Director of Operations - Office (Inswing)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 Office/Entry Lock	LB DG264 8205 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 O	EP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 103.0**

Doors: 01.15.06A

Description: Sgl WD - Assistant Coach Wrk Area - Office (Outswing)

4 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	BSP	MK
1 Office/Entry Lock	LB DG264 8205 E3MD	BSP	SA
1 Perm Core	DG2 6300	BSP	SA
1 Surface Closer	351 P10	BSP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
1 Wall/Door Stop	406/481(H) as req'd	BSP	RO
1 Gasketing	S88BL		PE

**Set: 104.0**

Doors: 01.04.05, 01.04.07, 01.04.09, 01.05.04, 01.05.05, 01.05.06, 01.05.07, 01.15.05C

Description: Sgl WD - Admin Offices - Office

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Office/Entry Lock	DG264 8205 E3MD	US32D	SA
1 Perm Core	DG264 6300	US15	SA
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO

Notes: Perimeter seal by aluminum frame provider.

**Set: 105.0**

Doors: 01.20.07A, 02.04.06, 02.15.01, 02.27.04, 02.28.04, 03.20.03B

Description: Sgl HM - Crew Kitchen, Market Prep, Pantry - Classroom (WIDE Inswing OHS)

1 Continuous Hinge	CFMxxHD1	ALUM	PE
1 Classroom Lock	DG264 8237 LNMD	US26D	SA

1 Perm Core	DG264 6300	US15	SA
1 Surf Overhead Hold Open	9-x26	630	RF
1 Surface Closer	351 O	EN	SA
1 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88BL		PE
1 Sweep	315CN		PE

Notes: Install sweep on interior side of opening.

**Set: 106.0 (NOT USED)**

**Set: 107.0**

Doors: 03.21.02

Description: Sgl HM - Video Production/On-Glass-FSE Lock (Inswing CR, DPS, Seals)

2 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US26D	MK
1 Hinge, Full Mortise, Hvy Wt	T4A3786 QCxx 5" x 4-1/2"	US26D	MK
1 Fail Secure Lock	DG264 RX 8271- LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S44BL		PE
1 Sound Gasketing	870AA (head x jambs)		ZE
1 Auto Door Bottom	369AA Z49-PL		ZE
1 Wiring Harness (transfer/door)	QC-Cxxx		MK
1 Wiring Harness (trasfer/jbox)	QC-CxxxxP		MK
1 Card Reader	By Security Provider		OT
1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Power Supply - Low Voltage	By Security Provider		OT

Notes: Operation:

1. Doors electrically unlocked or locked during established time zones as programmed by the access control system. When outside lever is locked the card reader grants access upon presentation of a valid credential. Locksets mechanically locked during power failure with a mechanical key override entry.
2. Egress always free from inside by depressing inside lever.
3. Request to exit switch in lever to signal authorized egress to the access control system.
4. Door position switch to signal door open/closed to the access control system.

**Set: 108.0**

Doors: 01.20.06C

Description: Sgl HM - Crew/Media Lounge - Classroom (Outswing)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 Classroom Lock	DG264 8237 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 P10	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 109.0**

Doors: 01.20.07C

Description: Sgl Rated HM - Crew Kitchen - Classroom (Outswing)

1 Continuous Hinge	CFMxxHD1	ALUM	PE
1 Classroom Lock	DG264 8237 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 P10	EN	SA
1 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 110.0**

Doors: 01.20.02A

Description: Sgl WD - Green Room/Lounge - Classroom (Inswing, Seals)

4 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	BSP	MK
1 Classroom Lock	DG264 8237 E3MD	BSP	SA
1 Perm Core	DG2 6300	BSP	SA
1 Surface Closer	351 O	BSP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
1 Wall Stop	RM867	BSP	RO
1 Gasketing	S88BL		PE
1 Auto Door Bottom	369AA Z49-PL		ZE

**Set: 111.0**

Doors: 03.27.02B

Description: Sgl HM - Suite Servery - Classroom (Outswing)

1 Continuous Hinge	CFMxxHD1	ALUM	PE
1 Classroom Lock	DG264 8237 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 P10	EN	SA
1 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE
1 Sweep	315CN		PE

**Set: 112.0**

Doors: 01.15.04, 01.15.05A

Description: Sgl WD\_HM - Hydrotherapy - Classroom (Outswing HO)

4 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 5" x 4-1/2"	BSP	MK
1 Classroom Lock	DG264 8237 E3MD	BSP	SA
1 Perm Core	DG2 6300	BSP	SA
1 Surface Closer (hold open)	351 CPSH	BSP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
1 Gasketing	S88BL		PE

**Set: 113.0**

Doors: 01.23.02A, 01.23.03C

Description: Sgl Rated HM - Receiving Corridor, Head End - Classroom (Outswing CPS)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 Classroom Lock	DG264 8237 LNMD	US26D	SA



1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 CPS	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88BL		PE

**Set: 114.0**

Doors: 02.12.02, 03.21.03

Description: Sgl HM - Market Kitchen, Service Corridor - Classroom (Outswing OHS)

1 Continuous Hinge	CFMxxHD1	ALUM	PE
1 Classroom Lock	DG264 8237 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surf Overhead Stop	9-x36	630	RF
1 Surface Closer (OHS arm)	351 PD10	EN	SA
1 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88BL		PE
1 Sweep	315CN		PE

**Set: 115.0**

Doors: 01.12.15A

Description: Sgl HM - Staff Lounge Connecting - Classroom (CPS)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Classroom Lock	DG264 8237 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer	351 CPS	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88BL		PE

**Set: 116.0**

Doors: 01.23.08, 01.23.09

Description: Sgl HM - Crew Toilet - Privacy/IND (Inswing)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Privacy Lock - IND - IND	LB V20 8265 LNMD	US26D	SA
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE
1 Coat Hook	RM802	US32D	RO

**Set: 117.0**

Doors: 01.30.04

Description: Sgl HM - Family Toilet - Privacy/IND (Inswing)

4 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Privacy Lock	LB V20 8265 E3MD	US32D	SA
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall Stop	RM867	US15	RO
1 Gasketing	S88BL		PE
1 Coat Hook	RM802	US32D	RO

**Set: 117.1**

Doors: 01.03.04, 02.04.05, 02.13.01, 02.17.03, 02.28.02, 02.29.03

Description: Sgl WD\_HM - Family Toilet, Changing, Mothers Room - Privacy/IND (Inswing)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Privacy Lock	LB V20 8265 E3MD	US32D	SA
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall Stop	RM867	US15	RO
1 Gasketing	S88BL		PE
1 Coat Hook	RM802	US32D	RO

**Set: 118.0**

Doors: 03.03.03, 03.13.03

Description: Sgl WD - Family Toilet - Privacy/IND (Inswing)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	BSP	MK
1 Privacy Lock - IND	LB V20 8265 E3MD	BSP	SA
1 Surface Closer	351 O	BSP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
1 Wall Stop	RM867	BSP	RO
1 Gasketing	S88BL		PE
1 Coat Hook	RM802	BSP	RO

**Set: 119.0**

Doors: 01.20.06A

Description: Sgl HM - Crew Lounge Toilet - Privacy/IND (Outswing)

4 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Privacy Lock - IND - IND	LB V20 8265 LNMD	US26D	SA
1 Surface Closer	351 CPS	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88BL		PE
1 Coat Hook	RM802	US32D	RO

**Set: 120.0 (NOT USED)****Set: 121.0**

Doors: 01.14.07, 01.17.04

Description: Sgl WD - Aux Star Toilet - Privacy/IND (Inswing)

4 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK
1 Privacy Lock - IND	LB V20 8265 LNMD	BSP	SA
1 Surface Closer	351 O	BSP	SA
1 Wall Stop	RM867	BSP	RO
1 Gasketing	S88BL		PE
1 Coat Hook	RM802	BSP	RO

**Set: 122.0**

Doors: 01.16.01, 01.16.02

Description: Sgl WD- Bunker Club - Privacy/IND (Inswing)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK
-----------------------	------------------------	-----	----

1 Privacy Lock - IND	LB V20 8265 E3MD	BSP	SA
1 Surface Closer	351 O	BSP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
1 Wall Stop	RM867	BSP	RO
1 Gasketing	S88BL		PE
1 Coat Hook	RM802	BSP	RO

**Set: 123.0**

Doors: 01.19.03A

Description: Sgl WD - Green Room Toilet - Privacy/IND (Inswing)

4 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK
1 Privacy Lock - IND	LB V20 8265 E3MD	BSP	SA
1 Surface Closer	351 O	BSP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
1 Wall Stop	RM867	BSP	RO
1 Gasketing	S88BL		PE
1 Coat Hook	RM802	BSP	RO

**Set: 124.0**

Doors: 01.13.04A

Description: Sgl Rated HM - Laundry - Passage (OHS)

1 Continuous Hinge	CFMxxHD1	ALUM	PE
1 Passage Latch	8215 LNMD	US26D	SA
1 Surf Overhead Stop	9-x36	630	RF
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88BL		PE

**Set: 125.0**

Doors: 01.15.05B

Description: Sgl HM - Marshalling Ramp Corridor - Panic/Passage

1 Continuous Hinge	CFMxxHD1	ALUM	PE
1 Rim Exit, Passage	PE8815 NEMD	US32D	SA
1 Surface Closer	351 P10	EN	SA
1 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 126.0 (NOT USED)****Set: 127.0**

Doors: 03.20.01

Description: Sgl HM - Audio/Multi-Purpose - Passage (Inswing, Seals)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US26D	MK
1 Passage Latch	8215 LNMD	US26D	SA
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S44BL		PE
1 Sound Gasketing	870AA (head x jambs)		ZE

1 Auto Door Bottom 369AA Z49-PL ZE

**Set: 128.0**

Doors: 01.05.03

Description: Sgl WD - Admin Conference - Passage

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Passage Latch	8215 E3MD	US32D	SA
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO

Notes: Perimeter seal by aluminum frame provider.

**Set: 129.0**

Doors: 01.01.01, 01.03.03, 01.04.03, 01.32.01

Description: Sgl WD\_HM - Mens/Womens Restroom - Push/Pull/DL (Inswing)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Classroom Deadlock	DG264 LB 4877	US32D	SA
1 Perm Core	DG264 6300	US15	SA
1 Push Plate	73F CFC CFTT (as req'd)	32D-316	RO
1 Offset Door Pull	RM3311-12 Mtg-Type 12XHD	US32D	RO
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

Notes: Install offset pull to allow for deadlock operation.

**Set: 130.0**

Doors: 03.04.02, 03.04.03, 03.12.04, 03.13.02, 03.19.02, 03.20.02, 03.29.01, 03.29.02

Description: Sgl WD - Suite Mens/Womens Restrooms - Push/Pull/DL (Inswing)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	BSP	MK
1 Classroom Deadlock	DG264 LB 4877	BSP	SA
1 Perm Core	DG2 6300	BSP	SA
1 Push Plate	73F CFC CFTT (as req'd)	BSP	RO
1 Offset Door Pull	RM3311-12 Mtg-Type 12XHD	BSP	RO
1 Surface Closer	351 O	BSP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
1 Wall Stop	RM867	BSP	RO
1 Gasketing	S88BL		PE

Notes: Install offset pull to allow for deadlock operation.

**Set: 131.0**

Doors: 03.01.02, 03.02.01, 03.02.02, 03.03.01, 03.14.02, 03.15.01, 03.15.02, 03.16.01, 03.17.01, 03.18.01, 03.18.02, 03.31.01, 03.31.02, 03.32.01

Description: Sgl WD - Suite Entry - Classroom (Inswing, OH Conc)

4 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	BSP	MK
1 Classroom Lock	DG264 8237 E3MD	BSP	SA
1 Perm Core	DG2 6300	BSP	SA
1 Concealed Closer	WPH91HDCP	BSP	RF

1 Wall Stop	RM867	BSP	RO
1 Gasketing	S88BL		PE
1 Auto Door Bottom	369AA Z49-PL		ZE

**Set: 132.0**

Doors: 03.01.01A, 03.01.01B, 03.16.02A, 03.16.02B

Description: Sgl - Suite Entry - Classroom (Outswing OH Conc)

4 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	BSP	MK
1 Classroom Lock	DG264 8237 E3MD	BSP	SA
1 Perm Core	DG2 6300	BSP	SA
1 Concealed Closer	WPH91HDCP	BSP	RF
1 Wall Stop	RM867	BSP	RO
1 Gasketing	S88BL		PE
1 Auto Door Bottom	369AA Z49-PL		ZE

Notes: Install offset pull to allow for deadlock operation.

**Set: 133.0**

Doors: 02.30.02

Description: Sgl HM - Sideline Club Kitchen/Pantry - Push/Pull/DL

1 Continuous Hinge	CFMxxHD1	ALUM	PE
1 Mortise Deadlock	DG264 4875	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Push Plate	73F CFC CFTT (as req'd)	32D-316	RO
1 Push Pull	BF 111x73C	32D-316	RO
1 Surf Overhead Hold Open	9-x26	630	RF
1 Surface Closer (OHS arm)	351 PD10	EN	SA
1 Armor Plate	K1050(F) 34" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88BL		PE
1 Sweep	315CN		PE

Notes: Conceal pull fasteners behind push plate. Install pull to avoid interference with deadlock operation.

**Set: 134.0**

Doors: 01.04.11B, 02.10.03A

Description: Sgl ALUM - Staff Entry Vestibule - Push/Pull

1 Continuous Hinge	CFMxxSLF-HD1	ALUM	PE
1 Offset Door Pull	RM3311-36 Mtg-Type 12XHD	US32D	RO
1 Push Bar	RM3112 Mtg-Type 6HD	US32D	RO
1 Conc Overhead Stop	1ADJ-x36	630	RF
1 Surface Closer	351 P10	EN	SA
1 Drop Plate	351D	EN	SA
1 Blade Stop Kit	581-2	EN	SA

Notes: Perimeter seal by aluminum door provider.

**Set: 135.0**

Doors: 01.19.09

Description: Sgl HM - Visiting Coaches Grooming - Push/Pull (Inswing)

4 Hinge, Full Mortise	TA2314 4-1/2" x 4-1/2"	US32D	MK
1 Push Plate	73F	32D-316	RO
1 Push Pull	BF 111x73C	32D-316	RO
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
3 Silencer - Metal Frame	608		RO

**Set: 136.0 (NOT USED)****Set: 137.0**

Doors: 02.02.01, 02.02.03

Description: Sgl WD - Sideline Club Men/Womens Restroom - Push/Pull (Inswing)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US4	MK
1 Push Plate	73F	US4	RO
1 Straight Door Pull	RM3301-12 Mtg-Type 12XHD	US4	RO
1 Surface Closer	351 O	US4 Cover	SA
1 Kick Plate	K1050(F) 10" x 2" LDW CSK BEV	US4	RO
1 Wall Stop	RM867	314E	RO
1 Gasketing	S88BL		PE

**Set: 138.0**

Doors: 01.12.11A

Description: Sgl HM - Staff Break Room - Push/Pull (Inswing)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	BSP	MK
1 Push Plate	73F	32D-316	RO
1 Push Pull	BF 111x73C	32D-316	RO
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 139.0**

Doors: 01.17.01C

Description: Sgl WD - Bunker Club Corridor - Panic/Class

3 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP 4-1/2" x 4-1/2"	BSP	MK
1 Rim Exit, Classroom	DG264 PE8813 NEMD	BSP	SA
1 Perm Core	DG2 6300	BSP	SA
1 Surface Closer	351 P10	BSP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
1 Wall Stop	RM867	BSP	RO
1 Gasketing	S88BL		PE

**Set: 140.1**

Doors: 01.14.15, 01.14.16, 01.14.18

Description: Sgl HM - Event Staff Restroom - Push/Pull (Inswing)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Push Plate	73F	32D-316	RO
1 Push Pull	BF 111x73C	32D-316	RO

1	Surface Closer	351 O	EN	SA
1	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1	Wall/Door Stop	406/481(H) as req'd	US32D	RO
3	Silencer - Metal Frame	608		RO

Notes: Conceal pull fasteners behind push plate.

**Set: 140.2**

Doors: 01.14.17

Description: Sgl HM - Event Staff Restroom - Push/Pull (Inswing)

3	Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Push Plate	73F	32D-316	RO
1	Push Pull	BF 111x73C	32D-316	RO
1	Surface Closer	351 P10	EN	SA
1	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1	Wall/Door Stop	406/481(H) as req'd	US32D	RO
3	Silencer - Metal Frame	608		RO

Notes: Conceal pull fasteners behind push plate.

**Set: 141.0**

Doors: 01.19.02A, 01.19.02B

Description: Sgl WD - Star Dressing/Toilet - Push/Pull (Outswing CPS)

4	Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	BSP	MK
1	Push Plate	73F	BSP	RO
1	Straight Door Pull	RM3301-12 Mtg-Type 12XHD	BSP	RO
1	Surface Closer	351 CPS	BSP	SA
1	Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
1	Gasketing	S88BL		PE

Notes: Conceal pull fasteners behind push plate.

**Set: 142.0 (NOT USED)**

**Set: 143.0**

Doors: 01.14.08

Description: Sgl WD - Aux Office - Office (No Closer)

4	Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK
1	Office/Entry Lock	LB DG264 8205 LNMD	BSP	SA
1	Perm Core	DG2 6300	BSP	SA
1	Wall Stop	RM867	BSP	RO
1	Gasketing	S88BL		PE

**Set: 144.0**

Doors: 01.12.05

Description: Sgl WD - Head Coach Office - Office (No Closer, Seal)

4	Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK
1	Office/Entry Lock	LB DG264 8205 E3MD	BSP	SA
1	Perm Core	DG2 6300	BSP	SA

1 Wall Stop	RM867	BSP	RO
1 Gasketing	S88BL		PE
1 Auto Door Bottom	369AA Z49-PL		ZE

**Set: 145.0**

Doors: 01.21.04A, 01.21.05A, 01.27.05, 01.27.06, 01.27.07

Description: Sgl HM - Show Offices, Kitchen Offices - Office (No Closer)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Office/Entry Lock	LB DG264 8205 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 146.0**

Doors: 01.19.08

Description: Sgl HM - Visiting Coaches Offices - Office (No Closer)

4 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Office/Entry Lock	LB DG264 8205 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 147.0**

Doors: 01.15.08, 01.16.05A

Description: Sgl HM - Aux Training - Classroom (Inswing HO)

4 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK
1 Classroom Lock	DG264 8237 LNMD	BSP	SA
1 Perm Core	DG2 6300	BSP	SA
1 Surface Closer (hold open)	351 H	BSP	SA
1 Wall Stop	RM867	BSP	RO
1 Gasketing	S88BL		PE

**Set: 148.0**

Doors: 02.01.01F

Description: Sgl HM - Sideline Club Kitchen - Push/Pull/DL (Inswing)

3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US4	MK
1 Mortise Deadlock	DG264 LB 4875	US4	SA
1 Perm Core	DG2 6300	US4	SA
1 Push Plate	73F	US4	RO
1 Door Pull	BF 111x73C	US4	RO
1 Surf Overhead Hold Open	9-x26	633	RF
1 Surface Closer	351 O	US4 Cover	SA
1 Armor Plate	K1050(F) 34" x 2" LDW CSK BEV	US4	RO
1 Wall Stop	RM867	314E	RO
1 Gasketing	S88BL		PE

**Set: 149.0**

Doors: 01.18.05

Description: Sgl HM - Visiting Treatment - Classroom (WIDE HO)



3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US26D	MK
1 Classroom Lock	DG264 8237 LNMD	US26D	SA
1 Perm Core	DG264 6300	US15	SA
1 Surface Closer (hold open)	351 H	EN	SA
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE

**Set: 150.0**

Doors: 01.18.01, 01.18.04

Description: Sgl WD - Star Toilet - Privacy/IND (OHS)

4 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK
1 Privacy Lock - IND	LB V20 8265 E3MD	BSP	SA
1 Surf Overhead Stop	9-x36	BSP	RF
1 Gasketing	S88BL		PE
1 Coat Hook	RM802	BSP	RO

**Set: 151.0**

Doors: 01.21.06

Description: Sgl WD\_HM - Production Toilet - Privacy/IND (Inswing)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Privacy Lock - IND - IND	LB V20 8265 LNMD	US26D	SA
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE
1 Coat Hook	RM802	US32D	RO

**Set: 152.0**

Doors: 01.19.01A, 01.19.01B, 01.20.04B, 01.20.04C

Description: Sgl WD - Star Toilets - Privacy/IND

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK
1 Privacy Lock - IND	LB V20 8265 E3MD	BSP	SA
1 Wall Stop	RM867	BSP	RO
1 Gasketing	S88BL		PE
1 Coat Hook	RM802	BSP	RO

**Set: 153.0**

Doors: 01.19.03B

Description: Sgl WD - Green Rm Shower - Privacy/IND

4 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK
1 Privacy Lock - IND	LB V20 8265 E3MD	BSP	SA
1 Wall Stop	RM867	BSP	RO
1 Gasketing	S88BL		PE
1 Coat Hook	RM802	BSP	RO

**Set: 154.0**

Doors: 02.04.02

Description: Sgl WD - Sensory Rm - Passage (Seals)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Passage Latch	8215 E3MD	US32D	SA
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE
1 Sound Gasketing	870AA (head x jambs)		ZE
1 Auto Door Bottom	369AA Z49-PL		ZE

**Set: 155.0**

Doors: 01.16.07

Description: Sgl HM - Exam Rm - Class/IND (Inswing)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK
1 Dormitory Lock - IND	DG264 LB V21 8225 LNMD	US26D	SA
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	US32D	RO
1 Wall/Door Stop	406/481(H) as req'd	US32D	RO
1 Gasketing	S88BL		PE
1 Auto Door Bottom	369AA Z49-PL		ZE

**Set: 156.0**

Doors: 01.12.03, 01.20.01A, 01.20.04A

Description: Sgl WD - Coaches Locker, Star Toilet - Passage (Inswing)

4 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK
1 Passage Latch	8215 E3MD	BSP	SA
1 Surface Closer	351 O	BSP	SA
1 Kick Plate	K1050(F) 10" x 2" LDW 4BE CSK	BSP	RO
1 Wall Stop	RM867	BSP	RO
1 Gasketing	S88BL		PE

**Set: 157.0**

Doors: 01.04.12A

Description: Sgl - Surface Sliding - Hotel Office - Locking Pull

1 Side Wall Track Kit	280C-SWTKIT/8-1413-2		PE
1 Mortise Cylinder	DG264 41 (length, cam, collar as req'd)	US32D	SA
1 Perm Core	DG264 6300	US15	SA
1 Locking Push/Pull	LP3301DBUPMPC ADA LC	US32D	RO

**Set: 158.0**

Doors: 01.15.06AD, 01.15.06AE, 01.15.06AF, 01.15.09, 01.17.03, 01.18.07B, 01.18.07C

Description: Sgl Auto Sliding Door - Home Team Locker, Visitor Locker, Grooming

1 Hardware	By Door Manufacturer		00
------------	----------------------	--	----

**Set: 159.0**

Doors: 01.31.04, 02.01.01C, 02.08.01, 02.22.02, 02.27.01, 03.12.03

Description: Dbl Acting Bar Gates

1 Gate Closer	355	689	RF
---------------	-----	-----	----

**Set: 160.0**

Doors: 02.01.01A, 02.01.01D, 02.03.01  
 Description: Dbl Acting Bar Gates

1 Gate Closer	355	696	RF
---------------	-----	-----	----

**Set: 161.0**

Doors: 01.22.02D, 01.22.02E, 01.22.02F, 01.22.02G, 01.22.02H, 01.26.06C, 01.28.07C  
 Description: Overhead Door (DPS)

1 Door Position Switch	By Security Provider (prep by Dr/Frm mfr)		SU
1 Balance of Hardware	By Door Manufacturer		OT

**Set: 162.0**

Doors: 01.03.01B, 01.04.02B, 01.06.01B, 01.06.01C, 01.15.02, 01.21.01B, 01.21.07B, 01.22.02I,  
 01.23.03A, 01.23.03B, 01.26.02D  
 Description: Overhead Door

1 Hardware	By Door Manufacturer		OT
------------	----------------------	--	----

END OF SECTION 087100

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 08 80 00 - GLAZING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Glass for windows, doors, interior borrowed lites, and storefront framing.
  - 2. Glazing sealants and accessories
- B. Related Requirements:
  - 1. Section 08 83 00 "Mirrors for opaque mirrored glass."

**1.2 DEFINITIONS**

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites or plies of an insulating-glass unit.

**1.3 COORDINATION**

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

**1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review temporary protection requirements for glazing during and after installation.

**1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- C. Glazing Accessory Samples: For sealants, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of adjoining framing system.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- E. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

- F. Shop Drawings: Submit shop drawings showing details of each type glazing system indicating sizes, shapes, material and quantity.
  - 1. Show details indicating sealant thickness and profile, bite on glass, glass edge clearance, depth of rabbet and thickness of glass.
  - 2. Identify materials, color, hardness and locations for all gasket materials, side spacer blocks, and setting blocks.
  - 3. Show the weep system in glass pockets.
  - 4. Details shall be full scale and fully drawn, not outlined.
- G. Calculations: Submit calculations demonstrating the structural capacity of each fabricated glass product to resist the design loads specified in the respective glass framing system specifications.
  - 1. Glass shall be designed using the probability of breakage of 8 lites per 1000 for vertically glazed areas, and one lite per 1000 for sloped glazed areas.
  - 2. Include strength and deflection, thermal stress, and secondary silicone sightline analysis calculations as part of this submittal.
  - 3. Calculations shall be performed by the glass fabricator.
  - 4. When glass fabricator cannot assure adequate structural performance of insulating glass units based upon combination of inner/outer lite, assume outer lite alone must satisfy structural requirements.
- H. Certifications: Submit certification from the glass fabricator stating that the glass fabricator has reviewed all glazing details, project conditions and thicknesses and compositions of all glass and finds same suitable for the purpose intended in accordance with these specifications.
  - 1. Submit certification from the glass fabricator stating that insulating glass units meet standards specified herein.
  - 2. Submit glass fabricator's certified identification, showing strength, grade, thickness, type and quality for each type of glass provided for this project.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricators of insulating-glass units with sputter-coated, low-E coatings ,glass testing agency and sealant testing agency.
- B. Product Certificates: For glass.
- C. Product Test Reports: For tinted glass, coated glass, insulating glass, and glazing sealants, for tests performed by a qualified testing agency.
  - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Sample Warranties: For special warranties.

## 1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass fabricator who is approved by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who is certified under National Glass Association's (NGA) Certified Glass Installer Program .
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

- E. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Install glazing in mockups specified in Section 08 41 13 "Aluminum-Framed Entrances and Storefronts", 08 44 13 "Glazed Aluminum Curtain Walls", and 08 51 13 "Aluminum Windows" to match glazing systems required for Project, including glazing methods.
- F. Mockups: Before glazing, build mockups for each glass product indicated in Part - Product Schedule to verify selections and to demonstrate aesthetic effects and qualities of materials and execution.
  - 1. Construction: Build mockups with glass and glazing systems specified for the project, including typical lite size, framing systems and glazing methods.
  - 2. Scheduling: Notify architect seven days in advance of dates and times when mockups will be available for viewing.
  - 3. Quality Assurance: Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work. Accepted mockups may become part of the completed work if undisturbed at the time of substantial completion.

## 1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
  - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
  - 2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
  - 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
  - 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
  - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

## 1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

## 1.11 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

- B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- D. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Basis-of-Design Glass Product: Subject to compliance with requirements, provide Viracon, Inc. product indicated in glass schedules or comparable product by one of the following:
  - 1. AGC Glass Company North America, Inc.
  - 2. Guardian Industries Corp.
  - 3. Pilkington North America.
  - 4. SCHOTT North America, Inc.
  - 5. Vitro Architectural Glass.
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
  - 1. Obtain tinted glass from single source from single manufacturer.
  - 2. Obtain reflective-coated glass from single source from single manufacturer.
- C. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazing.
  - 1. Glass Design: Glass thickness designations indicated are minimums and are for detailing only.
  - 2. Confirm glass thicknesses by analyzing Project loads and in-service conditions.



3. Provide glass lites in the thickness designations indicated for various openings, but not less than the thicknesses and in strengths (annealed or heat-treated) required to meet or exceed the following criteria:
  - a. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E1300, according to the following requirements:
    - 1) ASCE 7 Wind loads.
    - 2) ASCE 7 Snow Loads.
    - 3) ASCE 7 Ice Loads – Atmospheric Icing.
- C. Thermal Analysis:
  1. Evaluate effects of partial and full shading of glass under expected service temperature ranges.
  2. Evaluate effects of heat build-up and related thermal stresses on spandrel and/or shadow box areas under expected service temperature ranges.
- D. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E 1300:
  1. Design Wind Pressures: Determine design wind pressures applicable to Project in accordance with ASCE/SEI 7, based on heights above grade indicated on Drawings.
    - a. Wind Design Data: As indicated on Drawings.
  2. Design Snow Loads: As indicated on Structural Drawings.
  3. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
  4. Probability of Breakage for Sloped Glazing: For glass sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
  5. Probability of Breakage for Typical Glazing: For glass surfaces, design glass for a probability of breakage not greater than 8 lites per 1000.
  6. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
- E. Windborne-Debris-Impact Resistance: Exterior glazing shall pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone as indicated on Drawings for protection. Test specimens shall be no small in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.
  1. Large-Missile Test: For glazing located within 30 feet of grade.
  2. Small-Missile Test: For glazing located between 30 feet above grade.
- F. Safety Glazing: Where safety glazing is indicated and where required by IBC, provide glazing that complies with 16 CFR 1201, Category II.
- G. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  1. For monolithic-glass lites, properties are based on units with lites 6 mm minimum thick.
  2. For laminated-glass lites, properties are based on products of construction indicated.
  3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  4. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
  5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  6. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

**2.3 GLASS PRODUCTS, GENERAL**

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
  2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
  3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
  4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
1. Minimum Glass Thickness for Exterior Lites: 6 mm minimum.
  2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide heat soaking of all fully tempered float glass.

**2.4 GLASS PRODUCTS**

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Ultraclear Float Glass: ASTM C 1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. AGC Glass Company North America, Inc.; Krystal Klear.
    - b. Guardian Industries Corp.; Ultrawhite.
    - c. Pilkington North America; Optiwhite.
    - d. Vitro Architectural Glass; Starphire.
- C. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.
- D. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
    - a. Roll-Wave Distortion Limits: Maximum peak to valley deviation of 0.003 inch in center field of lite, and 0.008 inch within 10.5 inches of leading and trailing edges.
    - b. Millidiopter: Plus or minus 100 mD over 95 percent of glass surface.
    - c. Overall Bow/Warp, Maximum: Maximum bow and warp 1/32" per lineal foot.
    - d. Maintain measurement documentation for each lite. Upon request provide documentation for verification.

- E. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3
  - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
    - a. Roll-Wave Distortion Limits: Maximum peak to valley deviation of 0.003 inch in center field of lite, and 0.008 inch within 10.5 inches of leading and trailing edges.
    - b. Millidiopter: Plus or minus 100 mD over 95 percent of glass surface.
    - c. Overall Bow/Warp, Maximum: Maximum bow and warp 1/32" per lineal foot.
    - d. Maintain measurement documentation for each lite. Upon request provide documentation for verification.
- F. Reflective-Coated Vision Glass: ASTM C 1376.
- G. Anti-Reflective Coated Vision Glass: At 90-degree angle, less than 2 percent visible reflectance.
  - 1. Basis-of-Design Product: SCHOTT North America, Inc.; AMIRAN anti-reflective glass.
- H. Ceramic-Coated Vision Glass: ASTM C 1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in GANA's "Engineering Standards Manual."
  - 1. Basis-of-Design Product: Viracon, Inc.: Simulated Acid Etch Viraspan.
- I. Reflective- and Low-E-Coated Spandrel Glass: ASTM C1376.
- J. Ceramic-Coated Spandrel Glass: ASTM C 1048, Type I, Condition B, Quality-Q3.

## 2.5 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
  - 1. Construction: Unless otherwise indicated, laminate glass with or ionomeric polymer to comply with interlayer manufacturer's written instructions.
    - a. Ionomeric Polymer Interlayer: DuPont Kuraray SentryGlas Ionoplast Interlay.
  - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
  - 3. Interlayer Color: Clear unless otherwise indicated.
- B. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with the following to comply with interlayer manufacturer's written instructions:
  - 1. Ionomeric polymer interlayer
- C. Both plies of laminated glass to be of same thickness and have Ionoplast interlayer.

## 2.6 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E 2190.
  - 1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
  - 2. Spacer: Provide spacers with bent corners.
  - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

## 2.7 GLAZING SEALANTS

- A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  3. Field-applied sealants shall have a VOC content of not more than 250 g/L.
  4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.
- B. Glazing Sealant: Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C 920, Type S, Grade NS, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Corning Corporation; 795.
    - b. GE Advanced Materials - Silicones; SilPruf NB SCS9000.
    - c. Pecora Corporation; 895NST.
    - d. Sika Corporation U.S.; Sikasil WS-295.
    - e. Tremco Incorporated; Spectrem 2.

## 2.8 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
  2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.9 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
1. All material that contacts the edge of glass should be silicone.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks:
1. Elastomeric material with Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers:
1. Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks:
1. Elastomeric material of hardness needed to limit glass lateral movement (side walking).

- F. Cylindrical Glazing Sealant Backing: Closed cell sealant backing of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## **2.10 FABRICATION OF GLAZING UNITS**

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
  - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
    - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep systems.
  - 3. Minimum required face and edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

### **3.3 GLAZING, GENERAL**

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch-minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

### **3.4 TAPE GLAZING**

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

### **3.5 GASKET GLAZING (DRY)**

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal

without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### 3.7 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 08 81 13 - DECORATIVE GLASS GLAZING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Coated glass.
- B. Related Requirements:
  - 1. Section 08 80 00 "Glazing" for architectural glazing.
  - 2. Section 08 83 00 "Mirrors" for mirror glass.

**1.2 DEFINITION****1.3 COORDINATION**

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

**1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review temporary protection requirements for glazing during and after installation.

**1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For decorative glass. Show fabrication and installation details. Include the following:
  - 1. Size and location of penetrations.
  - 2. Glazing method.
  - 3. Mounting method.
  - 4. Attachments to other work.
  - 5. Full-size details of edge-finished profiles.
- C. Glass Samples: For the following products, 12 inches square:
  - 1. Each type of decorative glass.
  - 2. Each applied coating on type of decorative glass.
- D. Glazing Accessory Samples: For sealants, in 12-inch lengths. Install sealant Samples between two strips of material representative of the glazed system.
- E. Decorative Glazing Schedule: List decorative glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- F. Delegated Design Submittal: For decorative glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and sealant testing agency.

- B. Product Certificates: For each type of decorative glass.
- C. Preconstruction adhesion and compatibility test report.
- D. Sample Warranty: For special warranty.

#### **1.7 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For each type of decorative glass and each applied coating to include in maintenance manuals.

#### **1.8 QUALITY ASSURANCE**

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under NGA's Certified Glass Installer Program.
- B. Sealant Testing Agency Qualifications: An independent testing agency qualified in accordance with ASTM C 1021 to conduct the testing indicated.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### **1.9 PRECONSTRUCTION TESTING**

- A. Preconstruction Adhesion and Compatibility Testing: Test each laminated decorative glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
  - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
  - 2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
  - 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
  - 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
  - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

#### **1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Protect decorative glass and glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Retain packaging and sequencing numbers for decorative glass units.

#### **1.11 FIELD CONDITIONS**

- A. Environmental Limitations: Do not deliver or install decorative glass until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

### 1.12 WARRANTY

- A. Special Warranty on Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS OF DECORATIVE GLASS

- A. Source Limitations for Glass: Obtain each type of decorative glass from single source from single manufacturer.
- B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer, for each product and installation method.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design decorative glass.
- C. Structural Performance: Decorative glass installed adjacent to walking surfaces shall withstand the following design loads within limits and under conditions indicated:
  - 1. Differential deflection of adjacent unsupported edges shall not exceed glass thickness when subjected to 50 lbf/ft. applied horizontally to one panel at any point up to 42 inches above the adjacent walking surface.
  - 2. Base design on thickness at thinnest part of the glass.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

### 2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with glass product manufacturers' written instructions, NGA's "Laminated Glazing Reference Manual," and NGA's "GANA Glazing Manual" unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

- D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with requirements indicated. Where heat-strengthened glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with requirements indicated. Where fully tempered glass is indicated, provide fully tempered float glass.

## 2.4 GLASS PRODUCTS

- A. Ultraclear Float Glass: ASTM C 1036, Type I, Class I, Quality-Q3, and with visible light transmission not less than 91 percent.
1. Product: Subject to compliance with requirements, provide one of the following:
    - a. AGC Glass Company North America, Inc.; Krystal Klear.
    - b. Guardian Industries Corp.; UltraWhite.
    - c. Pilkington North America; Optiwhite.
    - d. Vitro Architectural Glass; Starphire.
    - e. Saint-Gobain Corporation; Diamant.
- B. Low-Iron Float Glass: ASTM C 1036, Type I, Class I, Quality-Q3, and with visible light transmission not less than 91 percent.
- C. Fully Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- D. Tempered Patterned Glass: ASTM C 1048, Kind FT (fully tempered), Type II, Class 1 (clear) or Class 2 (tinted) as indicated, Form 3; finish, pattern, and quality as indicated.
- E. Ceramic-Coated Glass: ASTM C 1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in NGA's "Engineering Standards Manual."
- F. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

## 2.5 GLAZING MATERIALS

- A. Glazing Sealants, Tapes, and Miscellaneous Glazing Materials: As specified in Section 08 80 00 "Glazing."
1. Colors: As selected by Architect from manufacturer's full range.

## 2.6 HARDWARE FOR GLASS INSTALLATION

- A. Hardware: Glass panel to wall clamps/connectors Continuous top track, or Continuous floor track.
1. Manufacturers: Subject to compliance with requirements, provide mounting hardware by decorative glass fabricator or comparable product by one of the following:
    - a. Gyford Productions, LLC.
    - b. KL meglA America, LLC.
    - c. Laurence, C. R. Co., Inc.
    - d. Sugatsune America, Inc.
  2. Dimensions: See Drawings.
  3. Material and Finish: Satin chrome or equal.
- B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- C. Gaskets: Manufacturer's standard, compatible with decorative glass type indicated.

- D. Anchors and Inserts: Provide devices as required for hardware installation. Provide metal expansion-bolt devices for drilled-in-place anchors. Provide stainless steel anchors and inserts for applications on inside face of exterior walls and where indicated.

## **2.7 DECORATIVE GLASS FABRICATION**

- A. Fabricate decorative glass and provide other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with product manufacturer's written instructions and with referenced glazing standard.
- B. Edge Finishing: Finish edges smooth and polished, without chips, scratches, or warps.
  - 1. Finished Edge: Rounded polished.
  - 2. Edge-Finished Glass Adhesive: Clear, nonyellowing, as recommended by manufacturer.
- C. Lite Treatment: Cut out as indicated on Drawings with smooth, uniform edge.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine decorative glass framing members, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Minimum required face or edge clearances.
  - 3. Effective sealing between joints of decorative glass framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate orientation of outer surfaces as indicated on Drawings. Label or mark units as needed so that surface orientation is readily identifiable. Do not use materials that leave visible marks in the completed Work.

### **3.3 INSTALLATION**

- A. Set decorative glass units in each series true in line with uniform orientation, pattern, draw, bow, and similar characteristics.
- B. Set glass lites with proper orientation so that each outer surface faces the direction indicated on Drawings.
- C. Set decorative glass in locations indicated on Drawings. Install glass with hardware and accessories according to hardware manufacturer's written instructions. Attach hardware securely to mounting surfaces and building structure.

### **3.4 GLAZING, GENERAL**

- A. Decorative Glass: Install glazing as specified in Section 08 80 00 "Glazing."
- B. Comply with combined written instructions of manufacturers of glass, gaskets, sealants, tapes, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.

- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is more than 50 inches.
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances, and to comply with system performance requirements.
  - 2. Provide 1/8-inch-minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

### **3.5 SEALANT GLAZING (WET)**

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels and between glass-to-glass joints to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants smooth.

### **3.6 CLEANING AND PROTECTION**

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

**SECTION 08 83 00 - MIRRORS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Silvered flat glass mirrors.
  - 1. Annealed monolithic glass mirrors.
  - 2. Laminated glass mirrors qualifying as safety glazing.
- B. Related Requirements:
  - 1. Section 08 80 00 "Glazing" for glass with reflective coatings used for vision and spandrel lites.
  - 2. Section 10 28 00 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Mirrors: Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
- B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.
- C. Samples: For each type of the following:
  - 1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
  - 2. Mirror Clips: Full size.
  - 3. Mirror Trim: 12 inches long.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of mirror and mirror mastic.
- C. Preconstruction Test Reports: From mirror manufacturer indicating that mirror mastic was tested for compatibility and adhesion with mirror backing and substrates on which mirrors are installed.
- D. Sample Warranty: For special warranty.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For mirrors to include in maintenance manuals.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: A qualified Installer, who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

**1.6 PRECONSTRUCTION TESTING**

- A. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing.
  - 1. Testing is not required if data are submitted based on previous testing of mirror mastic products and mirror backing matching those submitted.

**1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Protect mirrors in accordance with mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

**1.8 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

**1.9 WARRANTY**

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
  - 1. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
- B. Source Limitations for Mirror Accessories: Obtain mirror-glazing accessories from single source.

**2.2 SILVERED FLAT GLASS MIRRORS**

- A. Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
- B. Annealed Monolithic Glass Mirrors: Mirror Select Quality, clear.
  - 1. Nominal Thickness: 6.0 mm.
- C. Laminated Mirrors: ASTM C 1172, Type II.
  - 1. Glass for Outer Lite: Annealed float glass, Mirror Select Quality, clear.
  - 2. Nominal Thickness for Outer Lite: 6.0 mm.
  - 3. Glass for Inner Lite: Annealed float glass; ASTM C1036, Type I (transparent flat glass), Quality-Q3; Class 1 (clear).
  - 4. Nominal Thickness: 6.0 mm.
  - 5. Interlayer: Mirror manufacturer's standard 0.030-inch-thick, clear polyvinyl-butylal interlayer with a proven record of showing no tendency to delaminate from, or cause damage to, silver coating.
- D. Safety Glazing Products: For laminated mirrors, provide products that comply with 16 CFR 1201, Category II.



**2.3 MISCELLANEOUS MATERIALS**

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.
- D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

**2.4 MIRROR HARDWARE**

- A. Aluminum J-Channels and Cleat: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.
  - 1. Aluminum J-Channel and Cleat, Bottom and Side Trim: J-channels formed with front leg and back leg not less than 5/16 and 3/4 inch in height, respectively.
    - a. Product: Subject to compliance with requirements, provide the following:
      - 1) Laurence, C. R. Co., Inc.; D638A CRL FHA Type J-Channel.
  - 2. Aluminum J-Channel and Cleat, Top Trim: Formed with front leg with a height matching bottom trim and back leg designed to fit into the pocket created by wall-mounted aluminum cleat.
    - a. Product: Subject to compliance with requirements, provide the following:
      - 1) Laurence, C. R. Co., Inc.; D1638A CRL Top Channel and D1637M CRL Mill Mirror Mount System Cleat.
  - 3. Finish: Clear bright anodized.
- B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

**2.5 FABRICATION**

- A. Shop fabricate mirrors to greatest extent possible.
- B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts, so they fit closely around penetrations in mirrors.
- C. Mirror Edge Treatment: Flat high polished.
  - 1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
  - 2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

- B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

### 3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

### 3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced National Glass Association (NGA) publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
  - 1. NGA Publications: "Laminated Glazing Reference Manual," "Glazing Manual" and "Installation Techniques Designed to Prolong the Life of Flat Glass Mirrors."
- B. Provide a minimum airspace of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- C. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
  - 1. Aluminum J-Channels and Cleat: Fasten J-channel directly to wall and attach top trim to continuous cleat fastened directly to wall.
  - 2. Install mastic as follows:
    - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
    - b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
    - c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch between back of mirrors and mounting surface.

### 3.4 CLEANING AND PROTECTION

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. Do not permit edges of mirrors to be exposed to standing water.
- C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer and NGA's publication "Proper Procedures for Cleaning Flat Glass Mirrors."

END OF SECTION

**SECTION 08 88 53 - SECURITY GLAZING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes: monolithic polycarbonate for the following applications:
  - 1. Windows.
- B. Related Requirements:
  - 1. Section 06 16 00 "Sheathing" for ballistic-resistant opaque wall panels.
  - 2. Section 08 56 53 "Security Windows."

**1.2 DEFINITIONS**

- A. Glazing Manufacturers: Firms that produce primary glass, monolithic plastic glazing, or fabricated security glazing, as defined in referenced glazing publications.
- B. Interspace: Space between lites of air-gap security glazing or insulating security glazing.

**1.3 COORDINATION**

- A. Coordinate glazing channel dimensions to provide necessary bite on security glazing, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

**1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review temporary protection requirements for security glazing during and after installation.

**1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Security Glazing Samples: For each type of security glazing; 12 inches square.
- C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch lengths.
- D. Security Glazing Schedule: List security glazing types and thicknesses for each size opening and location. Use same designations indicated on Drawings. Indicate coordinated dimensions of security glazing and construction that receives security glazing, including clearances and glazing channel dimensions.
- E. Delegated Design Submittal: For security glazing indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.6 INFORMATIONAL SUBMITTALS**

- A. Test and Evaluation Reports:
  - 1. Product Test Reports:
    - a. For each type of security glazing, for tests performed by manufacturer and witnessed by a qualified testing agency.
    - b. For each type of glazing sealant, for tests performed by a qualified testing agency.

- 1) Provide test reports based on testing current sealant formulations within previous 36-month period.
2. Preconstruction Test Reports: For preconstruction adhesion and compatibility testing.
- B. Qualification Statements: For installers, manufacturers of insulating or air-gap security glazing with sputter-coated, low-e coatings.
- C. Delegated design engineer qualifications.
- D. Sample warranties.

### 1.7 QUALITY ASSURANCE

- A. Qualifications:
  1. Installers: Entity that employs installers for this Project who are certified under the National Glass Association Glazier Certification Program.
  2. Delegated Design Engineer: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of type indicated.
  3. Security Glazing Testing Agency: Subject to compliance with requirements, testing agency is one of the following:
    - a. Intertek.
    - b. Underwriters Laboratories, Inc.
    - c. Wiss, Janney, Elstner Associates, Inc.
  4. Sealant Testing Agency: An independent testing agency qualified in accordance with ASTM C 1021 to conduct the testing indicated.

### 1.8 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.
  1. Install security glazing in mockups specified in Section 08 56 53 "Security Windows" to match glazing systems required for Project, including glazing methods.
  2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### 1.9 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each security glazing type, tape sealant, gasket, glazing accessory, and glazing-framing member for adhesion to and compatibility with elastomeric glazing sealants.
  1. Testing will not be required if data based on previous testing of current sealant products and glazing materials match those submitted.
  2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to security glazing, tape sealants, gaskets, and glazing channel substrates.
  3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
  4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.

### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect security glazing and glazing materials according to manufacturer's written instructions. Prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.

- B. Comply with insulating security glazing and with air-gap security glazing manufacturers' written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

### 1.11 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

### 1.12 WARRANTY

- A. Manufacturer's Special Warranty for Polycarbonate Sheet: Manufacturer agrees to replace polycarbonate sheet that deteriorates within specified warranty period. Deterioration of polycarbonate sheet is defined as defects developed from normal use that are not attributed to maintaining and cleaning polycarbonate sheet contrary to manufacturer's written instructions. Defects include yellowing and loss of light transmission.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain each type of security glazing from single source from single manufacturer.
  - 1. Obtain tinted glass from single source from single manufacturer.
- B. Obtain glazing sealants from single source from single manufacturer for each product and installation method.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General:
  - 1. Installed security glazing will withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
  - 2. Installed security glazing will withstand security-related loads and forces without damage to the glazing beyond that allowed by referenced standards.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design security glazing.
- C. Structural Performance: Glazing will withstand the following design loads within limits and under conditions indicated.
  - 1. Design Procedure for Glass: ASTM E 1300 and the IBC.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
- E. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- F. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

### 2.3 SECURITY GLAZING, GENERAL

- A. Glazing Publications: Comply with published recommendations of security glazing and glazing material manufacturers and organizations below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. GANA Publications: "GANA Glazing Manual."
- B. Plastic Glazing Labeling: Identify plastic sheets with appropriate markings of applicable testing and inspecting agency, indicating compliance with required fire-test-response characteristics.
- C. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction. Label will indicate manufacturer's name, type of glazing, glass thickness, and safety glazing standard with which glazing complies.
- D. Thermal and Optical Performance Properties: Provide security glazing with performance properties specified, as indicated in manufacturer's published test data, based on construction products indicated and on procedures indicated below:
  - 1. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW 5.2 computer program.
  - 2. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

## 2.4 POLYCARBONATE SECURITY GLAZING

- A. Laminated Polycarbonate: Polycarbonate sheets laminated with clear urethane interlayer that complies with ASTM C 1349, Appendix X2, and has a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation. Provide laminated units that comply with requirements of ASTM C 1349 for maximum allowable laminating process blemishes and haze.
- B. Glass-Clad Polycarbonate: ASTM C 1349. Place glass layer at customer side of window.
  - 1. Spacer Specifications: Manufacturer's standard rigid spacer material and construction.

## 2.5 SPALL-RESISTANT FILM

- A. Composite of clear polyvinyl butyral film and clear abrasion-resistant polyester film.
- B. Laminating Process: Factory laminate spall-resistant film to glazing assemblies to produce laminated lites free of foreign substances, air, and glass pockets.

## 2.6 GLAZING SEALANTS

- A. General:
  - 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they contact, including security glazing, seals of insulating security glazing and air-gap security glazing, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  - 2. Suitability: Comply with sealant and security glazing manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  - 3. Colors of Exposed Glazing Sealants: Match Architect's samples.

## 2.7 GLAZING TAPES

- A. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## **2.8 MISCELLANEOUS GLAZING MATERIALS**

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of security glazing and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks:
  1. Elastomeric material with Shore Type A durometer hardness of 85, plus or minus 5.
- D. Spacers:
  1. Elastomeric blocks or continuous extrusions of hardness required by security glazing manufacturer to maintain security glazing lites in place for installation indicated.
- E. Edge Blocks:
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## **2.9 FABRICATION OF SECURITY GLAZING**

- A. Fabricate security glazing in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine framing for security glazing, with Installer present, for compliance with the following:
  1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  2. Presence and functioning of weep system.
  3. Minimum required face or edge clearances.
  4. Minimum required bite.
  5. Effective sealing between joints of framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Clean glazing channels and other framing members receiving security glazing immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

### **3.3 GLAZING, GENERAL**

- A. Comply with combined written instructions of manufacturers of security glazing, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect edges of security glazing from damage during handling and installation. Remove damaged security glazing from Project site and legally dispose of it off Project site. Damaged security glazing includes units with edge or face damage or other imperfections that, when installed, could weaken security glazing and impair performance and appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glazing unit manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by security glazing manufacturers for installing lites.
- F. Provide spacers for security glazing lites where the length plus width is larger than 50 inches.
  - 1. Locate spacers directly opposite each other on both inside and outside faces of security glazing. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with performance requirements.
  - 2. Provide 1/8-inch minimum bite of spacers on glazing lites and use thickness equal to sealant width. With glazing tape, use thickness of slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent security glazing from moving sideways in glazing channel, as recommended in writing by security glazing manufacturer and in accordance with requirements in referenced glazing publications.
- H. Set security glazing in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- J. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

### **3.4 TAPE GLAZING**

- A. Position tapes on fixed stops so that, when compressed by security glazing, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center security glazing in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.



- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

### **3.5 SEALANT GLAZING (WET)**

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between security glazing and glazing stops to maintain face clearances and to prevent sealant from extruding into glazing channel and blocking weep systems. Secure spacers, or spacers and backings, in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to security glazing and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from security glazing.

### **3.6 CLEANING AND PROTECTION**

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect security glazing from contact with contaminating substances resulting from construction operations, including weld splatter. Examine security glazing surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do contact with security glazing, remove substances immediately as recommended in writing by security glazing manufacturer. Remove and replace security glazing that cannot be cleaned without damage.
- C. Wash security glazing on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash security glazing as recommended in writing by security glazing manufacturer.

### **3.7 GLASS-CLAD POLYCARBONATE SECURITY GLAZING SCHEDULE**

- A. Glass Type GI-7: 1 1/4" glass-clad polycarbonate.
  - 1. Detention Security Grade: Grade 3 in accordance with ASTM F 1915.
  - 2. Maximum Overall Unit Thickness: 1 1/4 inch.
  - 3. Outdoor Lite: Tinted heat-strengthened or fully tempered float glass.
  - 4. Glass Tint Color: Gray.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 08 91 19 - FIXED LOUVERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Fixed extruded-aluminum louvers.
- B. Related Requirements:
  - 1. Section 07 92 00 "Joint Sealants" for sealants installed in perimeter joints between louver frames and adjacent construction.
  - 2. Section 09 91 13 "Exterior Painting" for field painting exterior louvers.

**1.2 DEFINITIONS**

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).
- C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- D. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing in accordance with AMCA 500-L.
- E. Windborne-Debris-Impact-Resistant Louver: Louver that provides specified windborne-debris-impact resistance, as determined by testing in accordance with AMCA 540.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
  - 2. For each louver include information air performance, water penetration and wind driven rain ratings.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
  - 1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
  - 2. Show mullion profiles and locations.
- C. Samples: For each type of metal finish required.
- D. Delegated Design Submittal: For louvers indicated to comply with structural and seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: Based on evaluation of comprehensive tests performed in accordance with AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- B. Manufacturer's windborne-debris-impact-resistance test reports.

- C. Sample Warranties: For manufacturer's special warranties.

### **1.5 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
  - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
- B. Obtain perimeter band louvers (operable and blanked off) from single manufacturer.
- C. Structural Requirements: Design all materials to withstand wind and snow loads as required by the applicable building code. Maximum allowable deflection for the louver structural members to be  $l/180$  or 0.75 inch, whichever is less. Maximum allowable deflection for the louver blades to be  $l/120$  or 0.50 inch across the weak axis, whichever is less.
- D. Professional Engineer Requirements: Drawings and structural calculations to be signed and sealed by a professional engineer licensed to practice in the project state.

### **1.6 FIELD CONDITIONS**

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

### **1.7 DELIVERY, STORAGE AND HANDLING**

- A. Visually inspect all materials for damage at time of delivery. Any damage louvers to be reported to supplier.
- B. Store louvers in packaging according to manufacturer's direction. Do not allow louvers to sit directly on the ground or allow it to be flooded.
- C. Store louvers under weather proof cover.
- D. Hoist louvers according to manufacturer's directions. Do not lift by head, sill or blades.

### **1.8 WARRANTY**

- A. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - c. Cracking, peeling, or chipping.
  - 2. Warranty Period: 10 years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.
- B. Structural Performance: Louvers withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures are considered to act normal to the face of the building.
  - 1. Wind Loads:
    - a. Determine loads based on pressures as indicated on Drawings.
- C. Windborne-Debris-Impact Resistance: Louvers located within 30 feet of grade pass protection, when tested in accordance with AMCA 540.
- D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width in accordance with AMCA 500-L.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- F. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

**2.3 FIXED EXTRUDED-ALUMINUM LOUVERS**

- A. Horizontal, Wind-Driven-Rain-Resistant Louver, Extruded Aluminum:
  - 1. Manufacturers: Subject to compliance with requirements, provide Architectural Louvers; Model E6JN, or comparable products by one of the following:
    - a. Aiolite Company, LLC (The).
    - b. Architectural Louvers
    - c. Construction Specialties, Inc.
    - d. Industrial Louvers, Inc.
    - e. Nystrom, Inc.
    - f. Ruskin Company; Tomkins PLC
  - 2. Louver Depth: 4 inches or as indicated on the Drawings.
  - 3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
  - 4. Louver Performance Ratings:
    - a. Free Area: Not less than 50% for 48-inch-wide by 48-inch-high louver.
    - b. Air Performance: Not more than 0.10-inch wg static pressure drop at [900-fpm free-area velocity.
    - c. Wind-Driven Rain Performance: Not less than 95 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 300 fpm.
  - 5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

## 2.4 LOUVER SCREENS

- A. General: Provide screen at each drainable-blade louver.
  - 1. Screen Location for Fixed Louvers: Interior face.
  - 2. Screening Type: Bird screening.
  - 3. Screening Type for Intake Louvers: Insect Screening.
- B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
  - 1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
  - 2. Finish: Mill finish unless otherwise indicated.
  - 3. Type: Non-rewirable, U-shaped frames.
- D. Louver Screening for Aluminum Louvers:
  - 1. Bird Screening, Aluminum: 1/2-inch-square mesh, 0.063-inch wire. Frame: Extruded Aluminum, 0.055 inch thick.
  - 2. Insect Screening, Aluminum: 18-by-16 mesh, mill finish, 0.011-inch wire. Frame; Extruded Aluminum, 0.055 inch thick.

## 2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
  - 1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
  - 2. For fastening aluminum, use aluminum or 300 series stainless steel fasteners.
  - 3. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Post-installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.6 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
  - 1. Decorative Louvers: Heads, sills, jambs and mullions to be one-piece structural aluminum members with integral caulking slot and retaining beads.
  - 2. Architectural Line, Drainable, Wind Resistant Fixed-Blade designed to collect and drain water to exterior at sill by means of multiple gutters in blades and channels in jambs and mullions.
- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

- C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
  - 1. Frame Type: Channel unless otherwise indicated.
  - 2. Fully weld perimeter frame.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.
  - 1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
  - 2. Exterior Corners: Prefabricated corner units with mitered blades with concealed close-fitting splices and with fully recessed mullions at corners.
- F. Sills: Louvers to be supplied with 4" high by full depth sill flashings formed from minimum 0.050" thick aluminum. Sill flashings to have welded side panels.
- G. Provide subsills made of same material as louvers for recessed louvers.
- H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

## 2.7 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
  - 1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 2. Color and Gloss: As selected by Architect from manufacturer's full range

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

### 3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

- C. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- D. Form closely fitted joints with exposed connections accurately located and secured.
- E. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- F. Erection Tolerances:
  - 1. Maximum variation from plane or location shown on the approved shop drawings: 1/8" per 12 feet of length, but not exceeding 1/2" in any total building length or portion thereof (non-cumulative).
  - 2. Maximum offset from true alignment between two members abutting end to end, edge-to-edge in line or separated by less than 3": 1/16" (shop or field joints). This limiting condition shall prevail under both load and no load conditions.
- G. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.
- H. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.
- I. Set units level, plumb and true to line, with uniform joints.
- J. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 92 00 "Joint Sealants" for sealants applied during louver installation.
  - 1. Seal blank-off panels to louver frame to ensure air/vapor barrier continuity.
  - 2. Louvers and sill flashings to be installed in accordance with the manufacturer's recommended procedures to ensure complete water integrity performance of the louver system.

### 3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
  - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.
- D. Protect installed materials to prevent damage by other trades.
  - 1. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION



**SECTION 09 21 16.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Gypsum board shaft wall assemblies.
- B. Related Requirements:

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each component of gypsum board shaft wall assembly.
- B. Shop Drawings: For gypsum board shaft wall assembly.
  - 1. Include plans, elevations, and sections.
- C. Samples for Selection: For each type of exposed finish indicated.
  - 1. Metal Finishes: 6-inch-long sections of, accessory fittings, and other items.
- D. Fabrication Sample: Provide assembly, made from 12-inch lengths of full-size components.
- E. Delegated-Design Submittal: For gypsum board shaft wall assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Engineer must be licensed in the State where the project is located.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Evaluation Reports: For shaft wall assemblies, firestop tracks, from ICC-ES.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and support them on risers on a flat platform to prevent sagging.

**1.5 FIELD CONDITIONS**

- A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.
- B. Do not install finish panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E90 and classified according to ASTM E413 by a testing and inspecting agency.

**2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES**

- A. Fire-Resistance Rating: As indicated on Drawings.
- B. STC Rating: 51, minimum.
- C. Gypsum Shaftliner Board:
  - 1. Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch thick, with double beveled long edges.
  - 2. Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with ASTM D 3273 mold-resistance score of 10 as rated according to ASTM D 3274, 1 inch thick, and with double beveled long edges.
  - 3. Moisture- and Mold-Resistant, Fiberglass-Mat Faced: ASTM C 1658/C 1658M; manufacturer's proprietary fire-resistive liner panels with ASTM D 3273 mold-resistance score of 10 as rated according to ASTM D 3274, 1 inch thick, and with double beveled long edges.
- D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C 645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.
  - 1. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized unless otherwise indicated.
- E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:
  - 1. Depth: 2-1/2 inches.
  - 2. Minimum Base-Metal Thickness: 0.033 inch.
- F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.
  - 1. Minimum Base-Metal Thickness: 0.033 inch.
- G. Firestop Tracks: Provide firestop track at head of shaft wall on each floor level.
- H. Elevator-Hoistway-Entrance Struts: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches, matching studs in depth, and not less than 0.033 inch thick.
- I. Room-Side Finish: Gypsum board.
- J. Shaft-Side Finish: Gypsum shaftliner board, moisture- and mold-resistant Type X.
- K. Sound Attenuation Blankets: As specified in Section 09 29 00 "Gypsum Board."

**2.3 PANEL PRODUCTS**

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

- B. Gypsum Shaftliner Board, Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with moisture- and mold-resistant core and surfaces.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corporation; ProRoc Moisture and Mold Resistant Shaftliner.
    - b. Georgia-Pacific Gypsum, LLC; Subsidiary of Georgia Pacific; Dens-Glass Ultra Shaftliner.
    - c. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner XP.
    - d. USG Corporation; Sheetrock Brand Mold Tough Gypsum Liner Panel (EcoSmart version is acceptable).
  - 2. Thickness: 1 inch.
  - 3. Long Edges: Double bevel.
  - 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- C. Gypsum Board: As specified in Section 09 29 00 "Gypsum Board."
- D. Cementitious Backer Units: As specified in Section 09 29 00 "Gypsum Board."

## 2.4 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 09 29 00 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
  - 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
  - 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Sound Attenuation Blankets: As specified in Section 09 29 00 "Gypsum Board."
- F. Acoustical Sealant: Section 07 92 00 "Joint Sealants."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 07 81 00 "Applied Fire Protection."
- B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

### 3.3 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.
- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
  - 1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
  - 2. Reinforcing: Provide where items attach directly to shaft wall assemblies, provide galvanized steel reinforcing strip with 0.033-inch minimum thickness of base metal (uncoated), accurately positioned and secured behind at least one layer of face panel.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.
- F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- G. Control Joints: Install control joints at locations indicated on Drawings according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
- I. Cant Panels: At projections into shaft exceeding 4 inches, install 1/2- or 5/8-inch thick gypsum board cants covering tops of projections.
  - 1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.
  - 2. Where non-load-bearing steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to shaft wall framing.
- J. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

**3.4 PROTECTION**

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Non-load-bearing steel framing systems for interior partition assemblies
  - 2. Suspension systems for interior gypsum ceilings, soffits, and grid system.
- B. Related Requirements:
  - 1. Section 05 40 00 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.
  - 2. Section 09 29 00 "Gypsum Board" for sound attenuation insulation.
- C. Nomenclature: Framing products provided under this Section are indicated on the Drawings as "steel studs." Structural framing specified in Section 05 40 00 "Cold-Formed Metal Framing" is indicated on the Drawings as "metal framing."

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Span and Deflection Design Criteria: Provide height to load deflection charts showing studs supplied conform to deflection limit scheduled and allowed per ASTM C 754.
  - 1. Mark on chart(s) showing all major partitions scheduled conformance with criteria.
  - 2. Submit manufacturer's certification of stud size, thickness, and spacing complying with performance requirements and selections made by architect are correct for application shown.
- B. Evaluation Reports: For firestop tracks, from ICC-ES.

**1.4 QUALITY ASSURANCE**

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Stud Manufacturers Association.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Notify manufacturer of damaged materials received prior to installation.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Performance Requirements: Provide metal framing assemblies to withstand the loads prescribed within the specified deflection limits.
  - 1. Horizontal Deflection: For wall assemblies per ASTM C 754: Allowing for 10 lbf/sq. ft. (480 Pa) lateral load.
    - a. Typical Finishes: L/240.
    - b. Tile, Plaster, Stone or Similar Finishes: L/360.
  - 2. Where partition heights exceed stud manufacturer's recommended unbraced spans, and to resist deflection limits, provide one of the following:
    - a. Heavier stud gage, except at walls with STC ratings.
    - b. Closer stud spacing.
    - c. Deeper stud size (space permitting, as determined by Architect).
    - d. Above-ceiling bracing, anchored to structure above
- B. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119 by an independent testing agency.
- C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

**2.2 FRAMING SYSTEMS**

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated
  - 2. Protective Coating: Comply with ASTM A 653/A 653M, G40; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
- B. Studs and Runners: ASTM C645. Use either steel studs and runners or embossed steel studs and runners.
  - 1. Steel Studs and Runners: Steel Studs (can be embossed or dimple): Minimum steel tensile strength 33 KSI.
    - a. Base-Metal Thickness: 0.0179 Minimum and as indicated in the Partition Type schedule in the Drawings.
    - b. Depth: as indicated in the Partition Type schedule in the Drawings.
  - 2. Embossed Steel Studs and Runners:
    - a. Basis of Design Product: Clark Dietrich ProStud 20 or equal as determined by Architect.
      - 1) Products: Subject to prior approval of Architect through Substitution Form, available products that may be incorporated into the Work include the following:
        - a) MarinoWare; ViperStud.
        - b) CEMCO; ViperStud.
        - c) Telling Industries; ViperStud.
      - b. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
  - 1. Single Long-Leg Track System: Top track with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
  - 2. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.



- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
  - 2) Telling Industries; True-Action Slotted Track.
  - 3) Steel Network Inc: VertiClip SLF or VTD.
- D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
    - b. Metal-Lite, Inc.; The System.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  - 1. Minimum Base-Steel Thickness: 0.053 inch.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  - 1. Minimum Base-Steel Thickness: 0.018 inch.
  - 2. Depth: 7/8 inch.

### 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Hanger Attachments to Concrete:
  - 1. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Carrying Channels : Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch-wide flanges.
  - 1. Depth: 1-1/2 inches.
- E. Furring Channels (Furring Members):
  - 1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
  - 2. Hat-Shaped, Rigid Furring Channels: 7/8 inch deep.
    - a. Minimum Base-Steel Thickness: 0.0329 inch.
- F. Grid Suspension Systems for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
    - b. Chicago Metallic Company LLC, a division of ROCKFON; Drywall Grid System.
    - c. USG Corporation; Drywall Suspension System.

### 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
  - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
  - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
  - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
  - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
  - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

**3.3 INSTALLATION, GENERAL**

- A. Installation Standard: ASTM C 754.
  - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

**3.4 INSTALLATION OF FRAMING SYSTEMS**

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
  - 2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
  - 3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.

- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
    - d. Provide box beam header at all door and framed openings larger than 3'-4" wide. Size header according to deflection and overall width of opening.
  3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
  6. Curved Partitions:
    - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.
- E. Direct Furring:
1. Screw to wood framing.
  2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

### 3.5 INSTALLATION OF SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
1. Hangers: 48 inches o.c.
  2. Carrying Channels (Main Runners): 48 inches o.c.
  3. Furring Channels (Furring Members): 16 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension

system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

- a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
  3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  5. Do not attach hangers to steel roof deck.
  6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

### **3.6 INSTALLATION OF GRID SUSPENSION SYSTEMS**

- A. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

### **3.7 FIELD QUALITY CONTROL**

- A. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

**SECTION 09 29 00 - GYPSUM BOARD****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Interior mold and mildew resistant gypsum board.
  2. Interior abuse-resistant gypsum board.
  3. Tile backing panels.
  4. Sound Batt Insulation.
  5. Tile backing panels.
- B. Related Requirements:
1. Section 06 16 00 "Sheathing" for gypsum sheathing for exterior walls.
  2. Section 07 92 19 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
  3. Section 09 22 16 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
  4. Section 09 21 16.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
  5. Section 09 30 13 "Tile" for cementitious backer units installed as substrates for ceramic tile.
  6. Section 09 91 23 "Interior Painting" for stipple painting to create gypsum board texture.

**1.2 ACTION SUBMITTALS**

- A. Product Data: Submit manufacturer's technical data for each type of gypsum board product, including related accessories. Furnish a material list with technical data documenting the location and primary function, quality, and performance of each material component or system to be used in the Work, or other such primary characteristics as required by the Drawing or Specifications.
1. Submit manufacturer's technical data for each gypsum drywall partition and each ceiling system.
- B. Shop Drawings: Show locations of gypsum board mounted to ceiling framing and control joint pattern. Show widths, details, and locations of expansion and control joints.

**1.3 DELIVERY, STORAGE AND HANDLING**

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

**1.4 FIELD CONDITIONS**

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E 90 and classified in accordance with ASTM E 413 by an independent testing agency.
  - 1. Conform to applicable code for fire rated assemblies. Construct assemblies to achieve fire resistance ratings indicated on Drawings in accordance with UL, or other acceptable tested approved assemblies. Where no test number is referenced, utilize and submit a tested approved assembly that achieves the fire rating required by the Drawings, including the Life Safety Plan.

**2.2 GYPSUM BOARD, GENERAL**

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

**2.3 INTERIOR GYPSUM BOARD**

- A. Abuse-Resistant Gypsum Board: ASTM C1396/C1396M, with Level 3 surface abrasion resistance, Level 1 or better indentation resistance, and Level 2 or better soft body impact resistance.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. American Gypsum; M-Bloc AR Type X.
    - b. CertainTeed Corp.; AirRenew Extreme Abuse.
    - c. National Gypsum Company; Gold Bond Hi-Abuse XP.
    - d. USG Mold-Tough A/R.
  - 2. Core: 5/8 inch, Type X.
  - 3. Long Edges: Tapered.
  - 4. Mold Resistance: ASTM D 3273, score of 10.
- B. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
  - 1. Product: Subject to compliance with requirements, provide one of the following:
    - a. American Gypsum; M-BLOC Type X.
    - b. CertainTeed Corp.; ProRoc Moisture and Mold Resistant Type X.
    - c. Georgia-Pacific Gypsum LLC; ToughRock Fireguard X Mold-Guard.
    - d. Gold Bond Building; Gold Bond Brand XP Fire-Shield.
    - e. USG Corporation; Sheetrock Mold Tough Firecode Core.
  - 2. Core: 5/8 inch, Type X.
  - 3. Long Edges: Tapered.
  - 4. Mold Resistance: ASTM D3273, score of 10.
- C. Flexible Gypsum Board: ASTM C 1396 / ASTM C1396 M.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. American Gypsum.
    - b. CertainTeed Corp.
    - c. Georgia-Pacific Gypsum, LLC.
    - d. National Gypsum Company; Gold Bond High Flex.
    - e. USG Corporation.
  - 2. Core: 5/8 inch, Type X.
  - 3. Long Edges: Tapered.

4. Mold Resistance: ASTM D3273, score of 10.

## 2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1325, with manufacturer's standard edges.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. FinPan, Inc; ProTEC Concrete Backer Board.
    - b. National Gypsum Company, Permabase Cement Board.
  2. Thickness: 5/8 inch.
  3. Mold Resistance: ASTM D 3273, score of 10.

## 2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
  2. Shapes:
    - a. Cornerbead.
    - b. Bullnose bead.
    - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - d. L-Bead: L-shaped; exposed long flange receives joint compound.
    - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    - f. Expansion (control) joint.
    - g. Curved-Edge Cornerbead: With notched or flexible flanges.

## 2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Compound for Interior Gypsum Board:
  1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use setting-type, sandable topping compound.
  4. Finish Coat: For third coat, use setting-type, sandable topping compound.
  5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.
- C. Joint Tape and Joint Compound : For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
  1. Interior Gypsum Board: Open-weave glass mesh, 2" minimum width.
    - a. Compound: Ready Mix.
      - 1) Basis of Design: National Gypsum, Proform Multi-use Joint Compound.
  2. Interior Moisture and Mold Resistant Board: fiberglass mesh, 1.9" minimum width.
    - a. Compound: setting type.
  3. Joint Compound for Tile Backing Panels:
    - a. Tape: Alkali resistant tape, 2" minimum width.
      - 1) Basis of Design: National Gypsum, PermaBase Cement Board Tape.
    - b. Compound: Thin set mortar.
      - 1) Basis of Design:
        - a) Laticrete 254 Platinum per ASTM A 118.4.
        - b) Laticrete 211 and Laticrete 4237 per ASTM A 118.1

- D. Tile Backing Panel Finish Materials for Non-Tiled Applications: For high-humidity and wet non-tiled and painted surfaces, use cement board and comply with tile backing panel manufacturer's written instructions and filling joints as described above in joint compound.
1. Base and Skim Coats: Portland cement and polymer adhesive based materials comparable to one of the following, and acceptable to panel manufacturer:
    - a. Dryvit; Genesis DM, DS174.
    - b. Sto Corporation; F-477 Flexyl.
    - c. Parex; ParFlex.
    - d. Synergy; Xtra-Stop.
  2. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh, made from continuous multiend strands with retained mesh tensile strength of not less than 120 lbf/in. per ASTM E 2098; complying with ASTM D 578 and the following:
    - a. Surface Reinforcing Mesh: Not less than 4.0 oz./sq. yd.
    - b. Joint and Corner Reinforcing Mesh: 6 inch coated mesh tape.
  3. Epoxy Paint Finish: As indicated in the Finish Schedule and Legend and specified in Section 09 91 23 "Interior Painting."

## 2.7 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound-Attenuation Blankets/Batts: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool. The depth of sound attenuation blanket to match the depth of the metal stud.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Mansville: MinWool or Sound & Fire Block batts.
    - b. Knauf: Ecose-fiberglas board
    - c. Owens Corning: PINK NEXT GEN fiberglass-Sound Attenuation Batts Fiber Glass.
- D. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Accumetric LLC; BOSS 826 Acoustical Sound Sealant.
    - b. GE Construction Sealants; RCS20 Acoustical.
    - c. Grabber Construction Products; Acoustical Sealant GSC.
    - d. PABCO Gypsum; Quiet Seal Pro.
    - e. Pecora Corporation; AIS-919.
    - f. Tremco, Incorporated; Tremco Acoustical Sealant.
    - g. USG Corporation; SHEETROCK Acoustical Sealant.
- E. Fire rated Joint Sealant: See Division 07.
- F. Thermal Insulation: As specified in Section 07 21 00 "Thermal Insulation."



**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL**

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

- J. Fire-Rated Assemblies: UL Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of fire rated sealant that matches wall rating. Install sealant at both faces of partitions at perimeters. Refer to Division 07 for firestopping to be used at penetrations.
- K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### 3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1.
  - 2. Moisture and Mold-Resistant Type: All dry vertical and ceiling surfaces, unless otherwise indicated.
- B. Single-Layer Application:
  - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
  - 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
  - 3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
  - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

### 3.4 INSTALLATION OF TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at at locations indicated to receive tile in areas subject to direct wetting (e.g. showers, hydrotherapy rooms, steam rooms), as a substrate for wall base at locations indicated to receive resinous flooring with integrally coved wall base, and where indicated.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.
- C. At resinous cove base locations, provide high cementitious backer units from floor to 6 inches above sub floor. Install scheduled board above cementitious backer band as noted on Drawings.

### 3.5 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints in accordance with ASTM C 840 and in specific locations approved by Architect for visual effect.
  - 1. Where possible, install vertical control joints at outer edge of door frame.
  - 2. At ceiling locations, describe on Shop Drawings prior to installation.

- C. Interior Trim: Install in the following locations:
  - 1. Cornerbead: Use at outside corners, unless otherwise indicated.
  - 2. LC-Bead: Use where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate
  - 3. L-Bead: Use where edge trim can only be installed after gypsum panels are installed. U-Bead: Use where indicated.
  - 4. U-Bead: Use where indicated.
  - 5. Reveals and Other profiles: As indicated on Drawings.

### 3.6 FINISHING OF GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
  - 1. Use elastomeric sealant at door frames in lieu of joint compound.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. At cove light locations, provide level 5 finish at horizontal ceiling surfaces illuminated by cove lighting. Adjacent vertical gypsum board inside the cove may be level 4.
- D. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
  - 1. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  - 2. Fill Coat: For second coat, use setting-type, sandable topping compound.
  - 3. Finish Coat: For third coat, use setting-type, sandable topping compound.
  - 4. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound, or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
- E. Gypsum Board Finish Levels: Finish panels to levels indicated below and in accordance with ASTM C 840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Panels that are substrate for tile and where indicated on Drawings.
  - 3. Level 4: At panel surfaces that will be exposed to view and scheduled to receive wall covering or flat paint finish (MPI Gloss Level 1), unless otherwise indicated. At curved partitions, partitions with continuous unbroken length of 20 feet or greater, horizontal and vertical surfaces of soffits, surfaces scheduled to receive paint finish with a sheen of Gloss Level 2 or greater, surfaces scheduled to receive wallcovering, and where indicated.
    - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
    - b. Extend wall finish level into coves and reveals.
  - 4. Level 5: At curved partitions, partitions with continuous unbroken length of 20 feet or greater, horizontal and vertical surfaces of soffits, surfaces scheduled to receive paint finish with a sheen of Gloss Level 2 or greater, surfaces scheduled to receive graphic film, and where indicated.
    - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
  - 5. Level 5: Provide Level 5 finish on gypsum partitions receiving wallcovering.
- F. Cementitious Backer Units: Finish according to manufacturer's written instructions.

- G. Tile Backing Panel Finish for High-Humidity and Wet Non-Tile Areas:
1. After filling joints with proper joint compound, apply base coat to exposed surfaces of tile backing panel in minimum thickness of 1/16-inch dry-coat thickness.
  2. Embed reinforcing mesh in wet base coat to produce wrinkle-free installation with mesh continuous at corners and overlapped not less than 2-1/2 inches. Do not lap reinforcing mesh within 8 inches of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are not visible.
  3. Apply skim coat to completely embed mesh over entire surface and to achieve a fine sand texture.
  4. Epoxy Paint Finish: As specified in Section 09 91 23 "Interior Painting."

### 3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

**SECTION 09 30 13 - TILE****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Porcelain tile.
  2. Ceramic mosaic tile.
  3. Glazed wall tile.
  4. Thresholds.
  5. Floor underlayment.
  6. Waterproof membranes.
  7. Crack isolation membranes.
  8. Setting material.
  9. Trim and accessories.
  10. Grout materials.
  11. Miscellaneous materials.
  12. Elastomeric sealants.
- B. Related Requirements:
1. Section 07 92 00 "Joint Sealants" for sealing of movement joints in tile surfaces.
  2. Section 09 29 00 "Gypsum Board" for tile backing panels.
  3. Section 09 30 23 "Glass Tiling."

**1.2 DEFINITIONS**

- A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Face Size: Actual tile size, excluding spacer lugs.
- D. Large Format Tile: Tiles with face size greater than 929 sqcm (144 sq. in.), or tiles with at least one side greater than 38cm (15 inches).
- E. Module Size: Actual tile size plus joint width indicated.
- F. Polished Finish: Smooth surface that produces sharp, mirrorlike reflections. Reflected images of overhead fluorescent tubes have straight lines without visible distortion when viewed at arm's length.
- G. Honed Finish: Smooth, nonreflective surface similar to that produced by grinding with a 400- to 1200-grit abrasive; with a gap not exceeding 0.127mm (0.005 inch) when faces are tested for flatness with a 610mm (24-inch) straightedge.
- H. Sand-Rubbed Finish: Uniform, fine-textured surface similar to that produced by grinding with a 40-grit abrasive; with a gap not exceeding 1/32 inch when faces are tested for flatness with a 610mm (24-inch) straightedge.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.
  - 2. Review joint locations and how each joint will be treated.
  - 3. Surface preparation.
  - 4. Oversized tile installation.
  - 5. Grouting materials and procedures.
  - 6. Cleaning and protecting of tile surfaces.

**1.4 SEQUENCING AND SCHEDULING**

- A. Sequence stone tile installation with other work to minimize possibility of damage and soiling during remainder of construction period.
- B. Install stone tile and accessories only after other finishing operations, including painting, are completed.

**1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations for each type of tile and tile pattern. Show widths, details, and locations of movement, contractions, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated.
  - 1. For of each type tile that comes in color blend patterns, provide full sheets of each color blend.
  - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
  - 3. Full-size units of each type of trim and accessory for each color and finish required.
  - 4. Metal flooring transitions 6-inch lengths.
  - 5. Grout samples for final color selection.

**1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product.
- D. Product Test Reports:
  - 1. Tile-setting and -grouting products.
  - 2. Certified porcelain tile.

**1.7 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For dimension stone tile to include in maintenance manuals.

**1.8 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
  2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

**1.9 QUALITY ASSURANCE**

- A. Installer Qualifications:
1. Individual installer(s) working for installing contractor are certified through Advanced Certifications for Tile Installers (ACT) for installation of Large Format Tile and Substrate Preparation.
  2. Installer meets the requirements of a program identified and approved by the architect with the criteria for such program similar to or exceeding Advanced Certifications for Tile Installers (ACT) for installation of Large Format Tile and Substrate Preparation, Membranes Shower Receptors or Ceramic Tile Education Foundation (CTEF) Certified Tile Installer Program or National Tile Contractors' Association (NTCA) Five Star Contractor Program or Tile Contractors' Association of America (TCAA) Trowel of Excellence Program.

**1.10 MOCKUPS**

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
1. Build mockup of each type of floor tile installation.
  2. Build mockup of each type of wall tile installation.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.11 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Oversized tiles have additional delivery and handling requirements and may require mechanized equipment; follow manufacturer's written recommendations.

**1.12 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in "Referenced Standards" Article in the Evaluations and manufacturer's written instructions.

**1.13 WARRANTY**

- A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace defective installation areas, material, and labor that fail under normal usage within specified warranty period.
1. Warranty Period: 10 years from date of Product Purchase.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products by the following:
1. American Olean; a division of Dal-Tile Corporation.
  2. Ceramiche Campogalliano.
  3. Crossville, Inc.
  4. Daltile.
  5. Deutsche Steinzeug America, Inc.
  6. Endicott Tile LLC.
  7. Epro Tile, Inc.
  8. Florida Tile, Inc.
  9. Florim USA.
  10. Interceramic.
  11. Interstyle Ceramic & Glass.
  12. Iris Ceramic US, Inc.
  13. Jeffrey Court, Inc.
  14. Lone Star Ceramics; Elgin Butler.
  15. Marazzi USA.
  16. Metropolitan Ceramics.
  17. Olympia Tile & Stone
  18. Portobello America, Inc.
  19. Provenza Floors.
  20. Seneca Tiles, Inc.
  21. Sonoma Tilemakers.
  22. Vitromex USA.

**2.2 SOURCE LIMITATIONS**

- A. Source of Limitations Tile: Obtain tile of each type and color or finish from single source or producer.
1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
1. Obtain setting and grouting materials, except for unmodified portland cement and aggregate, from single manufacturer.
  2. Obtain waterproof membrane, crack isolation, and other required membranes from manufacturer of setting and grouting materials.
- C. Source of Limitations to Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
1. Waterproof membrane.
  2. Crack isolation membrane.
  3. Metal edge strips.



4. Joint Sealants.

### 2.3 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
  1. Provide tile complying with Standard Grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
  1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

### 2.4 TILE PRODUCTS

- A. Tile:
  1. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
  2. Dynamic Coefficient of Friction: For floor tile, not less than 0.42.
  3. Tile Color and Pattern: As indicated by manufacturer's designations.
  4. Grout Color: As indicated by manufacturer's designations.
  5. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile, unless otherwise indicated. Provide shapes as follows, unless otherwise indicated, selected from manufacturer's standard shapes:
    - a. Base for Thinset Mortar Installations: Straight.
    - b. Wainscot Cap for Thinset Mortar Installations: Surface bullnose.
    - c. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it, same size as adjoining flat tile.
    - d. External Corners for Thinset Mortar Installations: Surface bullnose.
    - e. Internal Corners: Field-buttet square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.

### 2.5 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

### 2.1 FLOOR UNDERLAYMENT

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements,
  1. Ardex: K15.
  2. Uzin:
    - a. NC 170: self leveling.
    - b. NC 888: trowelable.

- C. Provide floor underlayment below all tiles that are more than 457mm (18 inches) long in any direction. Pour floor underlayment to provide a minimum slope of 3/16 inch in 10'-0" and a maximum slope of 1/32" in 1'- 0". Install underlayment according to manufacturer's guidelines and before waterproofing and crack isolation membranes.
1. Compressive Strength: Minimum of 24.13 MPa (3,500 psi) @ 28 days per modified ASTM C109.

## 2.2 WATERPROOF MEMBRANES

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.
1. Vapor Permeance: Maximum 0.5 perms; ASTM E 96, Procedure E.

## 2.3 CRACK ISOLATION MEMBRANES

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Where crack isolation and waterproof membranes are indicated for the same installation, a single membrane complying with requirements for both may be acceptable.

## 2.4 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Custom Building Products.
    - b. Laticrete International, Inc.
    - c. MAPEI Corporation.
    - d. Merkrete by Parex USA Inc.
  2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

## 2.5 TRIM AND ACCESSORIES

- A. Ceramic Accessories: See schedule at the end of this Section.
- B. Non-Ceramic Transition Trim and reducers: Maximum change in level: 12.6mm (0-1/2 inch). Maximum slope: 1:2 Material and finish, style and dimensions to suit application, for setting using tile mortar or adhesive; use in the following locations:
1. Transition between floor finishes of different heights.
  2. Thresholds at door openings.
  3. Movement and Control Joints for floors and walls:
  4. See schedule at the end of this Section.

## 2.6 GROUT MATERIALS

- A. High-Performance Tile Grout: ANSI A118.7.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Custom Building Products.
    - b. Laticrete International, Inc.
    - c. MAPEI Corporation.

2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

## 2.7 MISCELLANEOUS MATERIALS

- A. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Blanke Corporation.
    - b. Ceramic Tool Company, Inc.
    - c. Schluter Systems L.P.
- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- C. Grout Sealer: Grout manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.
  1. Grout sealers shall comply with requirements of FloorScore certification.

## 2.8 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 7 "Joint Sealants."
- B. Ensure sealant can physically and chemically withstand environmental conditions normally expected at installation areas.
  1. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.
  2. Ensure sealant is chemically compatible with tile, mortar, and grout.
  3. Joint Backing: Closed cell foam polyethylene  
Colors: Provide colors of exposed

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  2. Verify that concrete substrates for tile floors installed with bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
    - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
  3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.

4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.
- B. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped 1/4 inch per foot toward drains.
- D. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

### 3.3 INSTALLATION OF CERAMIC TILE SYSTEM

- A. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F2170 (Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes) in new construction or ASTM F1869 (Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride) in renovations to Architect and Owner prior to floor installation. Acceptable moisture content of concrete subfloor shall be within approved manufacture limits or lower prior to installation.
1. At inside corners of tile floors, base and walls, provide sealant joint. Joint width to match specified joint widths. Color of exposed sealant to match color of grout in tile.
- B. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.
1. For the following installations, follow procedures in ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
  2. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
  3. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
  4. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
  5. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
  6. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
    - a. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets, so joints between sheets are not apparent in finished Work.

- b. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
  - c. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- 7. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
  - a. Ceramic Mosaic Tile: 1.5mm (1/16 inch).
  - b. Pressed Floor Tile: 10mm (3/8 inch).
  - c. Glazed Wall Tile: 1.5mm (1/16 inch).
  - d. Large Format Tile: 6.35mm (1/4 inch).
- 8. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- C. Metal Edge Strips and reducers: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
- D. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.
  - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- E. Thresholds: Install stone and solid surface thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
  - 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in [modified dry-set] [improved modified dry-set] mortar (thinset).
  - 2. Do not extend [cleavage membrane] [waterproof membrane] [or] [crack isolation membrane] under thresholds set in [standard dry-set] [modified dry-set] [or] [improved modified dry-set] mortar. Fill joints between such thresholds and adjoining tile set on [cleavage membrane] [waterproof membrane] [or] [crack isolation membrane] with elastomeric sealant.
- F. Metal Flooring Transitions: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
- G. Metal Wall Trim: Install at locations indicated on Drawings.
- H. Grout Sealer: Apply grout sealer to cementitious grout joints specified in this Section in accordance with manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

### 3.4 FIELD QUALITY CONTROL

- A. Water Test:
  - 1. Test of waterproofing membrane in showers and similar areas to be performed by Installation Contractor before setting tile.
    - a. Perform test after 24 hours of waterproof membrane installation.
    - b. Insert test plug in drain or waste line.
    - c. Fill shower base with water, high enough that the membrane-to-drain connection and floor-to-wall transition can be evaluated, and mark wall.
    - d. Check for leaks after 24 hours.
  - 2. Test to be witnessed by Architect and authorities having jurisdiction.
- B. Nonconforming Work:
  - 1. Waterproof membrane will be considered defective if water level has dropped.
  - 2. Remove and replace defective components and retest.

### 3.5 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
  - 1. Remove grout residue from tile as soon as possible.
  - 2. Clean grout smears and haze from tile in accordance with tile and grout manufacturer's written instructions. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

### 3.6 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

### 3.7 THRESHOLD AND TRANSITION SCHEDULE

- A. Thin Set Floor Tile Transitions: Stainless Steel unless otherwise noted in the Drawings and Finish Schedule.
  - 1. Level Transition: Schluter-SCHIENE or equal.
  - 2. Minor Sloped Transition: Schluter-RENO-TK or equal.
  - 3. Larger Sloped Transition: Schluter-RENO-U or equal.
  - 4. Movement or Control Joint edges: Schluter-SCHIENE or equal.
  - 5. Decorative Accents: Schluter-DECO or equal.
- B. Wall Tile Transitions: Stainless Steel unless otherwise noted in the Drawings and Finish Schedule.
  - 1. Tile Wall to Tile Floor Transition: Schluter®-DILEX-AHK or equal.
  - 2. Tile Wall to Non-Tile Floor Transition: Schluter®-DILEX-AHKA or equal.
  - 3. Tile to Tile Wall Outside Corner: Schluter®-QUADEC or equal.
  - 4. Trim at Base: Schluter®-JOLLY or equal.

### 3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
  - 1. Ceramic Tile Installation: TCNA F113; thinset mortar, for slab-on-grade installations unless otherwise indicated.
    - a. Thin-Set Mortar: Latex- portland cement mortar, unless otherwise indicated.
      - 1) Large-Format Tile: Medium-bed, latex- portland cement mortar.
    - b. Grout: High-performance sanded, unless otherwise indicated.
      - 1) High-performance unsanded grout for joints less than 1/8-inch wide.
  - 2. Ceramic Tile Installation: TCNA F122; thinset mortar on waterproof membrane, for areas subject to moisture (e.g. toilet rooms, food preparation areas), and areas subject to direct wetting (e.g. showers).
    - a. Thin-Set Mortar: Latex- portland cement mortar, unless otherwise indicated.
      - 1) Large-Format Tile: Medium-bed, latex- portland cement mortar.
    - b. Grout: High-performance sanded, unless otherwise indicated.
      - 1) High-performance unsanded grout for joints less than 1/8-inch wide.

3. Ceramic Tile Installation: TCNA F125-Full; thinset mortar on crack isolation membrane, for dry, above-ground structural slab installations.
    - a. Thin-Set Mortar: Latex- portland cement mortar, unless otherwise indicated.
      - 1) Large-Format Tile: Medium-bed, latex- portland cement mortar.
    - b. Grout: High-performance sanded, unless otherwise indicated.
      - 1) High-performance unsanded grout for joints less than 1/8-inch wide.
  4. Ceramic Tile Installation: TCNA F131; water-cleanable, tile-setting epoxy; epoxy grout, where indicated.
    - a. Grout and Tile Setting: Water-cleanable epoxy grout.
- B. Interior Wall Installations, Masonry or Concrete:
1. Ceramic Tile Installation: TCNA W202; thinset mortar.
    - a. Thinset Mortar: Latex- portland cement mortar.
    - b. Grout: High-performance sanded, unless otherwise indicated.
      - 1) High-performance unsanded grout for joints less than 1/8-inch wide.
- C. Interior Wall Installations, Metal Studs or Furring:
1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units.
    - a. Thinset Mortar: Latex-portland cement mortar.
    - b. Grout: High-performance sanded, unless otherwise indicated.
      - 1) High-performance unsanded grout for joints less than 1/8-inch wide
  2. Ceramic Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.
    - a. Thinset Mortar: Latex-portland cement mortar.
    - b. Grout: High-performance sanded, unless otherwise indicated.
      - 1) High-performance unsanded grout for joints less than 1/8-inch wide.
- D. Shower Wall Installations, Metal Studs or Furring:
1. Ceramic Tile Installation: TCNA B412; thinset mortar on cementitious backer units.
    - a. Thinset Mortar: Latex-portland cement mortar.
    - b. Grout: High-performance sanded, unless otherwise indicated.
      - 1) High-performance unsanded grout for joints less than 1/8-inch wide.
      - 2) Grout and Tile Setting: Water-cleanable epoxy grout.
- E. Shower Receptor and Wall Installations:
1. Ceramic Tile Installation: TCNA B415; thinset mortar on waterproof membrane over cementitious backer units.
    - a. Thinset Mortar: Latex- portland cement mortar.
    - b. Grout: High-performance sanded, unless otherwise indicated.
      - 1) High-performance unsanded grout for joints less than 1/8-inch wide.
      - 2) Grout and Tile Setting: Water-cleanable epoxy grout.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 09 51 00 - SUSPENDED CEILING SYSTEMS****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes suspended ceiling systems for interior applications consisting of:
  - 1. Acoustical panels with exposed and concealed suspension systems.
- B. Related Requirements:
  - 1. Division 09 Section "Gypsum Board Assemblies" for interior suspended gypsum board ceilings and soffits.

**1.2 DEFINITIONS**

- A. LR: Light Reflectance coefficient.
- B. NRC: Noise Reduction Coefficient.

**1.3 COORDINATION**

- A. Coordinate layout and installation of linear metal pans and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

**1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product specified.
- B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
  - 1. Ceiling suspension system members.
  - 2. Method of attaching suspension system hangers to building structure.
  - 3. Ceiling-mounted items including light fixtures; air outlets and inlets; speakers; sprinklers; access panels; audio-visual equipment and mounting brackets; and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
  - 4. Ceiling perimeter and penetrations through ceiling; trim and moldings.
  - 5. Compression stud locations, spacings, and calculations.
  - 6. Minimum Drawing Scale: 1/8 inch = 1 foot.
- C. Samples for Verification: Full-size units of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.
  - 1. 6-inch-square samples of each acoustical panel type, pattern, and color.
  - 2. Set of 12-inch-long samples of exposed suspension system members, including moldings, for each color and system type required.
  - 3. Suspension System Members: 12-inch-long Sample of each type.
  - 4. Exposed Molding and Trim: Set of 12-inch-long Samples of each type, finish, and color.
  - 5. Filler Strips: Set of 12-inch-long Samples of each type, finish, and color.
  - 6. Sound Absorber: 12 inches long.
  - 7. End Cap: Full size.

- D. Delegated-Design Submittal: For design of attachment devices.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Performance Data: For installed products indicated to comply with design loads and other criteria, include structural analysis and other analytical data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- C. Product Test Reports: Indicate compliance of acoustical panel ceilings and components with requirements based on comprehensive testing of current products.
- D. Research/Evaluation Reports: Evidence of acoustical panel ceiling's and components' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

## 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

## 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
  - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
  - 3. Hold-Down Clips: Equal to 2 percent of quantity installed.
  - 4. Impact Clips: Equal to 1 percent of quantity installed.

## 1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations for Ceiling Units: Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
  - 1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
    - a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
    - b. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
  - a. Smoke-Developed Index: 450 or less.
- E. Mockups: Before installing acoustical panel ceilings, construct mockups for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for completed work:
  1. Locate mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
  2. Notify Architect seven days in advance of the dates and times when mockups will be constructed.
  3. Demonstrate the proposed range of aesthetic effects and workmanship.
  4. Obtain Architect's approval of mockups before starting construction of acoustical panel ceilings.
  5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
    - a. When directed, demolish and remove mockups from Project site.
    - b. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 01 Section "Project Management and Coordination."

#### **1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

#### **1.11 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
  1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.
- B. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Exterior ceiling systems shall withstand exterior exposure and the effects of gravity loads and the following loads and stresses without showing permanent deformation of ceiling system components including pans and suspension system; noise or metal fatigue caused

by vibration, deflection, and displacement of ceiling units; or permanent damage to fasteners and anchors.

1. Wind Load in rooms with operable exterior window walls: Uniform pressure as indicated on Drawings, acting inward or outward.

## 2.2 MANUFACTURERS

- A. Basis-of-Design Product: The design is based on the products named in the Finish Legend. Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers specified. Comparable products are subject to review and approval through the submittal process specified. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
1. Ceiling Panels:
    - a. American Gypsum.
    - b. Armstrong World Industries, Inc.
    - c. CertainTeed Corporation.
    - d. Rockfon (Roxul Inc.).
    - e. Tectum Inc.
    - f. United States Gypsum Company.
  2. Manufacturers Suspension Systems:
    - a. Armstrong World Industries, Inc.
    - b. CertainTeed Corporation.
    - c. Rockfon (Roxul, Inc).
    - d. United States Gypsum Company.

## 2.3 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Refer to the Finish Legend. Subject to compliance with requirements, provide product indicated on Finish Legend or comparable product by one of the listed Manufacturer of Acoustical Panels:
- B. Ceilings (CL):
1. Refer to the Finish Legend for each Basis of Design product selection details.
- C. Source Limitations:
1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
  2. Suspension System: Obtain each type from single source from single manufacturer.
- D. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- E. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
- F. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.
- G. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

## 2.4 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

## 2.5 METAL SUSPENSION SYSTEMS

- A. Basis-of-Design Product: Refer to the Finish Legend. Subject to compliance with requirements, provide product indicated on Finish Legend or comparable product by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. CertainTeed Corporation.
  - 3. Chicago Metallic Corporation.
  - 4. Rockfon (Roxul, Inc.).
  - 5. United States Gypsum Company.
- B. Ceilings:
  - 1. Refer to the Finish Legend for each Basis of Design product selection details.
- C. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
  - 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- D. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
  - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
    - a. Type: Postinstalled expansion and Postinstalled bonded anchors.
    - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
    - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
    - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
  - 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
- E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
  - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  - 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
  - 3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
  - 4. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch diameter wire.
- F. Hanger Rods and Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

- G. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.
- H. Compression Struts: Manufacturer's standard compression struts designed to accommodate wind forces.
- I. Hold-Down Clips: At all exterior locations, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

## 2.6 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. CertainTeed Corporation.
  - 3. Chicago Metallic Corporation.
  - 4. Fry Reglet Corporation.
  - 5. Gordon, Inc.
  - 6. United States Gypsum Company.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
  - 1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
  - 2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
  - 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:
  - 1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 for Alloy and Temper 6063-T5.
  - 2. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
  - 3. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## 2.7 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Pecora Corporation.
    - b. United States Gypsum Company.
- B. Acoustical Sealant for Concealed Joints:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. OSI Sealants; Henkel Corporation.

- b. Pecora Corporation.
  - c. Tremco, Inc.
- C. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- 1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
  - 2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

#### **3.3 INSTALLATION**

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
  - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  8. Do not attach hangers to steel deck tabs.
  9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
  11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet Miter corners accurately and connect securely.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans.
  2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
  3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
  5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by manufacturer.
  6. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
  7. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

### 3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION





**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 09 61 13 - FLOOR SEALERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes penetrating liquid concrete floor treatment for the following locations:
  - 1. Areas indicated on the Drawings.
  - 2. Areas indicated in the Finish Schedule.
  - 3. Exterior concrete concourses.
- B. Related Requirements:
  - 1. Section 03 30 00 "Cast-in-Place Concrete" for concrete slabs.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For floor sealers to include in maintenance manuals. Include the following:
  - 1. Methods for maintaining floor sealers, including cleaning and stain-removal products.
  - 2. Precautions for cleaning materials and methods that could be detrimental to floor sealers.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Mockups: Apply floor sealer to set quality standards for materials and execution.
  - 1. Size: 100 sq. ft. of each type of substrate to demonstrate surface preparation, finish, and standard of workmanship.
    - a. The Owner shall be given the opportunity to accept or reject the slip resistance of the sealed concrete prescribed by the Owner's insurance and legal counsels.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**PART 2 - PRODUCTS****2.1 FLOOR DENSIFIERS**

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on the Finish Legend or comparable product by one of the following:
  - 1. Curecrete Distribution, Inc.
  - 2. Dayton Superior Corporation.
  - 3. Euclid Chemical Company (The), an RPM company; Diamond Hard.
  - 4. L&M Construction Chemicals, Inc.
- C. Performance Requirements:
  - 1. VOC Content: Sealer shall have a VOC content of 0 g/L.
  - 2. Abrasion Resistance to Revolving Disks: At least a 30% improvement over untreated samples when tested in accordance with ASTM C 779.
  - 3. Surface Adhesion: At least a 20% increase in adhesion for epoxy when tested in accordance with ASTM D 3359.
  - 4. Hardening: As follows when tested in accordance with ASTM C 39:
    - a. After 7 Days: An increase of at least 35% over untreated samples.
    - b. After 28 Days: An increase of at least 33% over untreated samples.
  - 5. Coefficient of Friction: Minimum 0.8 dry, 0.65 wet when tested in accordance with ASTM C 1028.

**PART 3 - EXECUTION****3.1 PREPARATION**

- A. Prepare floor according to manufacturer's written instructions.
  - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  - 2. Do not use frozen material. Thaw and agitate prior to use.
  - 3. Repair cracked and eroded concrete in accordance with manufacturer's instructions. Remove and repair unsound substrates.

**3.2 APPLICATION**

- A. Apply penetrating liquid floor treatment according to manufacturer's written instructions.
  - 1. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
  - 2. Keep surface wet with sealer for manufacturer's minimum soak-in period without allowing it to dry or become slippery.
- B. Protect installed floors during construction and until chemical reaction process is complete. Clean up spills during construction. Do not allow construction debris to remain on treated floor.

END OF SECTION

**SECTION 09 61 23 - HAZARD STRIPING****PART 1 - GENERAL****1.1 SUMMARY**

- A. This section includes the following:
  - 1. Hazard and safety striping at stair nosings in the seating bowl as indicated on the Drawings.
  - 2. Wheelchair spaces and other floor identifications as indicated on the Drawings.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Slip Resistance: Provide finished surfaces with a verifiable slip resistance as recommended in the Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG), and as determined by the Owner and the Owner's insurance and legal counsels for slip and fall insurability and legal liability.

**1.3 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data for coating materials, including surface preparation requirements.
- B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.
- C. Manufacturer's surface preparation inspection report.
- D. Contractor shall prepare a field survey of all the existing conditions at all aisles verifying the actual deviations from nosing to nosing in 1/8" tolerance. This drawing shall locate the contractor's understanding of placement of the safety v. hazard striping locations. Architect' review and approval of each striping pattern on each aisle is required before field application will be accepted.

**1.4 QUALITY ASSURANCE**

- A. Paint Manufacturer shall inspect surface preparation procedures and results prior to application of paint.
- B. Field Samples: Apply hazard-coating materials to 4 stair nosings and one wheelchair space to demonstrate surface preparation, joint and crack treatment, thickness, slip resistance texture, color, and standard of workmanship.
  - 1. If Architect determines that field sample does not meet requirements, reapply materials until the field sample is accepted.
  - 2. Keep the accepted field samples undisturbed during construction as a standard for judging completed work. Undamaged field samples may be incorporated into the Work.
  - 3. The Owner and the Owner's insurance and legal counsels shall determine from these field samples the acceptability of the demonstrated slip resistance of the applied coatings.
- C. Source Limitations: Obtain primers and undercoat materials, if required, for each coating system from the same manufacturer as the finish coats.
- D. Contractor will perform an "in-place" mock-up of each type of striping for field approval by the Architect.

**PART 2 - PRODUCTS****2.1 MATERIALS**

- A. Basis-of-Design Product: The design is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by another manufacturer. Comparable products are subject to review and approval through the submittal process specified.
  - 1. ITW American Safety Technologies, Inc. - "AS-150"
  - 2. PPG Industries, "MegaSeal - NSP-Pedestrian - Anti-Slip 99-6511."
  - 3. Sherwin Williams; "ResuGrip 150."
- B. Colors: To be selected by Architect from manufacturer's full line of custom and standard colors.
- C. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
  - 1. Floor Coatings: VOC not more than 100 g/L.
- D. VOC Compliance: Provide materials that comply with the Air Quality Control regulations of the local Air Quality Management District having jurisdiction over the location of the project or EPA Region II. In the event that local regulations are silent on specific applications, comply with the National Volatile Organic Compound Emission Standards for Architectural Coatings (40 CFR Part 59).
- E. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
  - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

**PART 3 - EXECUTION****3.1 PREPARATION**

- A. Cementitious Materials: Prepare concrete surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
  - 1. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
  - 2. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
  - 3. Provide uniform surface profile in areas to be painted
- B. Mask off edges to provide a straight edge around area to be painted.

**3.2 APPLICATION**

- A. Application: Apply painted stripe full width of each tread nosing. Edges shall be straight and uniform. Width of stripe shall be as indicated on the Drawings.
- B. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

- C. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- D. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

### **3.3 CLEANING**

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
  - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

### **3.4 PROTECTION**

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in Painting and Decorating Contractors of America (PDCA) Specification P1.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Resilient base.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.
- C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

**1.3 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

**1.5 FIELD CONDITIONS**

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. In areas where both base and transitions strips are located, provide base and transition strips from same manufacturer to ensure color match.

**2.2 THERMOSET-RUBBER BASE**

- A. Basis-of-Design Product: Refer to the Finish Legend in the Drawings. Subject to compliance with requirements, provide product indicated on Finish Legend or comparable product by one of the following:
  - 1. Burke Mercer Flooring Products, Division of Burke Industries Inc.
  - 2. Flexco.
  - 3. Johnsonite; A Tarkett Company
  - 4. Roppe Corporation, USA. Pinnacle
- B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
  - 1. Style and Location:
    - a. Style A, Straight: Provide in areas with carpet.
    - b. Style B, Cove: Provide in areas with resilient flooring.
- C. Lengths: Coils in 120 foot length.
- D. Outside Corners: Preformed.
- E. Inside Corners: Preformed.
- F. Colors: As indicated on Finish Legend or as selected by Architect from full range of industry colors.

**2.3 RUBBER MOLDING ACCESSORY**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Burke Mercer Flooring Products, Division of Burke Industries Inc.
  - 2. Flexco.
  - 3. Johnsonite; A Tarkett Company
  - 4. Roppe Corporation, USA.
  - 5. VPI, LLC, Floor Products Division.
- B. Description: Rubber nosing for carpet nosing for resilient flooring reducer strip for resilient flooring joiner for tile and carpet, and transition strips.
- C. Profile and Dimensions: As indicated.
- D. Locations: Provide rubber molding accessories in areas indicated.
- E. Colors and Patterns: As selected by Architect from full range of industry colors.
  - 1. Unless indicated, otherwise, match resilient accessory to adjacent higher surface material,

**2.4 INSTALLATION MATERIALS**

- A. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- B. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

**3.2 PREPARATION**

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

**3.3 RESILIENT BASE INSTALLATION**

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Form without producing discoloration (whitening) at bends.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Miter or cope corners to minimize open joints.

**3.4 RESILIENT ACCESSORY INSTALLATION**

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

**3.5 CLEANING AND PROTECTION**

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
  - 1. Remove adhesive and other blemishes from surfaces.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

**SECTION 09 65 16 - RESILIENT SHEET FLOORING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Unbacked vinyl sheet flooring.
  - 2. Vinyl sheet flooring with backing.
  - 3. Unbacked rubber sheet flooring.
  - 4. Rubber sheet flooring with backing.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient sheet flooring.
  - 1. Include sheet flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
  - 2. Show details of special patterns.
- C. Samples: For each exposed product and for each color, texture, and pattern specified, in manufacturer's standard size, but not less than 6-by-9-inch sections.
  - 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.
- D. Samples for Verification: For each type of resilient sheet flooring, in manufacturer's standard size, but not less than 6-by-9-inch sections of each color, texture, and pattern required.
  - 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.
- E. Welded-Seam Samples: For seamless-installation technique indicated and for each resilient sheet flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.
- F. Product Schedule: Use same designations indicated on Drawings.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Stock Material: Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Resilient Sheet Flooring: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, in roll form and in full roll width for each type, color, and pattern of flooring installed.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for resilient sheet flooring installation and seaming method indicated.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by resilient sheet flooring manufacturer for installation techniques required.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Coordinate mockups in this Section with mockups specified in other Sections.
    - a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Store resilient sheet flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store rolls upright.

**1.8 FIELD CONDITIONS**

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive resilient sheet flooring during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during resilient sheet flooring installation.
- D. Close spaces to traffic for 48 hours after resilient sheet flooring installation.
- E. Install resilient sheet flooring after other finishing operations, including painting, have been completed.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

**2.2 UNBACKED VINYL SHEET FLOORING**

- A. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
  - 1. Armstrong World Industries, Inc.
  - 2. Forbo Industries, Inc.
  - 3. Gerflor.
  - 4. Johnsonite; A Tarkett Company.
  - 5. Mannington Mills, Inc.
  - 6. Polyflor, Ltd., Distributed by Gerbert Limited.
- B. Product Standard: ASTM F 1913.
- C. Thickness: 0.080 inch.
- D. Wearing Surface: Smooth.
- E. Sheet Width: As standard with manufacturer.
- F. Seamless-Installation Method: Heat welded.
- G. Colors and Patterns: Match Architect's samples.

**2.3 VINYL SHEET FLOORING WITH BACKING**

- A. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
  - 1. Altro Group.
  - 2. Armstrong World Industries, Inc.
  - 3. Congoleum Corporation.
  - 4. Forbo Industries, Inc.
  - 5. Gerflor.
  - 6. Lonseal, Inc.
  - 7. Mannington Mills, Inc.
  - 8. Polyflor, Ltd., Distributed by Gerbert Limited.
  - 9. TOLI International.
- B. Product Standard: ASTM F 1303.
  - 1. Type (Binder Content): Type I, minimum binder content of 90 percent.
  - 2. Wear-Layer Thickness: Grade 1.
  - 3. Overall Thickness: As standard with manufacturer.
  - 4. Interlayer Material: None.
  - 5. Backing Class: Class A (fibrous).
- C. Wearing Surface: Smooth.
- D. Sheet Width: As standard with manufacturer.
- E. Seamless-Installation Method: Heat welded.
- F. Colors and Patterns: Match Architect's samples.

**2.4 UNBACKED RUBBER SHEET FLOORING**

- A. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:

1. AB; American Biltrite.
  2. Flexco.
  3. Nora Systems, Inc.
  4. PRF USA, Inc.
  5. R.C.A. Rubber Company (The).
  6. VPI, LLC, Floor Products Division.
- B. Product Standard: ASTM F 1859.
1. Type: [Type I, homogeneous rubber sheet floor covering.
  2. Thickness: As standard with manufacturer.
  3. Hardness: Not less than required by ASTM F 1859.
- C. Wearing Surface: Smooth
1. Molded-Pattern Figure: Raised discs.
- D. Sheet Width: As standard with manufacturer.
- E. Seamless-Installation Method: Heat welded.
- F. Colors and Patterns: Match Architect's samples.

## 2.5 RUBBER SHEET FLOORING WITH BACKING

- A. Products: Subject to compliance with requirements, provide the following:
1. Nora Systems, Inc;.
- B. Product Standard: ASTM F 1860.
1. Type: Type I, homogeneous rubber sheet floor covering with backing.
  2. Wear-Layer Thickness: As standard with manufacturer.
  3. Overall Thickness: As standard with manufacturer.
  4. Interlayer Material: As standard with manufacturer.
  5. Backing: Fibrous.
  6. Hardness: Not less than required by ASTM F 1860.
- C. Wearing Surface: Smooth.
- D. Sheet Width: [As standard with manufacturer] [3.3 feet].
- E. Seamless-Installation Method: [Heat welded] [Chemically bonded].
- F. Colors and Patterns: Match Architect's samples.

## 2.6 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.
- C. Seamless-Installation Accessories:
1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
    - a. Colors: Match flooring.
  2. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.
- D. Integral-Flash-Cove-Base Accessories:
1. Cove Strip: 1-inch radius provided or approved by resilient sheet flooring manufacturer.
  2. Cap Strip: Tapered vinyl cap, provided or approved by resilient sheet flooring manufacturer.
  3. Corners: Metal inside and outside corners and end stops provided or approved by resilient sheet flooring manufacturer.



- E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient sheet flooring manufacturer.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient sheet flooring.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
  - 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft.] in 24 hours.
    - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum [75] percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient sheet flooring until materials are the same temperature as space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

#### **3.3 RESILIENT SHEET FLOORING INSTALLATION**

- A. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F2170 (Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes) in new construction or ASTM F1869 (Standard Test Method for Measuring

Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride) in renovations to Architect and Owner prior to floor installation. Acceptable moisture content of concrete subfloor shall be within approved manufacture limits or lower prior to installation.

- B. Comply with manufacturer's written instructions for installing resilient sheet flooring.
- C. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.
- D. Lay out resilient sheet flooring as follows:
  - 1. Maintain uniformity of flooring direction.
  - 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
  - 3. Match edges of flooring for color shading at seams.
  - 4. Avoid cross seams.
- E. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- F. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- H. Install resilient sheet flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.
- I. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- J. Seamless Installation:
  - 1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.
- K. Integral-Flash-Cove Base: Cove resilient sheet flooring 6 inches up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.
  - 1. Install metal corners at inside and outside corners.

### **3.4 CLEANING AND PROTECTION**

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient flooring.
- B. Perform the following operations immediately after completing resilient sheet flooring installation:
  - 1. Remove adhesive and other blemishes from surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient sheet flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from flooring surfaces before applying liquid floor polish. Apply number of coats as recommended by flooring manufacturer.
- E. Cover resilient sheet flooring until Substantial Completion.

END OF SECTION

**SECTION 09 65 19 - RESILIENT TILE FLOORING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Rubber floor tile.
  - 2. Vinyl composition floor tile.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Shop Drawings: For each type of floor tile.
  - 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
  - 2. Show details of special patterns.
- D. Samples: Full-size units of each color and pattern of floor tile required.
- E. Samples for Verification: Full-size units of each color and pattern of floor tile required.
- F. Product Schedule: Use same designations indicated on Drawings.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Coordinate mockups in this Section with mockups specified in other Sections.
    - a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

### 1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

### 1.9 WARRANTY

- A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace defective installation areas, material, and labor that fail under normal usage within specified warranty period.
  - 1. Warranty Period: 10 years from date of Product Purchase.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

### 2.2 SOLID VINYL FLOOR TILE

- A. Basis-of-Design Product: Refer to the Finish Legend in the Drawings. Subject to compliance with requirements, provide product indicated on Finish Legend or comparable product by one of the following:
  - 1. AB; American Biltrite.
  - 2. Altro Group.
  - 3. Amtico International Inc.

4. Armstrong World Industries, Inc.
  5. Burke Mercer Flooring Products, Division of Burke Industries Inc.
  6. Flexco, Inc.
  7. Gerflor.
  8. Johnsonite; A Tarkett Company.
  9. Polyflor, Ltd.
  10. Roppe Corporation, USA.
  11. TOLI International.
- B. Tile Standard: ASTM F 1700.
1. Class: Class I, Monolithic Vinyl Tile, unless indicated otherwise on Drawings.
  2. Type: A, Smooth Surface, unless indicated otherwise on Drawings.
- C. Thickness: 0.080 inch.
- D. Size: Refer to Finish Schedule.
- E. Seamless-Installation Method: [Heat welded] [Chemically bonded] <Insert requirements>.
- F. Colors and Patterns: Match Architect's samples.

### 2.3 RUBBER FLOOR TILE

- A. Basis-of-Design Product: Refer to the Finish Legend in the Drawings. Subject to compliance with requirements, provide product indicated on Finish Legend or comparable product by one of the following:
1. AB; American Biltrite.
  2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
  3. Flexco.
  4. Johnsonite; A Tarkett Company.
  5. Mannington Mills, Inc.
  6. Mondo Rubber International, Inc.
  7. Nora Rubber Flooring, Freudenberg Building Systems, Inc.
  8. PRF USA Inc.
  9. R.C.A. Rubber Company (The).
  10. Roppe Corporation, USA.
  11. VPI, LLC, Floor Products Division.
- B. Tile Standard: ASTM F 1344, Class I-A, Homogeneous Rubber Tile, solid color.
- C. Hardness: Not less than 85 as required by ASTM F 1344, measured using Shore, Type A durometer according to ASTM D 2240.
- D. Wearing Surface: Smooth.
- E. Thickness: 0.125 inch.
- F. Size: As indicated by Finish Legend.
- G. Seamless-Installation Method: Heat welded.
- H. Colors and Patterns: As indicated by Finish Legend.

### 2.4 VINYL COMPOSITION FLOOR TILE (VCT)

- A. Basis-of-Design Product: Refer to the Finish Legend in the Drawings. Subject to compliance with requirements, provide product indicated on Finish Legend or comparable product by one of the following:
1. AB; American Biltrite.
  2. Armstrong World Industries, Inc.
  3. Congoleum Corporation.

4. Mannington Mills, Inc.
  5. Mohawk Flooring.
  6. Shaw Hard Surface, Shaw Industries, Inc.
- B. Tile Standard: ASTM F 1066, Class 2, through pattern.
  - C. Wearing Surface: Smooth.
  - D. Thickness: 0.125 inch.
  - E. Size: As indicated by Finish Legend.
  - F. Colors and Patterns: As indicated by Finish Legend.

## 2.5 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
  3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10pH.
  4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

- b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

### 3.3 FLOOR TILE INSTALLATION

- A. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F 2170 (Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes) in new construction or ASTM F 1869 (Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride) in renovations to Architect and Owner prior to floor installation. Acceptable moisture content of concrete subfloor shall be within approved manufacture limits or lower prior to installation.
- B. Comply with manufacturer's written instructions for installing floor tile.
- C. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles in pattern indicated.
- D. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
- E. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- F. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- H. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- I. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

**3.4 CLEANING AND PROTECTION**

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
  - 1. Remove adhesive and other blemishes from surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
  - 1. Apply five coats (VCT).
- E. Cover floor tile until Substantial Completion.

END OF SECTION



**SECTION 09 66 23 - RESINOUS MATRIX TERRAZZO FLOORING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Thin-set, epoxy-resin terrazzo flooring and base.
  - 2. Precast epoxy-resin terrazzo units.
- B. Related Requirements:
  - 1. Section 07 92 00 "Joint Sealants" for sealants installed with terrazzo.
  - 2. Section 09 67 23 "Resinous Flooring" for decorative resinous flooring systems applied as self-leveling slurries or as troweled or screeded mortars.

**1.2 DEFINITIONS**

- A. Aggregate: Marble chips or other types of aggregate.
- B. NTMA: National Terrazzo and Mosaic Association, Inc.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to terrazzo including, but not limited to, the following:
    - a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
    - b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    - c. Review special terrazzo designs and patterns.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, component details, and relationship to other work. Show layout of the following:
  - 1. Divider strips.
  - 2. Control-joint strips.
  - 3. Accessory strips.
  - 4. Abrasive strips.
  - 5. Stair treads, risers, and landings.
  - 6. Precast terrazzo jointing and edge configurations.
  - 7. Terrazzo patterns.
- C. Samples: For each exposed product and for each color and texture specified, 6 inches in size.
- D. Samples for Initial Selection: NTMA's "Terrazzo Color Palette" showing the full range of colors and patterns available for each terrazzo type.

- E. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo Sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in sizes indicated below:
  - 1. Terrazzo: 6-inch- square Samples.
  - 2. Precast Terrazzo: 6-inch- square Samples.
  - 3. Accessories: 6-inch- long Samples of each exposed strip item required.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
  - 1. Include list of 5 projects completed in last 5 years indicating name and location of project, name of Owner, name and contact information for General Contractor, and name and contact information for Architect.
  - 2. Include letter from NTMA with name of member that states current member status.
- B. Material Certificates: For each type of terrazzo material or product.
- C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- D. Preinstallation moisture-testing reports.

### **1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For terrazzo to include in maintenance manuals.

### **1.7 QUALITY ASSURANCE**

- A. Installer Qualifications:
  - 1. Engage an installer who is a contractor member of NTMA.
  - 2. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockups for terrazzo including accessories.
    - a. Size: Minimum 100 sq. ft. of typical poured-in-place flooring and base condition for each color and pattern in locations directed by Architect.
    - b. Include first three stair treads.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
  - 1. Epoxy components shall be stored in a space where the ambient temperature can be maintained 60 and 90 deg. F before use.

**1.9 FIELD CONDITIONS**

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.
- B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.
- C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
  - 1. Maintain ambient temperatures in the area to receive terrazzo at not less than 60 deg. F.
- E. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.
- B. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

**2.2 PERFORMANCE REQUIREMENTS**

- A. NTMA Standards: Comply with NTMA's written recommendations for terrazzo type indicated unless more stringent requirements are specified.

**2.3 EPOXY-RESIN TERRAZZO**

- A. Epoxy-Resin Terrazzo: Comply with manufacturer's written instructions for matrix and aggregate proportions and mixing.
  - 1. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
    - a. Crossfield Products Corp., Dex-O-Tex Division; Cheminert.
    - b. General Polymers; Sherwin Williams; Terrazzo 1100.
    - c. Key Resin Company; Key Epoxy Terrazzo.
    - d. Master Terrazzo Technologies LLC; Morricite.
    - e. Quadrant Chemical Corporation; Quadset Epoxy Terrazzo.
    - f. TEC Specialty; H.B. Fuller Construction Products Inc; Tuff-Lite Epoxy Terrazzo.
    - g. Terrazzo & Marble Supply Companies; Terroxy Resin Systems.
  - 2. Thickness: 3/8 inch nominal.
- B. Formulated Mix Color and Pattern: As selected by Architect from NTMA thin-set terrazzo plates.
- C. Custom Mix Color and Pattern: Match Architect's sample.

- D. Materials:
1. Flexible Reinforcing Membrane: Manufacturer's resinous membrane for substrate-crack preparation and reflective-crack reduction.
    - a. Reinforcement: Fiberglass scrim.
  2. Primer: Manufacturer's product recommended for substrate and use indicated.
  3. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.
    - a. Physical Properties without Aggregates:
      - 1) Hardness: 60 to 85 per ASTM D 2240, Shore D.
      - 2) Minimum Tensile Strength: 3000 psi per ASTM D638 for a 2-inch specimen made using a "C" die per ASTM D 412.
      - 3) Minimum Compressive Strength: 10,000 psi per ASTM D 695, Specimen B cylinder.
      - 4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.
        - a) Distilled water.
        - b) Mineral water.
        - c) Isopropanol.
        - d) Ethanol.
        - e) 0.025 percent detergent solution.
        - f) 1.0 percent soap solution.
        - g) 5 percent acetic acid.
        - h) 10 percent sodium hydroxide.
        - i) 10 percent hydrochloric acid.
        - j) 30 percent sulfuric acid.
    - b. Physical Properties with Aggregates: For resin blended with Georgia white marble, ground, grouted, and cured per requirements in NTMA's "Terrazzo Specifications and Design Guide"; comply with the following:
      - 1) Flammability: Self-extinguishing, maximum extent of burning 1/4 inch according to ASTM D 635.
      - 2) Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F for temperature range of minus 12 to plus 140 deg F per ASTM D 696.
  4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
    - a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131.
    - b. 24-Hour Absorption Rate: Less than 0.75 percent.
    - c. Dust Content: Less than 1.0 percent by weight.
  5. Finishing Grout: Resin based.

## 2.4 STRIP MATERIALS

- A. Thin-Set Divider Strips: L-type angle, 1/4 inch deep.
  1. Material: As indicated.
  2. Top Width: As indicated.
- B. Heavy-Top Divider Strips: L-type angle in depth required for topping thickness indicated.
  1. Bottom-Section Material: As indicated.
  2. Top-Section Material: As indicated.
  3. Top-Section Width: As indicated.
- C. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.

- D. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
  - 1. Base-bead strips for exposed top edge of terrazzo base.
  - 2. Edge-bead strips for exposed edges of terrazzo.
  - 3. Nosings for terrazzo stair treads and landings.
- E. Abrasive Strips: Abrasive nosing strip and two-line abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
  - 1. Width: 1/2 inch.
  - 2. Depth: As required by terrazzo thickness.
  - 3. Length: As indicated.
  - 4. Color: As selected by Architect from full range of industry colors.

## 2.5 MISCELLANEOUS ACCESSORIES

- A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.
- B. Anchoring Devices:
  - 1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.
  - 2. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.
- C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- E. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.
- F. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; and is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.
  - 1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
  - 2. Acid-Base Properties: With pH factor between 7 and 10.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

### 3.2 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

- B. Concrete Slabs:
1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.
    - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    - b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written instructions.
    - c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.
- C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
1. Moisture Testing: Perform tests indicated below.
    - a. Calcium Chloride Test: Perform anhydrous calcium chloride test per ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
      - 1) Perform tests so that each test area does not exceed 200 sq. ft., and perform not less than two tests in each installation area and with test areas evenly spaced in installation areas.
      - 2) Report test results to Contractor and Architect.
    - b. In-Situ Probe Test: Perform relative-humidity test using in-situ probes per ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative-humidity-level measurement.
      - 1) Perform tests so that each test area does not exceed 200 sq. ft., and perform not less than two tests in each installation area and with test areas evenly spaced in installation areas.
      - 2) Report test results to Contractor and Architect.
    - c. Test Method: Test for moisture content by method recommended in writing by terrazzo manufacturer. Proceed with installation only after substrates pass testing.
- D. Preinstallation Moisture Testing:
1. Testing Agency: Owner will engage a qualified testing agency to perform tests.
  2. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
  3. Reinforce membrane with fiberglass scrim.
- E. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.
1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

### 3.3 EPOXY-RESIN TERRAZZO INSTALLATION

- A. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F 2170 (Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes) in new construction or ASTM F 1869 (Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride) in renovations to Architect and Owner prior to floor installation. Acceptable moisture content of concrete subfloor shall be within approved manufacture limits or lower prior to installation.
- B. Comply with NTMA's written recommendations for terrazzo and accessory installation.

- C. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions and NTMA's "Terrazzo Specifications and Design Guide."
- D. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet; noncumulative.
- E. Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
- F. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.
- G. Flexible Reinforcing Membrane:
  - 1. Prepare and prefill substrate cracks with membrane material.
  - 2. Install membrane to produce full substrate coverage in areas to receive terrazzo.
  - 3. Reinforce membrane with fiberglass scrim.
  - 4. Prepare membrane according to manufacturer's written instructions before applying substrate primer.
- H. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.
- I. Strip Materials:
  - 1. Divider and Control-Joint Strips:
    - a. Locate divider strips in locations indicated.
    - b. Install control-joint strips in locations indicated.
    - c. Install control-joint strips with 1/4-inch gap between strips, and install sealant in gap.
    - d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
  - 2. Accessory Strips: Install as required to provide a complete installation.
  - 3. Abrasive Strips: Install with surface of abrasive strip positioned 1/16 inch higher than terrazzo surface.

### 3.4 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

### 3.5 CLEANING AND PROTECTION

- A. Cleaning:
  - 1. Remove grinding dust from installation and adjacent areas.
  - 2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.
- B. Sealing:
  - 1. Seal surfaces according to NTMA's written recommendations.
  - 2. Apply sealer according to sealer manufacturer's written instructions.
- C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 09 67 23 - RESINOUS FLOORING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. MMA Resinous flooring systems including integral coves and accessories. Formulas include the following types:
    - a. Methyl Methacrylate (MMA) Resin, Acrylic Floor Coating System.
- B. Related Sections:
  - 1. Refer to Finish Legend for color/pattern of finish product.
  - 2. Section 03 30 00 "Cast-in-Place Concrete."
  - 3. Section 09 29 00 "Gypsum Board" for cementitious backer wall panels used as substrate for integral cove bases.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review manufacturer's written instructions for substrate preparation and environmental conditions affecting resinous flooring installation. Manufacturer Rep required to be in attendance.
  - 2. Review details on drawings and manufacturers standard details of integral cove bases, floor drains and floor sinks.
  - 3. Review manufacturer's written instructions for installing resinous flooring systems.
  - 4. Review protection measures for adjacent construction and installed flooring, floor drainage requirements, curbs, base details, and so forth.
  - 5. Discuss mockups and establish location. Discuss mockup approval process.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include manufacturer's technical data, installation instructions, and recommendations for each resinous flooring component required.
- B. Shop Drawings: Include installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:
  - 1. Patterns and colors.
  - 2. Transitions and divider strips.
  - 3. Control joints.
- C. Samples: For each resinous floor system required and for each color and texture specified, 6 inches square in size, applied to a rigid backing by Installer for this Project.
- D. Samples for Initial Selection: For each type of exposed finish required.
- E. Samples for Verification: For each resinous flooring system required and for each color and texture specified, 6 inches square, applied to a rigid backing by Installer for this Project.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer's on-site technical representative and for Installer.
- B. Material Certificates: For each resinous flooring component.
- C. Material Test Reports: For each resinous flooring system, by a qualified testing agency.

- D. Field quality-control reports.

### 1.5 SYSTEM DESCRIPTION

- A. The MasterTop 1853 SRS CQ floor topping system shall be 1/8" thick MasterTop SRS 61BC self-leveling (color and texture selected by owner), with appropriate Primer and Topcoat.
- B. The MasterTop 1853 SRS CQ topping system shall cure and be available to normal traffic in no more than 60 minutes at 68° F after application of last coat. It shall have a maximum water absorption value of 0.04 weight percent in accordance with ASTM D 570. It shall be chemically resistant to a wide range of acids, alkalis, salts, fats, oils, and other chemicals.
- C. The finished floor coating system shall be uniform in color, texture and appearance. All edges that terminate at walls, floor discontinuities, and other embedded items shall be sharp, uniform, and cosmetically acceptable with no thick or ragged edge. The Contractor shall work out an acceptable masking technique to ensure the acceptable finish of all edges.

### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.

### 1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain primary acrylic floor coating materials, including primers, resins, hardening agents, and topcoats, through one source from a single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials from manufacturer or from source recommended by manufacturer.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to conduct field observations of permanent work at progress completions of 25, 50, and 75 percent. Submit written observation report to Contractor, Installer, Architect, and Owner within three calendar days of completion of each field observation.
- C. General Contractor: Trained in the same certification as the qualified installer.
- D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
  - 1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
  - 2. Installer must have a minimum of 5 years of experience installing the specified flooring system and submit project references from projects of similar scale, scope and magnitude.
  - 3. Pre-qualification requirements: Each bidder for this project shall be prequalified as a Master Level Contractor by the material manufacturer at the time of bid submittal. Acceptability will include judgement on equipment, history, and financial strength. In no case will Master Builders Solutions permit the application of any of its materials by untrained, non-approved Contractor or personnel.
  - 4. Each approved installer shall have been trained by the Manufacturer in all phases of surface preparation and application of the specified flooring system(s).
  - 5. Each approved installer must have five years experience of installing the specified flooring system and submit a list of five projects/references as a prequalification requirement. All of the five projects/references must be with the specified product type, equal size, quantity, and magnitude to this project as a prequalification requirement. Owner and architect will personally inspect the projects/references to accept or reject any of the Contractors prior to bid time as a prequalification requirement.

- E. Manufacturer must document a minimum 10 year history of manufacturing MMA products for the Project type. Manufacturer must document a minimum of 10 projects with similar scale, scope and magnitude.
- F. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Apply full-thickness mockups on 200 sq. ft. floor area selected by Architect.
    - a. Include 96-inch length of integral cove base with inside and outside corner.
  - 2. Simulate finished lighting conditions for Architect's review of mockups.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- G. Field Sample: Apply 200 square foot (18.5 square meters) of acrylic floor coating to an area selected by the Architect to demonstrate surface preparation, joint and crack treatment, thickness, texture, color, and standard of workmanship.
  - 1. If Architect determines that field sample does not meet requirements, reapply coating until the field sample is accepted.
  - 2. Simulate finished lighting conditions for Architect's review of mockups.
  - 3. Keep the accepted field sample undisturbed during construction as a standard for judging completed Work. The undamaged field sample may be incorporated into the Work.
  - 4. The Owner shall determine from field samples the size and amount of non-slip aggregate required to provide the slip resistance prescribed by the Owner's insurance and legal counsels.
- H. Bond Testing: Surface preparation shall be evaluated by conducting Bond Tests (for the approved system) at the site prior to application of the flooring systems. Bond testing shall be performed in the presence of the manufacturer. At least two bond tests shall be performed in each day. Locations of bond tests shall be documented on the record drawing and cross-referenced to the actual bond test specimen. Maintain test specimens at project office until completion of Work. Proceed only after acceptance of test results by manufacturer.

## **1.8 REFERENCE STANDARDS**

- A. ACI 308 – Standard Practice for Curing Concrete.
- B. ACI 302.1R-80 – Guide for Concrete Floor and Slab Construction.
- C. US Department of Agriculture (USDA) and Food and Drug Administration (FDA) authorization for incidental contact with foodstuffs.

## **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

## **1.10 FIELD CONDITIONS**

- A. Environmental Limitations: Comply with written installation recommendations for substrate temperature, ambient temperature, moisture, ventilation, and other conditions provided by resinous flooring manufacturer, but not less than 20 deg F or more than 90 deg F and not less than 20 or more than 90 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

1. In all cases the temperature must be 5 degrees or more above dew point during application and for the length of time required by manufacturer.
- B. Concrete shall be moisture cured for a minimum of 7 days at 70 degrees F. The concrete must be fully cured for a minimum of 28 days prior to application of the coating system pending moisture testing.
  1. Surface contaminants such as curing agents, membranes, or other bond breakers should not be used.
  2. Concrete shall have a "broom finish" or a "steel trowel" finish in accordance with MMA manufacturer's instructions.
  3. Any drains should be placed at the level of the concrete grade rather than the finish grade of the topping as instructed by manufacturer's literature.
- C. Concrete shall have a moisture emission rate of no more than 5lbs. per 1000 sq.ft. per 24 hour period as determined by the Owner or his representatives.
- D. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring installation.
- E. Close spaces to traffic during resinous flooring installation and for 24 hours after installation unless manufacturer recommends a longer period.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.
  1. Acceptable Manufacturer: Master Builders Solutions Flooring, 32-2 Hamstead PI Pawleys Island SC 29585, 508-922-5769.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Verify flooring products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Flammability: Self-extinguishing in accordance with ASTM D 635.
- C. Regulatory Requirements: Comply with applicable provisions in The Department of Justice's 2010 ADAAG Standards, and ICC A117.1 and other local accessibility standards including tests for slip resistance of flooring. Coordinate with Owner, Owner's insurance carrier, and Owner's legal counsel for additional slip resistance requirements.

### **2.3 RESINOUS FLOORING**

- A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.
- B. Basis-of-Design Products: Subject to compliance with requirements, provide only MMA products per specification and per color indicated on the Finish Legend or equal products by the following manufacturers. Available manufacturers offering products that may be incorporated into the Work include:
  1. Sika, Master Builders Solutions Performance Sika Flooring, (Basis of Design Manufacturer).
  2. Duraflex. Inc.

3. Res-Tek.
- C. System Characteristics Seamless Flooring System (MasterTop 1853 SRS CQ):
  1. Color and Pattern: As indicated on the Finish Legend on Drawing.
  2. UV resistance.
  3. Fully cures in one hour.
- D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested in accordance with test methods indicated:
  1. Compressive Strength: 6000 psi minimum in accordance with ASTM C 579.
  2. Tensile Strength: 1050 psi minimum in accordance with ASTM D 638.
  3. Water Absorption: 0.05 percent maximum in accordance with ASTM D 570.
  4. Hardness: 70, Shore D in accordance with ASTM D 2240.
- E. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested in accordance with ASTM D 543, Procedure A, for immersion or ASTM C 267 for immersion in the following reagents for no fewer than seven days:
  1. Clorox.
  2. Cola.
  3. Ketchup.
  4. Mustard.
  5. Urine.
  6. Vinegar.
- F. Primer: Type recommended in writing by resinous flooring manufacturer for substrate and resinous flooring system indicated.
  1. Formulation Description: 100 percent solids.
- G. Body Coats:
  1. Resin: Methyl methacrylate.
  2. Formulation Description: 100 percent solids.
  3. Filler: Manufacturer's standard filler component.
  4. Type: Pigmented.
  5. Installation Method: Self-leveling slurry with broadcast aggregates.
    - a. Cove Bases: Manufacturer's non-self-leveling formula and filler to create cove bases.
  6. Number of Coats: One.
  7. Thickness of Coats: 1/8 inch.
  8. Aggregates: Colored quartz (ceramic-coated silica).
- H. Topcoats: Sealing or finish coats.
  1. Resin: Methyl methacrylate.
  2. Formulation Description: 100 percent solids.
  3. Type: Clear.
  4. Antimicrobial Additive: Manufacturer's standard.
  5. Non-slip Aggregate:
    - a. Glass beads (25-45 sieve) as required to meet field sample testing.
  6. Number of Coats: Two, or more as required by approved finish texture.

## 2.4 MATERIALS

- A. Basis of Design System: Mastertop 1853 SRS CQ Methyl- Methacrylate (MMA) Acrylic Resin Self-Leveling Flooring System with Decorative Quartz): (Anti-Slip, 2 top coat and 4" Integral Cove Base).
  1. Saturating Primer/Sealer Coat: MasterTop SRS 41P.
  2. Coving (if required: MasterTop SRS 61BC (with appropriate fillers).
  3. Overlay: MasterTop SRS 61BC.
  4. Patching /Slopping (if required): MasterTop 1817 SRS PC Polymer Concrete.

5. Topping: MasterTop SRS 61BC Self-Leveing, consisting of MasterTop SRS 61BC resin and MasterTop SRS 100SL with Colored Quartz broadcast.
6. Top Coat: MasterTop SRS 71TC Colorless Topcoat Resin.
7. SRS Colored Quartz for broadcasting: Chosen by Owner.

## 2.5 (BASIS OF DESIGN) PERFORMANCE CRITERIA (1853 SRS CQ)

- A. MasterTop SRS 41P Primer/Sealer
  1. Percentage Reactive Resin: 100 percent.
  2. Percentage Solids: 100 percent.
  3. Water Absorption, Wt percent (ASTM D 570): less than 0.06.
  4. Tensile Strength, psi (ASTM D 638) 3550.
  5. Tensile Modulus, psi X 10 to the 5th (ASTM D 638): 2.1.
  6. Coefficient of Thermal Expansion, in./in./deg.F (ASTM D 696): .000035.
  7. Electrical Resistivity (ASTM D 257):
    - a. Volume Resistance, ohm-cm: 10 to the 15th.
    - b. Surface Resistance, ohm: 10 to the 12th.
- B. MasterTop 1817 SRS PC Polymer Concrete
  1. Percentage Reactive Resin: 100 percent.
  2. Water Absorption, Wt percent (ASTM D 570): 0.02.
  3. Tensile Strength, psi (ASTM D 638): 1,200.
  4. Tensile Modulus, psi X 10 to the 5th (ASTM D 638): 1.2.
  5. Compressive Strength, psi (ASTM C 39): 7,000.
- C. MasterTop SRS 61BC Topping
  1. Percentage Reactive Resin: 100 percent.
  2. Percentage Solids: 100 percent.
  3. Water Absorption, Wt percent (ASTM D 570): 0.04.
  4. Compressive Strength, psi (ASTM C 109): 6,000-8,000.
  5. Tensile Strength, psi (ASTM D 638): 1,050.
  6. Tensile Modulus, psi (ASTM D 638): 720,000.
  7. Electrical Resistivity (ASTM D 25):
    - a. Volume Resistance, ohm-cm: 10 to the 14th.
  8. Compressive Strength: 8,000 psi.
- D. MasterTop SRS 71TC Colorless Topcoat Resin
  1. Percentage Reactive Resin: 100 percent.
  2. Percentage Solids: 100 percent
  3. Water Absorption, Wt. percent (ASTM D 570): 0.04.
  4. Tensile Strength, psi (ASM 638): 3,555.
  5. Tensile Modulus, psi (ASTM D 638): 210,000.
  6. Electrical Resistivity (ASTM D 257):
    - a. Volume Resistance, ohm-cm: 10 to the 15th.
    - b. Surface Resistance: ohm: 10 to the 12th.

## 2.6 INSTALLATION AND APPLICATION CRITERIA

- A. Pot Life at 68 degrees F: Follow manufacturer's instructions.
- B. Cure Time at 68 degrees F: Follow manufacturer's instructions.
- C. Recoat Time at 68 degrees F: Follow manufacturer's instructions.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Product Representative and Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resinous flooring systems.
- B. Proceed with installation only after unsatisfactory conditions have been corrected and proper preparation has been confirmed and signed off by product representative.

### 3.2 PREPARATION

- A. Prepare and clean substrates in accordance with resinous flooring manufacturer's written instructions, manufactures standard details and this specification for substrate indicated to ensure adhesion. Provide clean, dry substrate for resinous flooring application. No surfaces should contain any remnants of contaminates that are known to interfere with new flooring material adhesion. Provide manufacturers written approval of preparation of substrate prior to installation.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
  - 1. Roughen concrete substrates as follows:
    - a. Shot-blast surfaces to CSP of 4-5 with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
  - 2. Repair damaged and deteriorated concrete in accordance with resinous flooring manufacturer's written instructions.
  - 3. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 5 lb of water/1000 sq. ft. in 24 hours for MMA systems.
    - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent (90 percent acceptable for MMA systems only) relative humidity level measurement.
  - 4. Alkalinity and Adhesion Testing: Perform tests recommended in writing by resinous flooring manufacturer. Proceed with installation only after substrate alkalinity is not less than 6 or more than 8 pH unless otherwise recommended in writing by flooring manufacturer.
- C. Bond Testing: Manufacturer's recommended procedures for bond testing shall be performed at strategic locations prior to any placement of new flooring materials. Inform Owner/Architect if bond tests are not successful to manufacturer's standards.
- D. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates in accordance with manufacturer's written instructions.
  - 1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring in accordance with manufacturer's written instructions.
- E. Resinous Materials: Mix components and prepare materials in accordance with resinous flooring manufacturer's written instructions.

### 3.3 INSTALLATION

- A. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F 2170 (Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes) in new construction or ASTM F 1869 (Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride) in renovations to Architect and Owner prior to floor installation. Acceptable moisture content of concrete subfloor shall be within approved manufacture limits or lower prior to installation.
- B. Apply components of resinous flooring system in accordance with manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness specified.
  - 1. Coordinate installation of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
  - 2. Cure resinous flooring components in accordance with manufacturer's written instructions. Prevent contamination during installation and curing processes.
  - 3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- C. Primer: Apply primer over prepared substrate at spreading rate recommended in writing by manufacturer.
- D. Integral Cove Base Accessories: Adhesively install precast accessories before applying flooring coats and in accordance with manufacturer's written instructions.
- E. Field-Formed Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring coats. Apply in accordance with manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
  - 1. Integral Cove Base: 4 inches high or as indicated on Drawings.
- F. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness specified for flooring system.
  - 1. Aggregates: Broadcast aggregates at rate recommended in writing by manufacturer. After resin is cured, remove excess aggregates to provide surface texture indicated.
- G. Non-Slip Aggregates: Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated. Slip resistant aggregate is not required on cove bases.
- H. Topcoats: Apply topcoats in number indicated for flooring system specified, at spreading rates recommended in writing by manufacturer, and to produce wearing surface specified.

### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Technical Representative: Engage an authorized technical representative of manufacturer to observe and inspect preparation and installation on site.
- B. Bond Test: X. Second pour. Comply with ASTM D7234 and ASTM D4541.
- C. Material Sampling: Owner may, at any time and any number of times during resinous flooring installation, require material samples for testing for compliance with requirements.
  - 1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
  - 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
  - 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reinstall flooring materials to comply with requirements.



- D. Core Sampling: At Owner's direction and at locations designated by Owner, take one core sample per 1000 sq. ft. of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring. Correct deficiencies in installed flooring as indicated by testing.

### **3.5 PROTECTION**

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 09 68 00 - CARPETING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Carpet Tile.
- B. Related Requirements:
  - 1. Section 01 32 00 "Construction Progress Documentation" for long lead and scheduling requirements.
  - 2. Section 09 30 13 "Tile" for transition strips between tile and carpet.
  - 3. Section 09 65 13 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet.
- C. Carpet could have a long lead time. Contractor is strongly urged to address this situation at the beginning of the Project and to incorporate the time line into the Project Schedule.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to carpet installation including, but not limited to, the following:
    - a. Review delivery, storage, and handling procedures.
    - b. Review ambient conditions and ventilation procedures.
    - c. Review subfloor preparation procedures.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For the following, including installation recommendations for each type of substrate:
  - 1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
- B. Shop Drawings: Show the following:
  - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
  - 2. Carpet type, color, and dye lot.
  - 3. Locations where dye lot changes occur.
  - 4. Seam locations, types, and methods.
  - 5. Type of subfloor.
  - 6. Type of installation.
  - 7. Pattern type, repeat size, location, direction, and starting point.
  - 8. Pile direction.
  - 9. Type, color, and location of edge, transition, and other accessory strips.
  - 10. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Finish Legend on Drawings.
  - 1. Carpet: (1) Full size tile (24 x 24, 18 x 36, etc.).
  - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.
  - 3. Carpet Seam: 6-inch Sample.
  - 4. Mitered Carpet Border Seam: 12-inch-square Sample. Show carpet pattern alignment.

- D. Product Schedule: For carpet. Use same designations indicated on Drawings.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer.
- B. Product Test Reports: For carpet, for tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
  - 1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  - 2. Precautions for cleaning materials and methods that could be detrimental to carpet.

#### **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Stock Material: Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

#### **1.7 QUALITY ASSURANCE**

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockups at locations and in sizes shown on Drawings.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with CRI 104.

#### **1.9 FIELD CONDITIONS**

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

#### **1.10 WARRANTY**

- A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
  - 1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.

2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, excess static discharge, and delamination.
3. Warranty Period: 10 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Basis-of-Design Product (CA1, CA2, CA4, CA5, CA8): Refer to the Finish Legend.

### **2.2 MATERIALS**

- A. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height requires to protect exposed edge of carpet, and of maximum lengths to minimize running joints.
  1. Basis of Design: Schluter Systems LP.
  2. Provide all corners and connectors as required for a complete and detailed finished installation.

### **2.3 INSTALLATION ACCESSORIES**

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
  1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet manufacturer.
  2. Subfloor finishes comply with requirements specified in Section 03 30 00 "Cast-in-Place Concrete" for slabs receiving carpet.
  3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. General: Comply with CRI 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks,

holes and depressions 3mm (1/8 inch wide or wider, and protrusions more than 0.7mm (1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.

- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

### 3.3 INSTALLATION

- A. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F 2170 (Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes) in new construction or ASTM F 1869 (Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride) in renovations to Architect and Owner prior to floor installation. Acceptable moisture content of concrete subfloor shall be within approved manufacture limits or lower prior to installation.
- B. General: Comply with CRI 104 and carpet manufacturer's written installation instructions for the following:
  - 1. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation."
- C. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- D. Do not bridge building expansion joints with carpet.
- E. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- F. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Maintain dye lot integrity. Do not mix dye lots in same area.
- I. Install carpet with pattern running in one direction for all rooms within each building.

### 3.4 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing carpet:
  - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
  - 2. Remove yarns that protrude from carpet surface.
  - 3. Vacuum carpet using commercial machine with face-beater element.
- B. Protect installed carpet to comply with CRI 104, Section 16, "Protecting Indoor Installations."
- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

**SECTION 09 69 00 - ACCESS FLOORING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Low Profile Access Flooring structure.
  - 2. Access-flooring panels.
  - 3. Cementitious-core steel panel access flooring.
  - 4. Wood-core steel panel access flooring.
  - 5. Unfilled steel panel access flooring.
- B. Related Requirements:
  - 1. See Finish Legend for finish flooring. Flooring to be applied in the factory by the access flooring manufacturer.
  - 2. Section 23 36 00 "Air Terminal Units" for variable-air-volume diffusers.
  - 3. Section 26 05 26 "Grounding and Bonding for Electrical Systems" for connection to ground of access-flooring understructure.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review connections between access flooring and mechanical and electrical systems.
  - 2. Review requirements related to sealing the plenum.
  - 3. Review procedures for keeping underfloor space clean.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For access flooring:
  - 1. Include layout of access flooring and relationship to adjoining Work based on field-verified dimensions.
  - 2. Details and sections with descriptive notes indicating materials, finishes, fasteners, typical and special edge conditions, accessories, and understructures.
- C. Samples: For the following products:
  - 1. Floor Coverings: Full-size units for each color and texture specified.
  - 2. Exposed Metal Accessories: Approximately 10 inches in length.
  - 3. One full-size floor panel, pedestal, and understructure unit for each type of access flooring required.
- D. Samples for Verification: For the following products:
  - 1. Floor Coverings: Full-size units.
  - 2. Exposed Metal Accessories: Approximately 10 inches in length.
  - 3. One full-size floor panel, pedestal, and understructure unit for each type of access flooring required.
- E. Delegated Design Submittals: For seismic design of access flooring.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings:
  - 1. Coordinate mechanical and electrical work in underfloor cavity to prevent interference with access flooring.
  - 2. Mark pedestal locations on subfloor to enable mechanical and electrical work to proceed without interfering with access-flooring pedestals installed after mechanical and electrical work.
- B. Qualification Data: For Installer.
- C. Product Certificates: For each type of access flooring.
- D. Product Test Reports: For each type of access-flooring material and floor covering, performed by a qualified testing agency.
- E. Seismic Design Calculations: For seismic design of access flooring, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. Preconstruction Test Reports: For preconstruction adhesive field test.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Panels: 10.
  - 2. Gratings: 5.
  - 3. Pedestals: 8.
  - 4. Stringers: 4.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockup of typical access flooring, as shown on Drawings. Size to be an area no fewer than five floor panels in length by five floor panels in width.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.7 PRECONSTRUCTION TESTING**

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups.
  - 1. Use personnel, materials, and methods of construction that will be used at Project site.
  - 2. Notify Architect seven days in advance of the dates and times when laboratory mockups will be tested.
- B. Preconstruction Adhesive Field Test: Before installing pedestals, field test their adhesion to subfloor surfaces by doing the following:
  - 1. In areas representative of each subfloor surface, set typical pedestal assemblies in same adhesive, and use methods required for the completed Work.
  - 2. Allow test installation to cure for manufacturer's recommended cure time, with a pressure of 25 lbf applied vertically to pedestals during this period.



3. After curing, apply lateral load against a straight steel bar inserted 2 inches into pedestal stems. Measure the force needed to cause adhesive failure of pedestal base.
4. Remove and discard failed pedestals, and clean pedestals of adhered residue.
5. Proceed with installation only after tests show compliance with performance requirement specified for pedestals' capability to resist overturning moment.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install access flooring until spaces are enclosed, subfloor has been sealed, ambient temperature is between 50 and 90 deg F, and relative humidity is not less than 20 and not more than 70 percent.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design access flooring for seismic performance, including loads imposed on the access flooring by items and equipment installed on the access flooring.
- B. Seismic Performance: Access flooring to withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- C. Structural Performance: Provide access flooring capable of complying with the following performance requirements according to testing procedures in CISCA's "Recommended Test Procedures for Access Floors":
  1. Concentrated Loads: 1000 lbf with the following deflection and permanent set:
    - a. Top-Surface Deflection: 0.10 inch.
    - b. Permanent Set: 0.010 inch.
  2. Ultimate Loads: 2000 lbf.
  3. Rolling Loads: With local or overall deformation not to exceed 0.040 inch.
    - a. CISCA Wheel 1: 10 passes at 800 lbf.
    - b. CISCA Wheel 2: 10,000 passes at 800 lbf.
  4. Stringer Load Test: 225 lbf at center of span with a permanent set not to exceed 0.010 inch.
  5. Pedestal Axial Load Test: 5000 lbf.
  6. Pedestal-Overturning-Moment Test: 1000 lbf x inches.
  7. Uniform Load Test: 00 lbf/sq. ft. with a maximum top-surface deflection not to exceed 0.040 inch and a permanent set not to exceed 0.010 inch.
  8. Drop Impact Load Test: 125 lb.
- D. Fire Performance:
  1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  2. Combustion Characteristics: ASTM E 136.
- E. Low Profile system:
  1. Each unit has mini pedestals on the underside, which distributes the load from the floor above evenly without instability across unit under rolling or shifting loads.
  2. Profile height: 2.25 inches minimum to 2.75 inches maximum:
    - a. Install self levelling cementitious screed in the 3 inch concrete floor recess to bring the installed system up to the required elevation and provide a leveled substrate.
- F. Static Resistance Requirements for flooring:
  1. Anti-static
  2. Static Dissipative

3. Static Conductive.

## 2.2 MANUFACTURERS

- A. Source Limitations: Obtain access-flooring system from single source from single manufacturer.

## 2.3 LOW PROFILE FLOOR SYSTEM

- A. Source Limitations: Obtain access-flooring system from single source from single manufacturer.
- B. Manufacturer: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  1. DIRTT
  2. FreeAxez Manufacturing LLC, 1810 Underwood Blvd, (856) 764-0400, (856) 764-0700 fax, Delran, NJ 08075 System Designation: FreeAxez 70
  3. POWERFLOR USA, Inc., 1406 Waterford Drive – Bel Air, Maryland 21015 – Phone: (410) 893-0035 / email: powerflorusa@aol.com
  4. Tate Access Floors, Inc.
  5. Approved equal.
- C. Floor Panels, General: Provide low-profile access floor system consisting of a series of modular, removable, interchangeable steel or poly base units, corner plates, channel plates, border units and accessories that form an accessible under floor cavity to accommodate electrical, voice and data services. Modular panels shall be accessible and interchangeable with other field panels without disturbing adjacent panels or understructure.
  1. Size: Nominal 24 by 24 inches or 50cm by 50cm.
  2. Attachment to Understructure: By gravity.
- D. The panels are constructed with a modular matrix which provides high strength while remaining light and easy to handle. The panels are easy to customize by cutting out sections to fit around obstructions like columns, posts, walls and more, while retaining high structural integrity.
- E. Understructure: Low Profile (2.5 inch) multi pedestal system.
- F. Floor Panel Coverings: Refer to the Finish Legend, Finish Schedule and the Drawings.

## 2.4 ACCESS FLOOR PANELS

- A. Floor Panels, General: Provide modular panels interchangeable with other field panels without disturbing adjacent panels or understructure.
  1. Size: Nominal 24 by 24 inches.
  2. Attachment to Understructure: Bolted.
  3. One-to-One Carpet Tile: Fabricate panels to accept one-to-one carpet tile.
- B. Cementitious-Core Steel Panel Access Flooring: Fabricate panels from cold-rolled steel sheet, with die-cut flat top sheet and die-formed and stiffened bottom pan welded together. Protect metal surfaces against corrosion using manufacturer's standard factory-applied finish. Fully grout internal spaces of completed units with manufacturer's standard cementitious fill.
  1. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
    - a. ASM Modular Systems, Inc.
    - b. Bergvik North America, Inc.
    - c. Camino Modular Systems, Inc.
    - d. Computer Environments, Inc.
    - e. Haworth, Inc.
    - f. Tate Access Floors, Inc.

- C. Pedestal System Understructure: System consisting of base, column with provisions for height adjustment, and head (cap); made of steel.
1. Base: Square or circular base with not less than 16 sq. in. of bearing area.
  2. Column: Of height required to bring finished floor to elevations indicated. Weld column to base plate.
  3. Provide vibration-proof leveling mechanism for making and holding fine adjustments in height over a range of not less than 2 inches and for locking at a selected height, so deliberate action is required to change height setting and prevent vibratory displacement.
  4. Head: Designed to support the floor panel indicated.
    - a. Provide sound-deadening pads or gaskets at contact points between heads and panels.
    - b. Bolted Assemblies: Provide head with four holes aligned with holes in floor panels for bolting of panels to pedestals.
- D. Stringer System Understructure: Modular steel stringer systems designed to bolt to pedestal heads and form a grid pattern. Protect steel components with manufacturer's standard galvanized or corrosion-resistant paint finish.
1. Continuous Gaskets: At contact surfaces between panel and stringers to deaden sound, seal off the underfloor cavity from above, and maintain panel alignment and position.

## 2.5 WOOD-CORE STEEL PANEL ACCESS FLOORING

- A. Wood-Core Steel Panel Access Flooring: Fabricate panels with 1-inch-thick particleboard core laminated to top and bottom steel face sheets, and with a flame-spread index of 25 or less according to ASTM E 84. Provide core edges enclosed with upturned, die-formed, bottom-sheet edge or with perimeter steel channel welded to top sheet and welded or bonded to bottom sheet. Protect metal surfaces against corrosion by manufacturer's standard factory-applied finish.
1. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
    - a. ASM Modular Systems, Inc.
    - b. Bergvik North America, Inc.
    - c. Camino Modular Systems, Inc.
    - d. Computer Environments, Inc.
    - e. Tate Access Floors, Inc.

## 2.6 UNFILLED STEEL PANEL ACCESS FLOORING

- A. Unfilled Steel Panel Access Flooring: Fabricate panels from cold-rolled steel sheet, with die-cut flat top sheet and die-formed and stiffened bottom pan welded together. Protect metal surfaces against corrosion by manufacturer's standard factory-applied finish.
1. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
    - a. ASM Modular Systems, Inc.
    - b. Bergvik North America, Inc.
    - c. Camino Modular Systems, Inc.
    - d. Computer Environments, Inc.
    - e. Tate Access Floors, Inc.
  2. Solid Panels: Flat, solid top surface.
- B. Perforated Panels: Perforated top surface with slots of number, spacing, and size standard with manufacturer to produce a nominal open area of 24 percent. Provide mechanical dampers with each panel unit.
1. Quantity: As shown on Drawings.

2. Finish: To match solid panels.
- C. Grates: Grating ribs arranged in manufacturer's standard pattern to produce a nominal open area of 50 percent. Provide mechanical dampers with each panel unit.
  1. Quantity: As shown on Drawings.
  2. Finish: To match solid panels.
- A. Exposed-Concrete-Surface Panels: Fabricated with bottom pan that is die formed from metallic-coated steel sheet and filled with lightweight concrete that is reinforced and bonded to pan by shear ties.
  1. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
    - a. Haworth, Inc.
    - b. Approved equal.
- B. Pedestal System Understructure: System consisting of base, column with provisions for height adjustment, and head (cap); made of steel.
  1. Base: Square or circular base with not less than 16 sq. in. of bearing area.
  2. Column: Of height required to bring finished floor to elevations indicated. Weld to base plate.
  3. Provide vibration-proof leveling mechanism for making and holding fine adjustments in height over a range of not less than 2 inches and for locking at a selected height, so deliberate action is required to change height setting and prevent vibratory displacement.
  4. Head: Designed to support the floor panel indicated.
    - a. Provide sound-deadening pads or gaskets at contact points between heads and panels.
    - b. Bolted Assemblies: Provide head with four holes aligned with holes in floor panels for bolting of panels to pedestals.
- C. Stringer System Understructure: Modular steel stringer systems designed to bolt to pedestal heads and form a grid pattern. Protect steel components with manufacturer's standard galvanized or corrosion-resistant paint finish.
  1. Continuous Gaskets: At contact surfaces between panel and stringers to deaden sound, seal off the underfloor cavity from above, and maintain panel alignment and position.

## 2.7 FABRICATION

- A. Fabrication Tolerances:
  1. Size: Plus or minus 0.020 inch of required size.
  2. Squareness: Plus or minus 0.015 inch between diagonal measurements across top of panel.
  3. Flatness: Plus or minus 0.035 inch, measured on a diagonal on top of panel.
- B. Panel Markings: Clearly and permanently mark floor panels on their underside with panel type and concentrated-load rating.
- C. Bolted Panels: Provide panels with holes drilled in corners to align precisely with threaded holes in pedestal heads and to accept countersunk screws with heads flush with top of panel.
  1. Captive Fasteners: Provide fasteners held captive to panels.
- D. Cutouts: Fabricate cutouts in floor panels for cable penetrations and service outlets. Provide reinforcement or additional support, if needed, to make panels with cutouts comply with structural performance requirements.
  1. Number, Size, Shape, and Location: As indicated.
  2. Grommets: Where indicated, fit cutouts with manufacturer's standard grommets; or, if size of cutouts exceeds maximum grommet size available, trim edge of cutouts with manufacturer's standard plastic molding with tapered top flange. Furnish removable covers for grommets.

3. Provide foam-rubber pads for sealing annular space formed in cutouts by cables.

## 2.8 ACCESSORIES

- A. Adhesives: Manufacturer's standard adhesive for bonding pedestal bases to subfloor.
- B. Post-Installed Anchors: For anchoring pedestal bases to subfloor, provide two post-installed expansion anchors made from carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 (Mild), with the capability to sustain, without failure, a load equal to 1.5 times the loads imposed by pedestal-overturning moment on fasteners, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
- C. Service Outlets: Standard UL-listed and -labeled assemblies, for recessed mounting flush with top of floor panels; for power, communication, and signal services; and complying with the following requirements:
  1. Structural Performance: Cover capable of supporting a [300-lbf] [800-lbf] [1000-lbf] concentrated load.
  2. Cover and Box Type: Hinged polycarbonate cover with opening for passage of cables when cover is closed and including frame and steel box or formed-steel plate for mounting electrical receptacles.
  3. Location: In center of panel quadrant unless otherwise indicated.
  4. Receptacles and Wiring:
    - a. Electrical receptacles and wiring for service outlets are specified elsewhere.
    - b. Equip each service outlet with power receptacles to comply with the following requirements:
      - 1) Type of Receptacle: Heavy-duty duplex, two-pole, three-wire grounding, 20 A, 125 V, NEMA WD 6, Configuration 5-20R unless otherwise indicated.
      - 2) Number of Receptacles for Outlet: [One] [Two] [Four].
      - 3) Factory Wired: For field hardwiring with armored cable, containing three insulated No. 12 AWG solid-copper conductors, terminated with a 6-inch-long pigtail.
      - 4) Power-in Connectors: Built into outlet housing, of type to fit power-in and power-out connectors of branch-circuit cables supplied with building electrical system.
- D. Floor Grilles: Standard load-bearing grilles formed from aluminum to produce removable one-piece unit precisely fitted in factory-prepared openings of standard field panels, with adjustable/removable dampers and complying with the following requirements:
  1. Air-Distribution Characteristics: 468 cfm at 0.10-inch wg static pressure.
  2. Structural Performance: Capable of supporting a 1000-lbf concentrated load.
  3. Fire-Test-Response Characteristics: Classified 94V-0 according to UL 94.
- E. Plenum-Wall Brush Grommets: Self-sealing cable brush grommet with 3-inch round usable area for passage of power and signal cables through plenum walls. Provide aluminum frame with passageway of interwoven nylon filaments and intermediate layer of EPDM. Provide units with plastic cable tray for support of cables and protection of wallboard.
- F. Cavity Dividers: Provide manufacturer's standard metal dividers located where indicated to divide underfloor cavities.
- G. Fascia Closures: Where underfloor cavity is not enclosed by abutting walls or other construction, provide metal closure plates with manufacturer's standard finish.
- H. Ramps: Manufacturer's standard ramp construction of width and slope indicated, but not steeper than 1:12, with raised-disc or textured rubber or vinyl-tile floor coverings, and of same materials, performance, and construction requirements as access flooring.
- I. Steps: Provide steps of size and arrangement indicated with floor coverings to match access flooring. Apply nonslip aluminum nosings to treads unless otherwise indicated.

- J. Railings: Standard extruded-aluminum railings at ramps and open-sided perimeter of access flooring where indicated. Include handrail, intermediate rails, posts, brackets, end caps, wall returns, wall and floor flanges, plates, and anchorages where required.
  - 1. Provide railings that comply with structural performance requirements specified in Section 05 52 13 "Pipe and Tube Railings."
- K. Panel Lifting Device: Panel manufacturer's standard portable lifting device for each type of panel required for each computer room.
- L. Perimeter Support: Where indicated, provide manufacturer's standard method for supporting panel edge and forming transition between access flooring and adjoining floor coverings at same level as access flooring.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, with Installer and manufacturer's authorized representative present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify that substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of conditions and deleterious substances that might interfere with attachment of pedestals.
  - 2. Verify that concrete floor sealer and finish have been applied and cured.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Lay out floor panel installation to keep the number of cut panels at floor perimeter to a minimum. Avoid using panels cut to less than 6 inches.
- B. Locate each pedestal, complete any necessary subfloor preparation, and vacuum subfloor to remove dust, dirt, and construction debris before beginning installation.

#### **3.3 INSTALLATION**

- A. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F 2170 (Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes) in new construction or ASTM F 1869 (Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride) in renovations to Architect and Owner prior to floor installation. Acceptable moisture content of concrete subfloor shall be within approved manufacture limits or lower prior to installation.
- B. Install access flooring and accessories under supervision of access-flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.
- C. Adhesive Attachment of Pedestals: Set pedestals in adhesive, according to access-flooring manufacturer's written instructions, to provide full bearing of pedestal base on subfloor; and as required to meet seismic design requirements.
- D. Mechanical Attachment of Pedestals: Attach pedestals to subfloor with post-installed mechanical anchors as required to meet seismic design requirements.
- E. Adjust pedestals so installed panels are flat, level, and at the proper height.

- F. Stringer Systems: Secure stringers to pedestal heads according to access-flooring manufacturer's written instructions.
- G. Install flooring panels securely in place, leaving them properly seated with panel edges flush. Do not force panels into place.
- H. Scribe perimeter panels to provide a close fit, with adjoining construction having no voids greater than 1/8 inch where panels abut vertical surfaces.
  - 1. To prevent dusting, seal cut edges of steel-encapsulated, wood-core panels with sealer recommended in writing by panel manufacturer.
- I. Cut and trim access flooring and perform other dirt-or-debris-producing activities at a remote location or as required to prevent contamination of subfloor under installed access flooring.
- J. Grounded Access Flooring: Ground access flooring as recommended by manufacturer and as needed to comply with performance requirements for electrical resistance of floor coverings.
  - 1. Panel-to-Understructure Resistance: Not more than 10 ohms as measured without floor coverings.
- K. Underfloor Dividers: Scribe and install underfloor-cavity dividers to closely fit against subfloor surfaces, and seal with mastic.
- L. Closures: Scribe closures to closely fit against subfloor and adjacent finished-floor surfaces. Set in mastic and seal to maintain plenum effect within underfloor cavity.
- M. Clean dust, dirt, and construction debris caused by floor installation, and vacuum subfloor area as installation of floor panels proceeds.
- N. Seal underfloor air cavities at construction seams, penetrations, and perimeter to control air leakage, according to manufacturer's written instructions.
- O. Install access flooring without change in elevation between adjacent panels and within the following tolerances:
  - 1. Plus or minus 1/16 inch in any 10-foot distance.
  - 2. Plus or minus 1/8 inch from a level plane over entire access flooring area.

### 3.4 PROTECTION

- A. Prohibit traffic on access flooring for 24 hours and removal of floor panels for 72 hours after installation, to allow pedestal adhesive to set.
- B. After completing installation, vacuum access flooring and cover with continuous sheets of reinforced paper or plastic. Maintain protective covering until time of Substantial Completion.
- C. Replace access-flooring panels that are stained, scratched, or otherwise damaged or that do not comply with specified requirements.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 09 72 00 - WALL COVERINGS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Vinyl wall covering.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.
- B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement seams and termination points.
- C. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36 inches long in size.
  - 1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments applied.
    - a. Show complete pattern repeat.
    - b. Mark top and face of fabric.
- D. Samples for Verification: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36 inches long in size.
  - 1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments applied.
- E. Product Schedule: For wall coverings. Use same designations indicated on Drawings.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For wall coverings to include in maintenance manuals.

**1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Stock Material: Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 5 percent of amount installed.

**1.7 QUALITY ASSURANCE**

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation.

1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F 1141 for appearance shading characteristics.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.
- B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates in accordance with test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 75 or less.
    - b. Smoke-Developed Index: 450 or less.
  2. Fire-Growth Contribution: No flashover and heat and smoke release when tested in accordance with NFPA 286.

### 2.2 VINYL WALL COVERING

- A. Basis-of-Design Product (WC1 – WC15): Refer to the Finish Legend on Drawings.
- B. Description: See the Finish Legend for product details.
  1. Provide vinyl products in rolls from same production run and complying with the following:
    1. CFFA-W-101 for Type II, Medium -Duty products.
    2. ASTM F793/F793M for strippable wall coverings.
      - a. Category: II, Decorative with Medium Serviceability.
- C. Width: See Finish Legend.
- D. Backing: Per manufacturer's product guidelines.
- E. Repeat: Per manufacturer's product recommendations.
- F. Mildew Resistance: Rating of zero or 1 when tested in accordance with ASTM G 21.
- G. Colors, Textures, and Patterns: Match Architect's samples.

### 2.3 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.
  - 1. Adhesive shall have a VOC content of 50 g/L or less.
- B. Primer/Sealer: Mildew resistant, complying with requirements in Section 09 91 23 "Interior Painting" and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.
- C. Seam Tape: As recommended in writing by wall-covering manufacturer.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation surfaces being true in plane and vertical and horizontal alignment, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, and mildew.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unbound coatings, cracks, and defects.
  - 1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
  - 2. Plaster: Allow plaster to cure for at least 90 days. Neutralize areas of high alkalinity. Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
  - 3. Metals: If not factory primed, clean and apply metal primer as recommended in writing by metal-primer manufacturer and wall-covering manufacturer.
  - 4. Gypsum Board: Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
  - 5. Painted Surfaces:
    - a. Check for pigment bleeding. Apply primer/sealer to areas susceptible to pigment bleeding as recommended in writing by primer/sealer manufacturer.
    - b. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.
- D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

#### **3.3 INSTALLATION OF WALL COVERING**

- A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.
- B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.

1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.
- D. Install wall covering without lifted or curling edges and without visible shrinkage.
- E. Match pattern 72 inches above the finish floor.
- F. Install seams vertical and plumb at least 6 inches from outside corners and 6 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.
- G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.
- H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

### **3.4 CLEANING**

- A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION

**SECTION 09 72 19 - GRAPHIC WALL COVERINGS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Vinyl wall covering.
- B. Related Sections:
  - 1. Section 04 20 00 "Unit Masonry" for masonry materials.
  - 2. Section 09 72 00 "Wall Coverings" for other types of wall coverings.
  - 3. Section 09 91 23 "Interior Painting" for paint products installed on wall coverings.
  - 4. Section 10 14 00 "Signage" for graphic artwork, digital requirements and printing requirements for custom wallcoverings specified in this Section.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.
- B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement (print proof), seams and termination points.
- C. Samples: For each type of wall covering and for each color, pattern, backing, texture, and finish specified, full width by 36-inch- long in size.
  - 1. Print Proof: Refer to Signage Section for printing requirements for custom artwork.
- D. Product Schedule: For wall coverings. Use same designations indicated on Drawings.
  - 1. Show roll identification on schedule.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For wall coverings to include in maintenance manuals.

**1.6 FIELD CONDITIONS**

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.
- B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 76 or less.
    - b. Smoke-Developed Index: 450 or less.
  - 2. Fire-Growth Contribution: No flashover and heat and smoke release according to NFPA 286.

**2.2 VINYL WALL COVERING**

- A. Basis-of-Design Product: Refer to the Finish Legend in the Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable product by one of the following:
  - 1. Koroseal Digital Surfaces.
  - 2. Dreamscape.
- B. Description: See Signage Detail Manual for product detail.
- C. Provide mildew-resistant products in rolls from same production run and complying with the following:
  - 1. FS CCC-W-408D and CCC-W-408-D for Type II, Medium-Duty products.
  - 2. ASTM F 793 for strippable wall coverings.
    - a. Category: II, Decorative with Medium Serviceability.
- D. Total Weight: , excluding coatings.
- E. Width: 21 oz. per linear yard 54 inches.
- F. Backing: Osnaburg fabric.
  - 1. Fiber Content: Polycotton.
  - 2. Basis of Design: Koroseal, Linen backing.
- G. Colors, Textures, and Patterns: Artwork to be provided by Architect.

**2.3 ACCESSORIES**

- A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.
- B. Primer/Sealer: Mildew resistant, complying with requirements in Section 09 91 23 "Interior Painting" for Level 5 finish and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.
- B. Field verify all wall locations that Level 5 finish standard have been met.

- C. Review Signage specification for field verification for wall size, templating and provision of digital templates.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
  - 1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
  - 2. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
  - 3. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items. Wallcovering contractor to reinstall all hardware and hardware accessories that they remove.
- E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

### **3.3 WALL-COVERING INSTALLATION**

- A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.
- B. Install wallcovering in same order according to Signage Template.
- C. Install wall covering without lifted or curling edges and without visible shrinkage.
- D. Match pattern 72 inches above the finish floor.
- E. Install seams vertical and plumb at least 6 inches from outside corners and 6 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.
- F. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.
- G. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.
- H. Install metal corner guards according to 10 26 00 "Wall and Door Protection" section.

### **3.4 CLEANING**

- A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 09 84 33 - SOUND-ABSORBING WALL UNITS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:
  - 1. Sound-absorbing wall panels.
  - 2. Perforated sound-absorbing metal wall panels.
- B. Related Requirements:
  - 1. Section 09 72 00 "Wall Coverings" for adhesively applied textile wall coverings.

**1.2 DEFINITIONS**

- A. NRC: Noise Reduction Coefficient.
- B. SAA: Sound Absorption Average.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include fabric facing, panel edge, core material, and mounting indicated.
- B. Shop Drawings: For unit assembly and installation.
  - 1. Include plans, elevations, sections, and mounting devices and details.
  - 2. Include details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge profile and core materials.
  - 3. Include details at cutouts and penetrations for other work.
  - 4. Include direction of fabric weave and pattern matching.
- C. Samples for Initial Selection: For each type of fabric facing.
  - 1. Include Samples of hardware and accessories involving color or finish selection.
- D. Samples for Verification: For the following products:
  - 1. Fabric: Full-width by approximately 36-inch- long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
  - 2. Panel Edge: 12-inch-long Sample(s) showing each edge profile, corner, and finish.
  - 3. Core Material: 12-inch-square Sample at corner.
  - 4. Mounting Devices: Full-size Samples.
  - 5. Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Electrical outlets, switches, and thermostats.
  - 2. Items penetrating or covered by units including the following:
    - a. Air outlets and inlets.
    - b. Speakers.
    - c. Alarms.
    - d. Sprinklers.
  - 3. Show operation of hinged and sliding components covered by or adjacent to units.
- B. Product Certificates: For each type of unit.
- C. Sample Warranty: For manufacturer's special warranty.

**1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.

**1.7 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fabric: For each fabric, color, and pattern installed, provide length equal to 10 percent of amount installed, but no fewer than 10 sq. yd., full width of bolt.
  - 2. Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than five devices, including unopened adhesives.

**1.8 QUALITY ASSURANCE**

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials, fabrication, and installation.
  - 1. Build mockup of typical wall area. Include intersection of wall and ceiling, corners, and perimeters.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

**1.10 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.
- C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

**1.11 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to the following:
    - a. Acoustical performance.
    - b. Fabric sagging, distorting, or releasing from panel edge.
    - c. Warping of core.
  - 2. Warranty Period: Two years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Source Limitations: Obtain wall units specified in this Section from single source from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 76 or less.
    - b. Smoke-Developed Index: 450 or less.
  - 2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.
- B. Acoustic Performance: Sound absorption NRC of not less than 0.80 according to ASTM C 423 for Type A mounting according to ASTM E 795.

**2.3 SOUND-ABSORBING WALL UNITS (INTERNAL LAYERS)**

- A. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of inorganic glass fibers with a thermosetting resin binder and formed into semi-rigid or rigid rectangular boards.
- B. Basis-of-Design Product: Refer to the Finish Legend in the Drawings. Subject to compliance with requirements, provide Owens Corning company, Type 703 Fiberglas Insulation Boards or comparable product by one of the following:
  - 1. Acoustical Solutions, Inc.
  - 2. Decoustics Limited; a Saint Gobain company.
  - 3. Panel Solutions, Inc.
  - 4. Tectum Inc.
- C. Panel Requirements:
  - 1. Panel Shape: Flat.
  - 2. Mounting: Back mounted with manufacturer's recommended standard attachment to substrate.
  - 3. Nominal Core Thickness: As indicated on Drawings.
  - 4. Panel Width: As indicated on Drawings.
  - 5. Panel Height: As indicated on Drawings.

**2.4 SOUND-ABSORBING WALL UNITS (EXTERNAL LAYERS; FINISHED FACES)**

- A. Sound-Absorbing Wall Panel: Refer to Finish Legend in the Drawings. Manufacturer's standard panel construction consisting of inorganic glass fibers with a thermosetting resin binder and formed into semi-rigid or rigid rectangular boards.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Owens Corning Company; SelectSound Black Acoustic Boards or comparable product approved by architect.:
  - 2. Panel Shape: Flat.
  - 3. Mounting: Back mounted with manufacturer's recommended standard attachment to substrate or internal layer, as specified.
    - a. Finish Color at Exposed Edges: Black or as selected by Architect from manufacturer's full range.
  - 4. Edge Profile: Square.
  - 5. Nominal Core Thickness: As indicated on Drawings.
  - 6. Panel Width: As indicated on Drawings.
  - 7. Panel Height: As indicated on Drawings.

**2.5 MATERIALS**

- A. Core Materials: Manufacturer's standard.
  - 1. Glass-Fiber Board: ASTM C 612; of type standard with manufacturer; nominal density of 6 to 7 lb/cu. ft., unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
- B. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as follows:
  - 1. Construction adhesive: Manufacturer's standard recommendation.
  - 2. Metal Clips or Bar Hangers: Manufacturer's standard two-part metal "Z" clips, with one part of each clip mechanically attached to back of unit and the other part to substrate, designed to permit unit removal.

**2.6 FABRICATION**

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated.
- B. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:
  - 1. Thickness.
  - 2. Edge straightness.
  - 3. Overall length and width.
  - 4. Squareness from corner to corner.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align fabric pattern and grain with adjacent units.

**3.3 INSTALLATION TOLERANCES**

- A. Variation from Plumb and Level: Plus or minus 1/16 inch in 48 inches, noncumulative.
- B. Variation of Joint Width: Not more than 1/16-inch variation from hairline in 48 inches, noncumulative.

**3.4 CLEANING**

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 09 84 36 - SOUND-ABSORBING CEILING UNITS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following: Sound-absorbing ceiling panels.

**1.2 DEFINITIONS**

- A. NRC: Noise Reduction Coefficient.
- B. SAA: Sound Absorption Average.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For unit assembly and installation.
  - 1. Include reflected ceiling plans, elevations, sections, and mounting devices and details.
  - 2. Include details at joints and corners; and details at ceiling intersections and intersections with walls. Indicate panel edge profile and core materials.
  - 3. Include direction of fabric weave and pattern matching.
- C. Samples: For the following products:
  - 1. Fabric: Full-width by approximately 36-inch- long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
  - 2. Panel Edge: 12-inch-long Sample(s) showing each edge profile, corner, and finish.
  - 3. Core Material: 12-inch-square Sample at corner.
  - 4. Mounting Devices: Full-size Samples.
  - 5. Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Electrical outlets.
  - 2. Suspended ceiling components above ceiling units.
  - 3. Structural members to which suspension devices will be attached.
  - 4. Items penetrating or covered by units including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Alarms.
    - e. Sprinklers.
    - f. Access panels.
  - 5. Show operation of hinged and sliding components covered by or adjacent to units.

- B. Product Certificates: For each type of unit.
- C. Sample Warranty: For manufacturer's special warranty.

#### **1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturer's written cleaning and stain-removal instructions.

#### **1.7 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Stock Material: Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Panels: For each fabric, color, and pattern installed, furnish length equal to 10 percent of amount installed, but no fewer than 10 sq. yd., full width of bolt.
  - 2. Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than five devices.

#### **1.8 QUALITY ASSURANCE**

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials, fabrication, and installation.
  - 1. Build mockup of typical ceiling area 96 inches wide by full width by truss spacing. Include intersection of wall and ceiling, corners, and perimeters.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

#### **1.10 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.
- C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.



**1.11 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Acoustical performance.
    - b. Fabric sagging, distorting, or releasing from panel edge.
    - c. Warping of core.
  - 2. Warranty Period: Two years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Source Limitations: Obtain ceiling units specified in this Section from single source from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Class A.
    - b. Flame-Spread Index: 25 or less.
    - c. Smoke-Developed Index: 50 or less.
  - 2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.

**2.3 SOUND-ABSORBING CEILING UNITS**

- A. Sound-Absorbing Lapedary Ceiling Panel: Manufacturer's standard panel construction consisting of facing material wrapping over core and bonded at ends to stretcher bars for uniformly draped attachment to structure.
  - 1. Basis of Design Manufacturers: Subject to compliance with requirements, provide MBI Products model 4000S-2065-S or an equivalent product from one of the following:
    - a. Acoustical Panel Systems (APS, Inc.).
    - b. Acoustical Solutions, Inc.
    - c. Armstrong World Industries.
    - d. AVL Systems, Inc.
    - e. Benton Brothers Solutions, Inc.
    - f. Decoustics Limited; a Saint Gobain company.
    - g. Golterman & Sabo.
    - h. MBI Products Company, Inc.
    - i. Pinta Acoustic, Inc.
    - j. Rockfon (Roxul Inc.).
    - k. Sound Concepts Canada, Inc.
    - l. Sound Management Group LLC.
    - m. Wall Technology, Inc.; an Owens Corning company.
    - n. Wenger Corporation.

## 2. Acoustical Performance:

MBI Lapidary Panels Product Model	Absorption Coefficient - E 400 Mounting						
	<u>125</u>	<u>250</u>	<u>500</u>	<u>1000</u>	<u>2000</u>	<u>4000</u>	<u>NRC</u>
4000S-2065-S	0.83	1.02	1	1.04	0.64	0.39	0.95
(2" x 1.65# Core, Sailcloth, Stiffeners)							

3. Panel Shape: Lapidary blanket, rectangular.
4. Mounting: Aluminum end batten, secured to substrate.
5. Core: Glass-fiber blanket, 1.65 lb/sqft.
6. Edge Construction: Manufacturer's standard fully wrapped panel with anodized aluminum gripper bar, predrilled for attachment
7. End Attachment: (heavy duty plastic tie) (coated wire tie) (beam clamps) (washer plates) (cable)
8. Reveals between Panels: reveals as indicated on Drawings.
9. Facing Material: Sailcloth.
10. Nominal Thickness: 50mm (2 inches).
11. Panel Width: 1.2 meter (48 inches).
12. Panel Length: As indicated on Drawings.
13. Color: As selected by Architect from Manufacturer's full range.

**2.4 MATERIALS**

- A. Sustainable Design Requirements:
- B. Core Materials: Manufacturer's standard.
  1. Glass-Fiber Blanket: ASTM C 612, ASTM C 553, or ASTM C 665; of type standard with manufacturer; nominal density of 3 to 4 lb/cu. ft.; flexible; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
- C. Facing Material : Fabric from same dye lot; color and pattern as indicated by manufacturer's designations.

**2.5 FABRICATION**

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated, with facing material applied to face, edges, and back border of dimensionally stable core and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Measure each area and establish layout of panels and joints of uniform size with balanced borders at opposite edges within a given area.
- C. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
  1. Square Corners: Tailor corners. Heat-seal vinyl fabric seams at corners.
  2. Radius and Other Nonsquare Corners: Attach facing material so there are no seams or gathering of material.
  3. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches adjacent units.
- D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:
  1. Thickness.
  2. Edge straightness.
  3. Overall length and width.
  4. Squareness from corner to corner.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install units in locations indicated. Unless otherwise indicated, install units with edges in alignment with walls and other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align fabric pattern and grain with adjacent units.

**3.3 INSTALLATION TOLERANCES**

- A. Variation from Alignment with Surfaces: Plus or minus 1/16 inch in 48 inches, noncumulative.
- B. Variation from Level or Slope: Plus or minus 1/16 inch.
- C. Variation of Joint Width: Not more than 1/16 inch wide from hairline in 48 inches, noncumulative.

**3.4 CLEANING**

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 09 91 13 - EXTERIOR PAINTING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
1. Concrete.
  2. Fiber-cement board.
  3. Clay masonry.
  4. Concrete masonry units (CMUs).
  5. Steel and iron.
  6. Galvanized metal.
  7. Aluminum (not anodized or otherwise coated).
  8. Copper.
  9. Stainless steel.
  10. Wood.
  11. Fiberglass.
  12. Plastic.
  13. Portland cement plaster (stucco).
  14. Gypsum board.
  15. Cotton or canvas insulation covering.
  16. Bituminous-coated surfaces.
- B. Related Requirements:
1. Section 05 12 00 "Structural Steel Framing" for shop priming of metal substrates.
  2. Section 05 50 00 "Metal Fabrications" for shop priming metal fabrications.
  3. Section 05 51 16 "Metal Floor Plate Stairs" for shop priming metal floor plate stairs.
  4. Section 05 51 19 "Metal Grating Stairs" for shop priming metal grating stairs.
  5. Section 05 52 13 "Pipe and Tube Railings" for shop painting pipe and tube railings.
  6. Section 05 53 13 "Bar Gratings" for shop priming metal gratings.
  7. Section 09 96 00 "High-Performance Coatings" for tile-like coatings.
  8. Section 09 93 00 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on exterior wood substrates.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
1. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
1. Submit Samples on rigid backing, 8 inches (200 mm) square.
  2. Apply coats on Samples in steps to show each coat required for system.
  3. Label each coat of each Sample.
  4. Label each Sample for location and application area.

- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

#### 1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

#### 1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products from one of the approved manufacturers below:

1. ICI Paints World Group (ICI).
2. Devoe and Reynolds Co. (Devoe).
3. The Glidden Company (Glidden).
4. Benjamin Moore and Co. (Moore).
5. PPG Industries, Pittsburgh Paints (Pittsburgh).
6. Pratt and Lambert (P & L).
7. The Sherwin-Williams Company (S-W).
8. TNEMEC Company, Inc.

## 2.2 PAINT, GENERAL

- A. Material Compatibility:
1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. Colors: As indicated in a color schedule on Drawings.

## 2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
  2. Testing agency will perform tests for compliance with product requirements.
  3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
  2. Fiber-Cement Board: 12 percent.
  3. Masonry (Clay and CMUs): 12 percent.
  4. Wood: 15 percent.
  5. Portland Cement Plaster: 12 percent.
  6. Gypsum Board: 12 percent.
- C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.
- D. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

- F. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
  - 1. SSPC-SP 2
  - 2. SSPC-SP 3.
  - 3. SSPC-SP 7/NACE No. 4.
  - 4. SSPC-SP 11.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
  - 1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
  - 2. Sand surfaces that will be exposed to view, and dust off.
  - 3. Prime edges, ends, faces, undersides, and backsides of wood.
  - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.



2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
  3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
  4. Paint entire exposed surface of window frames and sashes.
  5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed to view:
    - a. Equipment, including panelboards and switch gear.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Tanks that do not have factory-applied final finishes.

### 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
  2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

**3.6 EXTERIOR PAINT SCHEDULE:**

- A. General: Provide the following paint systems for the various substrates indicated.

**P-1: IRON AND STEEL SURFACES:**

1. ICI:
  - a. Primer: 4100, Alkyd Metal Primer.
  - b. Finish: 2516-XXXX, Exterior Alkyd Semi-Gloss Finish; 2 Coats.

**P-2: GALVANIZED STEEL AND ALUMINUM SURFACES:**

1. ICI:
  - a. Primer: 4160, Alkyd Multi-Purpose Primer.
  - b. Finish: 2516-XXXX, Exterior Alkyd Semi-Gloss Finish; 2 Coats.

**P-3: PAINTED STUCCO AND CONCRETE SURFACES:**

1. ICI:
  - a. Primer: 2220, Exterior Acrylic Flat Finish.
  - b. Finish: 2220-XXXX, Exterior Acrylic Flat Finish; 1 coat at Concrete, and 2 Coats at Stucco.

**P-4: CMU AND MASONRY SURFACES:**

1. ICI:
  - a. Primer: 4000, Acrylic Latex Block Filler; 2 Coats; Brush and Roller application only.
  - b. Finish: 2516-XXXX, Exterior Alkyd Semi-Gloss Enamel; 2 Coats; Brush and Roller application only.
  - c. All block pores shall be completely filled.

**P-5: PAINTED WOOD SURFACES - (Opaque Finish):**

1. ICI:
  - a. Primer - (for spot priming pine knots): 3210, Ultra-Hide Aquacrylic Gripper, Stain Killer Primer-Sealer.
  - b. Primer: 2110, Exterior Alkyd Primecoat.
  - c. Finish: 2516-XXXX, Exterior Alkyd Semi-Gloss Finish; 2 Coats.

**P-6: PAINTED PLYWOOD SURFACES:**

1. ICI:
  - a. Primer - (for spot priming pine knots): 3210, Ultra-Hide Aquacrylic Gripper, Stain Killer Primer-Sealer.
  - b. Primer: 2110, Exterior Alkyd Primecoat.
  - c. Finish: 2516-XXXX, Exterior Alkyd Semi-Gloss Enamel; 2 Coats.

END OF SECTION

**SECTION 09 91 23 - INTERIOR PAINTING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: surface preparation and the application of paint systems on interior substrates.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for shop priming metal fabrications.
  - 2. Section 09 29 00 "Gypsum Board" for painted finishes on non-tiled substrates in wet areas.

**1.1 DEFINITIONS**

- A. Gloss Level 1 (Flat): Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2 (Velvet): Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3 (Eggshell): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4 (Satin): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5 (Semigloss): 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6 (Gloss): 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7 (High Gloss): More than 85 units at 60 degrees, according to ASTM D 523.
- H. Areas Subject to Moisture and Food Preparation: These spaces are those that have permanent plumbing connections and appliances. These include, but are not limited to, toilet rooms connected to shower areas, janitor's closets, locker rooms connected to shower rooms, shower rooms, steam rooms, training rooms, first aid rooms, concession stands, commissaries, kitchens, and laundries. These areas require epoxy painting systems.
  - 1. Toilet rooms consisting of toilets and sinks are not included in this definition.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  - 2. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- C. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

**1.3 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

**1.4 QUALITY ASSURANCE**

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- B. EPA VOC Regulations: All products supplied under this specification section for the locations listed below must be compliant with the VOC limits set in the following districts.
  - 1. Kentucky: Follow USEPA AIM VOC rules.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

**1.6 FIELD CONDITIONS**

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
  - 1. Benjamin Moore & Co.
  - 2. PPG Paints
  - 3. Sherwin Williams
  - 4. KEIM Mineral Coatings of America, Inc.
  - 5. Tnemec, Inc
- B. Source Limitations: Obtain each paint product from single source from single manufacturer.

**2.2 PAINT PRODUCTS, GENERAL**

- A. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.
- C. Colors: As indicated in a color schedule.

**2.3 PAINT, PRODUCTS**

- A. See Interior Painting Schedule for full coating instructions based on substrate.
- B. Block filler: Provide at all new concrete and concrete masonry walls to be painted.
  - 1. Benjamin Moore: Masonry Interior /Exterior Hi-Build block filler
  - 2. PPG Professional: Perma-Crete LTC Concrete Block & Masonry Filler.
  - 3. Sherwin Williams: PrepRite block filler.
  - 4. KEIM Mineral Coatings of America, Inc.: Masonry Spackle.
- C. Concrete Stain: Provide at all new concrete and concrete masonry walls to be stained.
  - 1. KEIM Mineral Coatings of America, Inc.: KEIM CONCRETAL Pigmented Mineral Stain.
- D. Primer: Provide at all new wall construction as indicated in Interior Painting Schedule at the end of this Section.
  - 1. Gypsum and Plaster substrates: primers to be compatible with substrate and finish coat.
    - a. Benjamin Moore, Ultra Spec 500 Interior Primer.
    - b. PPG Professional, Pure Performance interior latex primer.
      - 1) PPG SpeedHide MaxBuild.
    - c. S-W, ProMar 200 zero VOC interior latex primer.
      - 1) SW, Tuff Stuff interior primer.
  - 2. Interior Metals: primers to be compatible with substrate and finish coat.
    - a. Benjamin Moore, Super Spec HP Acrylic Metal Primer.
    - b. PPG Professional, Corafon DTM Primer.
    - c. Sherwin Williams, Pro Industrial Pro-Cryl Universal Primer.
- E. Acrylic Latex
  - 1. Benjamin Moore, Ultra Spec 500.
  - 2. PPG Professional, Speedhide.
  - 3. Sherwin Williams, ProMar 200 zero VOC.
- F. Epoxy
  - 1. Benjamin Moore: Super Spec HP, waterborne polyamide epoxy.
  - 2. PPG Professional: Aquapon WB water based epoxy.
  - 3. Sherwin-Williams: Pro Industrial water based Catalyzed Epoxy.

**2.4 SOURCE QUALITY CONTROL**

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
  - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
  - 2. Testing agency will perform tests for compliance with product requirements.

3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  1. Concrete: 12 percent.
    - a. Allow masonry to cure a minimum of 30 days prior to paint application regardless of moisture content readings.
  2. Masonry (Clay and CMUs): 12 percent.
  3. Allow masonry to cure a minimum of 30 days prior to paint application regardless of moisture content readings.
  4. Wood: 15 percent.
  5. Gypsum Board: 12 percent.
  6. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth and complies with the Level standard specified.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- F. Proceed with coating application only after unsatisfactory conditions have been corrected.
  1. Application of coating indicates acceptance of surfaces and conditions.

#### **3.2 PREPARATION**

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Un-primed Steel Substrates: Remove oil, grease, dust, dirt, rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. Shop Priming Preparation: SSPC-SP 7/NACE No. 4.
  - 2. Field Priming Preparation: SSPC-SP 11.
  - 3. Do not coat steel to be fireproofed with paint from this section.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
  - 1. Do not coat steel to be fireproofed with paint from this section.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
  - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - 2. Sand surfaces that will be exposed to view, and dust off.
  - 3. Prime edges, ends, faces, undersides, and backsides of wood.
  - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.
- L. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth. Exercise care to avoid raising nap of paper.

### 3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint exposed surfaces, except where the Finish Schedule indicates that a surface or material is not to be painted or is to remain natural. If the schedule does not indicate color or finish, match adjacent materials or surfaces.
  - 3. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 4. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

- D. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in occupied spaces:
    - a. Equipment, including panelboards.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - h. Other items as directed by Architect.
  2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.
- E. Stencil Painted Signs: Apply stencil painted signs on both sides of all fire rate Partitions. Locate bottom of the signs no more than 12 inches above removable ceilings. Repeat application of stencil at maximum horizontal spacing of 12 feet and at every intersecting room partition.
1. Use stencils with all capital letters that are 3" high. Color of sign letters is to be bright red. Font for stencils to be a sans serif font similar to Arial or Helvetica.
  2. Provide stencil painted signs with the following messages corresponding to the new walls. See Life Safety plans for wall ratings.
    - a. "1 HOUR RATED WALL"
    - b. "2 HOUR RATED WALL"
    - c. "3 HOUR RATED WALL"
    - d. "1 HOUR RATED WALL AND SMOKE BARRIER"
    - e. "2 HOUR RATED WALL AND SMOKE BARRIER"

### 3.4 FIELD QUALITY CONTROL

- A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
  2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
  2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
  3. Allow empty paint cans to dry before disposal.
  4. Collect waste paint by type and deliver to recycling or collection facility.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.



- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.6 INTERIOR PAINTING SCHEDULE

- A. General: Provide the following paint systems for the various substrates, as indicated; unless noted otherwise in the Construction Documents.
1. Pipe and Equipment Identification Schedule:
    - a. Painting: Paint entire surface of pipe for mechanical and electrical services in accordance with schedule provided on mechanical and electrical drawings and/or contained in mechanical and electrical specifications.
    - b. Concrete Substrates, Nontraffic Surfaces: Not less than 2.5 mills dry, acrylic semi-gloss, over 1 coat of block filler and 1 coat of high performance acrylic concrete/masonry primer, unless otherwise indicated.
  2. Areas Subject to Moisture and Food Preparation: Not less than 3.0 mills dry, water-based 2 part catalyzed semi-gloss epoxy over 1 coat of epoxy filler and 1 coat of epoxy sealer.
- B. CMU Substrates: Not less than 2.5 mills dry, acrylic semigloss, over 1 coat of block filler and 1 coat of over high performance acrylic concrete/masonry primer, unless otherwise indicated.
1. Administrative Areas Finish Coats: Not less than 2.5 mills dry, zero VOC latex eggshell.
  2. Areas Subject to Moisture and Food Preparation: Not less than 3.0 mills dry, water-based 2 part catalyzed semi-gloss epoxy over 1 coat of epoxy filler and 1 coat of epoxy primer.
- C. Miscellaneous Steel Substrates: 1 coat of rust-inhibitive acrylic universal primer, and not less than 2.5 mills dry, zero VOC acrylic semi-gloss.
1. Include hollow metal doors and frames.
- D. Structural Steel Substrates (Unprotected): Primer and finish coating is specified in Section 09 96 00 "High Performance Coatings."
- E. Galvanized-Metal Substrates, Except Railings: Acrylic universal primer, and not less than 3 mills dry, zero VOC acrylic semi-gloss, see Exterior Painting for paint product.
- F. Galvanized-Metal Railings: High solids, high build, polyamide epoxy prime coat, with semi-gloss aliphatic acrylic polyurethane finish coat, see Exterior Painting for paint product.
- G. Aluminum Substrates: Acrylic universal primer, and not less than 3 mills dry, zero VOC acrylic semigloss.
- H. Wood Substrates; Opaque Finish: Latex system.
- I. Wood Substrates: Transparent Finish: Specified in Section 09 93 00 "Staining and Transparent Finishing."
- J. Gypsum Board Substrates:
1. Wall Primer: surfaces scheduled to receive paint finish with a sheen of Gloss Level 2 or greater shall receive ,
  2. Walls: Not less than 2.5 mills dry, zero VOC latex eggshell over zero VOC interior latex primer.
  3. Ceilings: Not less than 2.5 mills dry, zero VOC latex flat over zero VOC interior latex primer.
  4. Epoxy: Not less than 3.0 mills dry, water-based 2 part catalyzed semi-gloss epoxy over epoxy primer.
- K. Concrete Substrates, Vertical Surfaces: Locations indicated in Drawings to receive concrete stain, as indicated.
1. Manufacturer Basis-of-Design Product: Refer to the Finish Legend and the Drawings. Subject to compliance with requirements, provide KEIM CONCRETAL Pigmented Mineral Stain for Concrete or the following:

- a. Comparable products of other manufacturers approved by Architect.

END OF SECTION

**SECTION 09 93 00 - STAINING AND TRANSPARENT FINISHING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Primers
  - 2. Wood stains.
  - 3. Transparent finishes.
- B. Related Requirements:
  - 1. Section 09 91 23 "Interior Painting" for stains and transparent finishes on concrete floors.
  - 2. Section 09 96 00 "High-Performance Coatings" for transparent high-performance coatings on concrete floors and clay masonry.

**1.2 DEFINITIONS**

- A. Gloss Level 4 (Satin): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 7 (High Gloss): More than 85 units at 60 degrees, according to ASTM D 523.

**1.3 ACTION SUBMITTALS**

- A. Product Data:
  - 1. For each type of product.
  - 2. Include preparation requirements and application instructions.
  - 3. Indicate VOC content.
- B. Samples for Initial Selection: For each type of product.
- C. Samples for Verification: Sample for each type of finish system and in each color and gloss of finish required on representative samples of actual wood substrates.
  - 1. Size: 8 inches square or 8 inches long.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

**1.4 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Stock Material: Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. of each material and color applied.

**1.5 MOCKUPS**

- A. Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of stain color selections will be based on mockups.
    - a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

**1.7 FIELD CONDITIONS**

- A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply finishes when relative humidity exceeds 85 percent, at temperatures of less than 5 deg F above the dew point, or to damp or wet surfaces.
- C. Do not apply exterior finishes in snow, rain, fog, or mist.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. Industria Chimica Adriatica SpA (ICA); distributed by Power Process Equipment, Inc.
  - 3. PPG Architectural Finishes, Inc.
  - 4. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in wood finish systems schedules for the product category indicated.

**2.2 SOURCE LIMITATIONS**

- A. Source Limitations: Obtain each coating product from single source from single manufacturer.

**2.3 MATERIALS, GENERAL**

- A. Material Compatibility:
  - 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

- B. Stain Colors: As indicated in a color schedule.

## 2.4 SOURCE QUALITY CONTROL

- A. Testing of Materials: Owner reserves the right to invoke the following procedure:
  - 1. Owner will engage the services of a qualified testing agency to sample wood finishing materials. Contractor will be notified in advance and may be present when samples are taken. If materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
  - 2. Testing agency will perform tests for compliance with product requirements.
  - 3. Owner may direct Contractor to stop applying wood finishes if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and refinish surfaces finished with rejected materials. Contractor will be required to remove rejected materials from previously finished surfaces before refinishing with complying materials if the two finishes are incompatible or produce results that, in the opinion of the Architect, are aesthetically unacceptable.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with finish application only after unsatisfactory conditions have been corrected.
  - 1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
  - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
  - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
  - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.
- D. Interior Wood Substrates:
  - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - 2. Apply wood filler paste to open-grain woods to produce smooth, glasslike finish.

3. Sand surfaces exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

### 3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions.
  1. Use applicators and techniques suited for finish and substrate indicated.
  2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
  3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

### 3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

- A. Wood Substrates, Wood Trim Architectural Woodwork and Wood Board Paneling:
  1. Polyurethane Varnish over Stain System:
    - a. Stain Coat: Stain, semitransparent, for interior wood.
      - 1) Sherwin-Williams Company; Wood Classics Interior Oil Stain - 250; A49-800 Series.
    - b. First Intermediate Coat: Polyurethane varnish matching topcoat.
    - c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
    - d. Topcoat: Varnish, interior, polyurethane, water-based, satin (Gloss Level 4).
      - 1) Sherwin-Williams Company; Wood Classics Waterborne Polyurethane Varnish, A68 Series, Satin.
    - e. Topcoat: Varnish, interior, polyurethane, water-based, high gloss (Gloss Level 7).
      - 1) Sherwin-Williams Company; Wood Classics Waterborne Polyurethane Varnish, A68 Series, Gloss.
- B. Wood Countertops: Bar tops.
  1. Clear, Two-Component Polyurethane System, not less than 16 mils dry overall thickness:
    - a. Prime Coat: Two-component aliphatic acrylic polyurethane.
      - 1) Industria Chimica Adriatica SpA (ICA); FAC242 Clear Base Coat High Build.
    - b. Intermediate Coat: Two-component aliphatic acrylic polyurethane.
      - 1) Industria Chimica Adriatica SpA (ICA); FAC242 Clear Base Coat High Build.
    - c. Topcoat: Varnish, aliphatic acrylic polyurethane, two component.
      - 1) Industria Chimica Adriatica SpA (ICA); OAC363US Clear Matte with UV Filter.

END OF SECTION

**SECTION 09 96 00 - HIGH-PERFORMANCE COATINGS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes surface preparation and the application of high-performance coating systems on the following substrates:
  - 1. Structural Steel Framing, all exterior and exposed steel surfaces.
- B. Related Requirements:
  - 1. Section 09 91 13 "Exterior Painting" for special-use coatings general field painting.
  - 2. Section 09 91 23 "Interior Painting" for special-use coatings general field painting.

**1.2 DEFINITIONS**

- A. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- B. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Indicate VOC content.
- B. Structural Steel Coatings Procedure Manual: Prepared by manufacturer, specifying application and touch-up requirements specifically for this Project. Include the following:
  - 1. Weather and Dew Point.
  - 2. Method of Application (brush, roll or spray including what type of equipment).
  - 3. Dry film thickness and time between surface preparation and application of primer.
  - 4. Equipment cleanliness.
  - 5. Surface preparation prior to application of each coat.
  - 6. Drying time between primer and finish coat(s) and after application of finish coat.
  - 7. Pot Life.
  - 8. Thinning.
  - 9. General application techniques for critical areas to be coated.
  - 10. Maintenance and repair procedures providing a systematic process for inspection, record keeping and observation, coating application, and repair procedures.
  - 11. Types and extent of failures requiring repairs.
- C. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
  - 1. Submit Samples on rigid backing, 8 inches square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.

**1.4 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Coatings: 5 percent, but not less than of each material and color applied.

**1.5 QUALITY ASSURANCE**

- A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each coating system.
    - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft..
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

**1.7 FIELD CONDITIONS**

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, from systems listed in the Schedule at the end of this Section:
  - 1. Carboline Company.
  - 2. International Protective Coatings; an AkzoNobel Brand.
  - 3. PPG Protective & Marine Coatings.
  - 4. Sherwin-Williams Company Protective & Marine Coatings.
  - 5. Tnemec Company, Inc.

**2.2 HIGH-PERFORMANCE COATINGS, GENERAL**

- A. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.



3. When unprimed surfaces are to be coated, entire coating system shall be by the same coating manufacturer to assure compatibility of coatings.
  4. When shop-painted surfaces are to be coated, ascertain whether finish materials will be compatible with shop coating. Inform Engineer/Architect of any unsuitable substrate or coating conditions.
  5. Products shall be of same manufacturer for each coat in a coating system.
- B. Colors: As selected by Architect from manufacturer's full range.
1. Paint (HC-1) Color: Black product to be selected for material compatibility from manufacturer's full range of products.

### 2.3 SURFACES NOT TO BE COATED

- A. Pre-finished metal wall panels and accessories.
- B. Aluminum, stainless steel, or other non-ferrous metals.
- C. Equipment name plates and testing labels.
- D. Electrical equipment.
- E. Plastic, rubber, or other synthetic materials.

### 2.4 METAL PRIMERS

- A. Shop Primer, Organic Zinc-Rich, with Epoxy or Urethane Binder:
  1. Minimum Volume Solids: 50 percent.
  2. Minimum Zinc Content: 80 percent.
  3. ASTM A 490 Class B Slip Coefficient.
  4. Dry Film Thickness: 2.5 to 3.5 mils.
- B. Touch-Up Primer: Manufacturer's recommended primer for field touchup over marginally prepared rusted steel, compatible with shop primer and finish coat.
  1. Minimum Recoat Window: 12 months.

### 2.5 EPOXY PRIMERS UNDER FIREPROOFING

- A. All primers under fireproofing must be tested with the fireproofing as an assembly and approved for use under the fireproofing being installed in the project.
  1. Bond strength test: maintain 150 lbs/sq. ft. per ASTM E736, Section (E).
- B. All primers for steel deck must be individually tested by UL.
- C. Cafco 300 AC SFRM spray-applied fireproofing: Primer to be Sherwin Williams MacroPoxy 646 or other equal product.
  1. For primed steel beams and columns.
- D. Grace Monocoat z146: Primer to be PPG Amerlock 2 or Amerlock 385.

### 2.6 POLYURETHANE COATINGS

- A. Polyurethane, High-Build Acrylic Polyurethane, Pigmented, Semigloss or Gloss (Gloss Levels 5 or 6):
  1. Minimum Volume Solids: 60 percent.
  2. Abrasion Resistance: ASTM D 4060; Not more than 75 mg loss after 1000 cycles.
  3. Adhesion: ASTM D 4541; Not less than 825 psi average of 3 trials.
  4. Corrosion Resistance: ASTM B 117; Not more than 1/32 inch rust creepage at scribe, and none at edges after 1000 hours.
  5. Dry Film Thickness: 3 to 5 mils.

## 2.7 SOURCE QUALITY CONTROL

- A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
  - 1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
  - 2. Testing agency will perform tests for compliance with product requirements.
  - 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Fiber-Cement Board: 12 percent.
  - 3. Masonry (Clay and CMUs): 12 percent.
  - 4. Wood: 15 percent.
  - 5. Gypsum Board: 12 percent.
  - 6. Plaster: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.
- B. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
    - a. Minimum Surface Profile: 1.5 mils.
- C. Steel Substrates for Field Touch-Up Priming: Remove rust, loose mill scale, back to sound primer. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 11/NACE No., "Power Tool cleaning to bare metal."
    - a. Minimum surface profile.

- D. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.
  - 1. SSPC SP-3 Solvent Wipe for mechanically galvanized surfaces.

### 3.3 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
  - 2. Surfaces to be field welded.
    - a. Hold back primer 6 inches from weld.
- B. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions, as indicated in Structural Steel Coatings Procedure Manual submitted, and at rate recommended to provide minimum dry film thickness. Use priming methods that result in full coverage of joints, corners, edges, bolted connections, and exposed surfaces.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
  - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

### 3.4 FINISH COATING

- A. At the Contractor's option, finish coat may be applied in the shop or in the field after erection.
- B. Shop-Applied Finish Coat:
  - 1. Apply finish coat to primed structural steel surfaces except the following:
    - a. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
    - b. Surfaces to be field welded.
    - c. Surfaces to be high-strength bolted with slip-critical connections.
    - d. Surfaces to receive sprayed fire-resistive materials.
  - 2. After erection, clean field welds, bolted connections, and abraded areas according to manufacturer's instructions. Apply touch-up primer and finish coat according to manufacturer's instructions.
- C. Field-Applied Finish Coat:
  - 1. After erection, clean field welds, bolted connections, and abraded areas of shop paint according to manufacturer's instructions, and apply touch-up primer.
  - 2. Apply finish coat to primed structural steel surfaces except the following:
    - a. Surfaces to receive sprayed fire-resistive materials

### 3.5 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations indicated in Structural Steel Coatings Procedure Manual submitted.
  - 1. Use applicators and techniques suited for coating and substrate indicated.
- B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

**3.6 FIELD QUALITY CONTROL**

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
  - 1. Contractor shall touch up and restore coated surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

**3.7 CLEANING AND PROTECTION**

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.
- E. All off-gassing must be complete prior to substantial completion.

**3.8 MAINTENANCE AND REPAIR**

- A. Responsibility:
  - 1. Contractor: Responsible for coating maintenance and repair established in the Structural Steel Coatings Procedure Manual prepared for this Project, from the date of Notice to Proceed to Final Completion of the Contract.
  - 2. Owner: Responsible for coating maintenance and repair established in the Structural Steel Coatings Procedure Manual prepared for this Project, after Final Completion of the Contract.

**3.9 HIGH-PERFORMANCE COATING SCHEDULE**

- A. Structural Steel Framing Substrates including metal decking:
  - 1. Pigmented Polyurethane over Organic Zinc-Rich Primer System:
    - a. Carboline Company:
      - 1) Shop Primer: Carbozinc 859
      - 2) Finish Coat: Carbothane 133 MC
    - b. International Protective Coatings; an AkzoNobel Brand:
      - 1) Shop Primer: Interzinc 315
      - 2) Finish Coat: Interthane 870UHS
    - \*\*\*\*\* OR \*\*\*\*\*
      - 3) Shop Primer: Catha-Coat 315
      - 4) Finish Coat: Devthane 378
    - c. PPG Protective & Marine Coatings:
      - 1) Shop Primer: Ameron 68HS
      - 2) Finish Coat: Durethane DTM.
    - d. Sherwin-Williams Company Protective & Marine Coatings:
      - 1) Shop Primer: Zinc-Clad 4100
      - 2) Finish Coat: Acrolon 218 HS Acrylic Polyurethane

- e. Tnemec Company, Inc:
  - 1) Shop Primer: Series 90-97 Tneme-Zinc
  - 2) Finish Coat: Series 1075U, Endura-Shield II

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 10 11 00 - VISUAL DISPLAY UNITS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Markerboards.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.3 ACTION SUBMITTALS**

- A. Product Data Submittals: For each type of product indicated.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
- B. Shop Drawings: For visual display units.
  - 1. Include plans, elevations, sections, details, and attachment to other work.
  - 2. Show locations of panel joints.
  - 3. Show locations and layout of special-purpose graphics.
  - 4. Include sections of typical trim members.
- C. Samples for Verification: For each type of visual display unit indicated.
  - 1. Visual Display Panel: Not less than 8-1/2 by 11 inches, with facing, core, and backing indicated for final Work. Include one panel for each type, color, and texture required.
  - 2. Trim: 6-inch-long sections of each trim profile.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Sample Warranties: For manufacturer's special warranties.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

**1.6 FIELD CONDITIONS**

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.
  - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

**1.7 WARRANTY**

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Surfaces lose original writing and erasing qualities.
    - b. Surfaces exhibit crazing, cracking, or flaking.
  - 2. Warranty Period:
    - a. 10 years from date of Substantial Completion.
    - b. Life of the building.

**PART 2 - PRODUCTS****2.1 VISUAL DISPLAY BOARD ASSEMBLIES**

- A. Visual Display Board Assemblies:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Deko Markerboards, phone: (844) 366-1545, [www.dekomarkerboards.com](http://www.dekomarkerboards.com); or comparable product by one of the following:
  - 1. Claridge Products and Equipment, Inc.
  - 2. Egan Visual Inc.
  - 3. Peter Pepper Products, Inc.
- C. Markerboard Panel: Porcelain-enamel-faced magnetic markerboard panel on core indicated.
  - 1. Color: As selected by Architect from full range of industry colors.
- D. Magnetic Tray: Manufacturer's standard.
  - 1. Box Type: Extruded aluminum with slanted front, and cast-aluminum end closures.
- E. Accessories:
  - 1. Starter Pack – 6 Erasable markers.
  - 2. Individual magnet units – package of 20.
    - a. Color: Silver.

**2.2 MARKERBOARD PANELS**

- A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated magnetic markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with low-gloss finish.
  - 1. Face Sheet Thickness: 0.021 inch uncoated base metal thickness.
  - 2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
  - 3. MDF Core: 7/16 inch thick; with manufacturer's standard moisture-barrier backing.
  - 4. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

**2.3 MATERIALS**

- A. Porcelain-Enamel Face Sheet: PEI-1002, with magnetic face sheet per manufacturer's standard two- or three-coat process.
- B. Extruded Aluminum: ASTM B 221, Alloy 6063.



**2.4 GENERAL FINISH REQUIREMENTS**

- A. Comply with NAAMM/NOMMA AMP 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

**2.5 ALUMINUM FINISHES**

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.

**3.3 INSTALLATION**

- A. General: Install visual display surfaces in locations indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings, or if not indicated, at heights indicated below.
  - 1. Mounting Height : 36 inches above finished floor to bottom of unit or as shown on Drawings.
- C. Install clear silicone caulk along entire top edge of all markerboards and tackboards where they meet the wall.

**3.4 CLEANING AND PROTECTION**

- A. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

**3.5 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain motorized, sliding visual display units.

END OF SECTION

**SECTION 10 12 00 - DISPLAY CASES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Bulletin boards.
- B. Related Requirements:
  - 1. Section 09 77 23 "Fabric-Wrapped Panels" for tackable, fabric-covered wall panels.

**1.2 DEFINITIONS**

- A. Bulletin Board: Glazed cabinet with tackboard panel, without shelves, typically of shallow depth for display of paper documents.
- B. Display Case: Glazed cabinet with tackboard panel back surface and adjustable shelves.
- C. Tackboard Panel: A material for holding push-pins or tacks, typically consisting of a facing such as fabric, vinyl, or cork; adhered to a substrate such as fiberboard, hardboard, or particleboard.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Bulletin boards.
- B. Product Data Submittals: For each product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for bulletin boards. Include furnished specialties and accessories.
  - 2. Include electrical characteristics for illuminated bulletin boards.
- C. Shop Drawings: For bulletin boards.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Show location of seams and joints in tackboard panels.
  - 3. Include sections of typical trim members.
  - 4. Include diagrams for wiring of illuminated bulletin boards.
- D. Samples: For each exposed product and for each color and texture specified; not less than 8-1/2 by 11 inches for tackboard panels and 6 inches long for trim with factory finish.
- E. Samples for Initial Selection: For each type of exposed finish.
  - 1. Include Samples of tackboard panels and factory-finished trim involving color finish selection.
- F. Samples for Verification: For each type of exposed finish for the following:
  - 1. Tackboard Panel: Not less than 8-1/2 by 11 inches, with facing and substrate indicated for final Work. Include one panel for each type, color, and texture required.
  - 2. Trim: 6-inch-long sections of each trim profile.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: For fabrics, tackboard panels, for tests performed by a qualified testing agency.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For bulletin boards to include in maintenance manuals.

## 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install bulletin boards for indoor installations until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.3 BULLETIN BOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Claridge Products and Equipment, Inc.
  - 2. Ghent Manufacturing, Inc.
  - 3. Laurence, C. R. Co., Inc.
  - 4. U-Line.
- B. General: Factory-fabricated unit consisting of manufacturer's standard wall-mounted cabinet with tackboard panel on back inside surface and operable glazed doors at front.
  - 1. Frame and Cabinet Profile: Square frame section with square cabinet corners.
  - 2. Mounting: Surface mounted.
  - 3. Size:
    - a. As indicated on Drawings.
- C. Aluminum-Framed Cabinet: Manufacturer's standard baked-enamel or powder-coat finish.
  - 1. Color: As selected by Architect from manufacturer's full range.
- D. Wood-Framed Cabinet: Refr to Finish Schedule on Drawings for species with stained finish.
- E. Exterior Bulletin Boards: Aluminum-framed units of weather-resistant construction; with vents to dissipate trapped moisture, weather-resistant tackboard panel, and weather-stripped hinged doors.

- F. Glazed Sliding Doors: Tempered glass; unframed; with extruded-aluminum top and bottom track; supported on nylon or ball-bearing rollers; with plastic top guide and rubber bumpers. Equip each door with ground finger pull and adjustable cylinder lock with two keys.
  - 1. Thickness: Not less than 6 mm thick.
  - 2. Number of Doors: As indicated on Drawings.
- G. Glazed Hinged Doors: Tempered glass; set in frame matching cabinet material and finish. Equip each door with full-height continuous hinge and cylinder lock with two keys.
  - 1. Thickness: Not less than 6 mm thick.
  - 2. Number of Doors: As indicated on Drawings.
- H. Header Panel: Nonilluminated; with opaque acrylic sheet panel set within overall cabinet frame; with matching frame that separates header panel from bulletin board.
  - 1. Graphic Content and Style: Provide header panel copy that complies with requirements indicated on Drawings for size, style, spacing, content, height, location, material, and colors of graphics.
  - 2. Color: As selected by Architect from full range of industry colors.
- I. Illumination System: Concealed top-lighting system consisting of fluorescent-strip fixtures. Include lamps and internal wiring with single, concealed electrical connection to building system. Coordinate electrical characteristics with power supply provided.
  - 1. Ballasts: Low-temperature, high-power-factor, low-energy, fluorescent lamp ballasts that comply with Certified Ballast Manufacturers Association standards and carry its label. Provide exterior ballasts for exterior bulletin boards.
    - a. Electrical Characteristics: Single-phase, 120 V.
- J. Back Panel: Manufacturers standard vinyl-fabric-faced tackboard panel.
- K. Vinyl Back Panel: Vinyl-fabric-faced tackboard panel.

## 2.4 TACKBOARD PANELS

- A. Vinyl-Fabric-Faced Tackboard Panel:
  - 1. Vinyl fabric factory laminated to 1/2-inch- thick, fiberboard backing.
  - 2. 1/16-inch-thick, vinyl-fabric-faced-cork sheet factory laminated to 3/8-inch-thick, fiberboard backing.
  - 3. 1/8-inch-thick, vinyl-fabric-faced-cork sheet factory laminated to 3/8-inch-thick, fiberboard backing.
  - 4. 1/4-inch-thick, vinyl-fabric-faced-cork sheet factory laminated to 1/4-inch-thick, hardboard backing.

## 2.5 MATERIALS

- A. Hardboard: ANSI A135.4, tempered.
- B. Fiberboard: ASTM C208.
- C. Particleboard: ANSI A208.1, Grade M-1 , made with binder containing no urea formaldehyde.
- D. Hardwood Plywood: HPVA HP-1, made with adhesive containing no urea formaldehyde.
- E. Vinyl Fabric: ASTM F 793/F 793M, Type II, burlap weave; weighing not less than 13 oz./sq. yd.; with flame-spread index of 25 or less when tested in accordance with ASTM E 84.
- F. Extruded-Aluminum Bars and Shapes: ASTM B2 21, Alloy 6063.
- G. Aluminum Tubing: ASTM B 429/B 429M, Alloy 6063.
- H. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.

- I. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished), colorless sheet with visible light transmittance of 92 percent measured in accordance with ASTM D 1003.
- J. Opaque Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet).
- K. Translucent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished). Provide white-colored sheet unless otherwise indicated, of density required to produce uniform brightness and minimum halation effects.
- L. High-Pressure Plastic Laminate: ISO 4586-3.
- M. Fasteners: Provide screws, bolts, and other fastening devices made from same material as items being fastened, except provide hot-dip galvanized, stainless steel, or aluminum fasteners for exterior applications. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.

## 2.6 FABRICATION

- A. Fabricate bulletin boards to requirements indicated for dimensions, design, and thickness and finish of materials.
- B. Use metals and shapes of thickness and reinforcing required to produce flat surfaces, and to impart strength for size, design, and application indicated.
- C. Fabricate cabinets and door frames with reinforced corners, mitered to a hairline fit, with no exposed fasteners.
- D. Fabricate shelf standards plumb and at heights to align shelf brackets for level shelves.

## 2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA AMP 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603, except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine walls, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of illuminated units.

- C. Examine walls and partitions for proper backing for bulletin boards.
- D. Examine walls and partitions for suitable framing depth if recessed units will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Prepare recesses for display cases as required by type and size of unit.

### **3.3 INSTALLATION**

- A. General: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
  - 1. Mounting Height: 72 inches above finished floor to top of cabinet.
- B. Bulletin Boards: Attach units to wall surfaces with concealed clips, hangers, or grounds.
- C. Comply with requirements specified elsewhere for connecting illuminated bulletin boards.
- D. Install display case shelving level and straight.

### **3.4 ADJUSTING AND CLEANING**

- A. Adjust doors to operate smoothly without warp or bind and so contact points meet accurately. Lubricate operating hardware as recommended in writing by manufacturer.
- B. Touch up factory-applied finishes to restore damaged areas.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 10 14 00 - SIGNAGE****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes engineering, furnishing, and installing the following signage and support systems:
  - 1. Signs and supports.
  - 2. Wayfinding signs, directories, and room identification signs.
  - 3. Dimensional characters and icons.
- B. Related Sections:
  - 1. Section 05 05 13 – Decorative Metal Coatings.
- C. Sign and display locations are indicated on the Sign Location plans. Sign and display details are indicated in the Signage Detail Manual. Both are under separate cover.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide signs and anchorage points capable of withstanding the effects of gravity, wind, snow, and seismic loads and stresses, as indicated in the General Notes of the Structural Drawings determined according to the local building code and authorities having jurisdiction, reference specification section 01 40 00 Quality for Engineer.
  - 1. Deflection of signs and supports in vertical and horizontal direction shall be no greater than 1/360 of clear span or .75-inch (19 mm) (19 mm), whichever is smaller.
- B. Thermal Movements: Provide post and panel signs that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

**1.3 SUBMITTALS**

- A. Required with the Bid:
  - 1. Provide per Unit Prices for each item type.
  - 2. Provide Unit Price as a square foot cost breakdown for graphic vinyl wall graphics & wall coverings.
- B. Product Data: Submit manufacturer's technical data, assembly methods, and installation instructions relative to materials, dimensions of individual components, profiles, and finishes for each type of material required.
- C. Shop Drawings: Submit shop drawings for fabrication including installation/mounting method for each typical sign type or display type. Include plans, elevations, Isometric views, and large-scale details of each element. Include large scale sections of typical members and other components. Show fabrication joints, seams, grain direction and fasteners. Show anchors, grounds, reinforcement, accessories, layout, and installation details. All products and components shall be identified, including manufacturer, series, model/part number.
  - 1. Shop drawing submittals shall not be created from replicating the Contract Documents views or details. All views shall specifically show project-specific information.
  - 2. Field dimensions shall be indicated, and those awaiting verification shall clearly be notated their status.

3. For items requiring coordination – the specific requirements and schedule requirements shall be indicated in submittals.
  4. For items required to comply with design loads, include structural analysis data signed and sealed by the licensed professional engineer responsible in this jurisdiction for their preparation.
  5. Submit graphic layouts for verification, including outline of sign face, character spacing, line spacing, and copy composition. Submit sign layouts for all signs within each sign type.
  6. Engineering, document & sample review, fabrication, and construction schedule.
  7. For signs supported by or anchored to permanent construction, provide setting drawings, full-size spacing templates, and directions for installation of anchor bolts and other appropriate anchors to be installed.
  8. Provide sealed engineering calculations for each mounting condition including substrate and anchor type.
  9. Submit drawings in 11-inch by 17-inch format unless otherwise requested by the Architect.
  10. Provide a full-color printed proof of all final artwork (digital proofs are not sufficient). Proofs to be printed on the specified material for each item, using the same print or application processes that will be used for the final installed items. Proofs are to include a swatch of the 100% full size graphic at least 8"x8", as well as a scaled version of the entire artwork. Approved print proofs will function as control samples for color, resolution and print quality.
- D. Samples: Submit three 6-inch (150 mm) square samples of each material showing finishes, colors, surface textures and qualities of manufacturer and design of each component including graphics. One sample set to be kept by Architect, contractor, and client as a record to later match against items in the field.
1. Submit full-size sample first article units, per Section 3.6, before production run is commenced. Acceptable units may be installed as part of the work.
- E. Provide method of translation and written documentation that the braille translation included on the manufacturer's signage provided in this section has been evaluated by a Braille translator certified in writing by either The Library of Congress or the National Federation for the Blind, and is, in their opinion, correct and compliant with ADAAG.
- F. Maintenance Data: Provide a Maintenance and Operating Manual comprised of cleaning and operations needs for each sign/graphic/display type. This shall include information on repair due to common vandalism, changing of messages and parts replacement needs. Include manufacturers' brochures and parts lists describing the actual materials used in the work, including metal alloys, finishes, electrical components, and other major components. Provide working art file templates to the owner for future use.

#### 1.4 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for design and installations of signs, and miscellaneous supports and anchor types that are similar to those indicated for this Project in material, design, and extent.

- B. **Manufacturer Qualifications:** All fabrication within this section shall be performed by a manufacturer with a minimum of five (5) years-experience producing and installing architectural signs, and a minimum of five (5) years-experience producing compliant signs as specified in ANSI 117.1 (1986), Minimum Guidelines and Requirements for Accessible Design (MGRAD), Uniform Federal Accessibility Standards (UFAS) and Americans with Disabilities Act Accessibility Guidelines (ADAAG).
- C. **Drawings and Specifications:** The Architect will provide electronic files of typical sign layout drawings in Adobe Illustrator CC format. For electronic files requested in any format other than Adobe Illustrator CC, the Contractor shall reimburse the Owner, for additional services required of the Architect for converting the electronic files. Architect will provide electronic files indicating fonts, icons, designs, and key visual parameters of the design intent. Fabricator shall develop and produce final, high-resolution production-ready artwork based on these guides and the details on the Drawings – this includes any up-sampling or interpolation required for large scale photo-based graphics.
1. Drawings and specifications indicate spacing of members, sizes of components, profile, dimensions, materials, and design, assembly, and fabrication requirements for the signs.
  2. Requests for deviations from indicated dimensions and profiles will be considered provided that the intended aesthetic effect is not modified, as judged and approved solely by Architect. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. **Uniformity of Manufacturer:** For each separate type of material, finish or sign or display type, obtain signs from a single manufacturer to ensure consistency.
1. Manufacturer's name, trade name, or trade mark shall not appear on any visible surface.
- E. **Adhesion Testing –** For all applied graphic films and vinyl products, perform adhesion tests on accordance with manufacturer's specifications. Provide results of adhesion testing to the Architect and the contractor for approval.
- F. **Fire-Test-Response Characteristics:** Provide banners and flags constructed of fabrics that are identical to products that pass Test Method 1 of NFPA 701 performed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
1. Flame-Spread Index: 25 or less.
  2. Smoke-Developed Index: 450 or less.
- G. **Welding Standards:** Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
  2. AWS D1.2, "Structural Welding Code--Aluminum."
  3. AWS D1.3, "Structural Welding Code--Sheet Steel."
  4. AWS D1.6, "Structural Welding Code--Stainless Steel."
- H. **Aesthetic Requirements:** Provide copy with straight and true edges; space characters with tracking and leading as indicated; reproduce typefaces accurately with square corners and even curves; provide uniform letters and symbols; and provide smooth finishes with no visible imperfections.
- I. **Regulatory Requirements –** Comply with applicable requirements of the applicable laws and authorities. Obtain necessary approvals and permits from all such authorities as required.
- J. **ADA Accessibility Guidelines:** All signage shall comply with the ADA Accessibility Guidelines where applicable. Characters and graphics, including but not limited to, copy height, letter stroke, symbols, materials, and finishes indicated on the Drawings are intended as guidelines for compliance. Implement each applicable ADA Guideline. Should conflicts arise, notify the Architect before proceeding.

- K. Mockups: Provide one mockup sign of each type indicated in the schedule at the end of this Section, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and fabrication.
  - 1. Approved mockups may be forwarded to the Project site and may become part of the completed Work.
- L. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of install locations for all items by field measurement before fabrication and indicate measurements, and any obstructions on Shop Drawings.
  - 1. Wall Graphic Dimensions. Field verify dimensions and provide digital templates to the Architect for all applied wall graphics. Note all obstructions (fire strobes, hatches, panels, electrical boxes, exit signs, columns, etc.), and as-built dimensions. These templates are to be used in the preparation of all production-ready art files. Where required, the artwork is to be modified to eliminate any conflicts obstructions, or variations in install size. The Architect is to review and approve all such necessary changes to the artwork before fabrication.
  - 2. Established Dimensions: Every effort shall be made to verify dimensions in the field before production. In the case where field measurements cannot be made without significantly delaying the Work, the Fabricator is to review the established installation location and dimensions with the Contractor and the Architect. The Contractor is responsible to provide an installation surface that accommodates the established dimensions identified.
  - 3. Existing Utilities and other below-grade obstacles: Verify all existing below grade utilities, and/or other below grade obstacles such as abandoned footings and foundations within the footprint of new sign foundations.
  - 4. Every effort shall be made to verify conflicts including potholing to confirm depth, nature, and plan location of all utilities that may be impacted by the signage foundations
  - 5. Confirm substrate conditions are acceptable for sign type support requirements and anchorage type per sign type.

### 1.6 COORDINATION AND SCHEDULE

- A. Installation: Coordinate installation with the Contractor. For items supported by or anchored to permanent construction, coordinate specific requirements for types and placement of anchorage devices and similar items to be used for attaching signs and displays.
  - 1. For any items supported by, anchored to or mounted to permanent construction, furnish templates to the Contractor for installation of blocking, anchorage devices, and electrical conduits.
  - 2. For any wall coverings that require a level 5 finish furnish templates to the Contractor and coordinate wall preparation in keeping with the product manufacturers specifications.
- B. Prepare a schedule indicating engineering, sample, and material reviews, print proofs, fabrication, delivery, installation, and final inspection of the Work. Submit this schedule to the Architect and Owner for approval and coordination with other work at the Project Site.
- C. Coordinate location of remote transformers with building construction. Ensure that transformers are accessible and tied into building control system per Owner preference on location after completion of Work.

**1.7 DELIVERY, STORAGE AND HANDLING**

- A. Package material in like groups and label accordingly.
- B. Protect items during transit, delivery, handling, and storage to prevent damage, soiling, and deterioration. Minor damage to finishes may be repaired provided the final finishes are equal to the original finishes, are without noticeable flaws, and are acceptable to the Architect. If not in like-new condition, or if not acceptable to the architect, remove and replace damaged items with new signs.
- C. Coordinate delivery and storage of sign materials with the Contractor in advance. Schedule delivery to minimize storage requirements. Materials stored at the Project Site without prior approval may have to be relocated at the Fabricator's expense.

**1.8 MAINTENANCE**

- A. Furnish a list of cleaning materials appropriate for maintenance of signs, graphics and displays to both the Owner and the Contractor. Provide written instructions for proper maintenance, electrical access, and character and lighting replacement procedures. Include recommended methods for removal of residual adhesives from wall surfaces after removal of adhered items.

**PART 2 - PRODUCTS****2.1 MATERIALS, GENERAL**

- A. Use materials of size and thickness indicated or, if not indicated as required to produce strength and durability in finished product for use intended. Work to dimensions shown or accepted on shop drawings, using proven details of fabrication and support. Use type of materials shown or specified for various components of work.
- B. All materials shall be free from defects impairing strength, durability, and appearance. No fabrication or installation materials or procedures shall be used that will in any way change the usual quality or in any manner have an adverse effect on existing materials and surfaces. All materials shall be new stock, unless the Architect has specified a reclaimed or recycled material.
- C. Graphic Content and Style: Provide graphic layouts and sign copy that complies with requirements indicated in the Signage Detail Manual and Signage Message Schedule and on preliminary artwork supplied by Architect for size, fonts, style, spacing, content, mounting height and location, materials, finishes, and colors.
  - 1. Contractor shall incorporate any requested final naming changes, including but not limited to room or level numbering conventions, room names/descriptions, and sponsorship or rebranding.

**2.2 MATERIALS**

- A. General: For the fabrication of exposed metal work, use only materials which are smooth and free of surface blemishes including pitting, roughness, seam marks roller marks, and trade names. Do not use materials which have stains or discolorations.
  - 1. Provide stretcher leveled standard of flatness.
- B. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M) (ASTM B 209 (ASTM B 209M)), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of alloy 5005-H15.
  - 1. Thickness: Provide aluminum sheets and plates in sizes specified or indicated on the Drawings.

- C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M) (ASTM B 221 (ASTM B 221M)M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of alloy 6063-T5.
- D. Stainless Steel: Grade and type designated below for each form required:
  - 1. Tubing: ASTM A 554, Grade MT 316.
  - 2. Pipe: ASTM A 312/A 312M, Grade TP 316.
  - 3. Castings: ASTM A 743/A 743M, Grade CF 8M.
  - 4. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 316.
  - 5. Bars and Shapes: ASTM A 276, Type 316.
- E. Metal Laminate: Grade 83 (.25-inch (0.7mm)) solid metals and solid metal strips. Solid aluminum mechanically etched sheet with light epoxy protection.
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following for specific applications:
    - a. Wilsonart International
    - b. ChemMetal
    - c. NuMetal
    - d. Formica
    - e. Moz Metals

### 2.3 PLASTIC

- A. General: Plastic shall be free of imperfections from forming or fabrication. All surfaces shall be free from scratches and shall be cleaned and polished per manufacturer's instructions at completion of installation. Edges shall be flame polished, free of saw marks and chips, and be eased, unless otherwise noted.
- B. Monolithic Acrylic Sheet (methylmethacrylate): ASTM D 4802, Category A-1 (cell-cast sheet), Type UVF (UV filtering), of thickness indicated, with Finish 1 (smooth or polished finish) and Finish 3 (abrasion resistant coating) as indicated.
  - 1. Transparent: Provide colorless sheet with visible light transmittance of 92 percent measured per ASTM D 1003.
    - a. Provide Finish 3.
  - 2. Translucent: Provide white translucent sheet of density required to produce uniform brightness and minimum halation effects.
    - a. Provide Finish 1.
  - 3. Opaque: Provide colors and finishes indicated or, if not indicated, as selected by Architect from manufacturer's full range.
    - a. Provide Finish 1.
- C. Colored Coatings for Acrylic Sheet: For copy and background and frame colors, provide Pantone Matching System (PMS) colored coatings, including inks and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are nonfading for application intended.

### 2.4 GRAPHIC FILM

- A. General: Provide vinyl graphic film suitable for interior and exterior applications of types indicated below.
  - 1. Vinyl Thickness: 2-mil (0.05 mm), minimum.
  - 2. Adhesive: Clear, pressure sensitive, permanent adhesive (unless removable adhesive is specified).
  - 3. Overlamine: Include a Matte overlamine for all interior vinyl graphic films unless otherwise indicated in the Signage Detail Manual.
  - 4. Installation: Use minimum overlapping seams advised by the manufacturer.

- B. Basis-of-Design Products: The design is based on the products named. Subject to compliance with requirements, provide either the named products or comparable product by one of the other specified manufacturers. Comparable products are subject to review and approval through the submittal process specified. Note: All film/vinyl materials require an adhesion test prior to printing to confirm successful adhesion.
1. Opaque Vinyl Film: Non-reflective, pre-spaced die-cut letters and film, supplied in specified typeface, color, and spacing on a quick-release backing sheet.
  2. Transparent Vinyl Film: 3M Scotchcal™ Clear Graphic Film 8626 ES.
  3. Translucent Vinyl Film: 3M Scotchcal™ Translucent Graphic Film 8628 ES.
  4. Opaque Imaging Media for smooth surfaces: 3M Controltac Graphic Film with Comply v3 Adhesive IJ180CV3-10 with 3M Scotchcal Matte Overlamine 8510M
    - a) Provide alternate pricing for 3M Scotchcal Graphic Film with Comply Adhesive IJ40C-10R with 3M Scotchcal Matte Overlamine 8510M
  5. 3M Scotchcal™ for Textured Surfaces; Series IJ8624 with 3M Luster Overlamine 8524.
  6. 3M Panaflex™ Awning and Sign Facing; Series 945GPS.
  7. 3M Vinyl 8150 with 7 Year Lifespan for window graphics.
- C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. 3M
  2. Avery Dennison Graphics Division
  3. Orocal/Orofol Graphic Products

## 2.5 HARDWARE, FASTENERS, AND ADHESIVES

- A. Fasteners: Unless otherwise indicated, use concealed fasteners fabricated from metals that are non-corrosive to either the sign material or the mounting surface. If concealed fasteners are not practical or possible, provide vandal-resistant fasteners.
- B. Fabricate brackets and fittings for bracket-mounted signs from materials compatible with panel sign construction and mounting conditions indicated. Factory-paint brackets in color matching background color of panel sign.
1. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500, Grade B.
  2. Structural Steel Shapes, Plates, and bars: Cold formed steel fabrications complying with ASTM A 36.
- C. Anchors and Inserts: Use non-ferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
1. For attachment to metal panels, use #12 stainless steel, Type 410, self-tapping screws with integral neoprene washers.
- D. Adhesives: Provide products equal to "Depend 330" as manufactured by Loctite Acrylic Adhesives. (216)881-2828. Fabricator shall verify with painting manufacturer compatibility of the adhesive to the paint.
- E. Very High Bond (VHB) Tape: Provide 3M (or approved equal) VHB tape at the appropriate thickness/strength required for the weight and size of each item installed.
- F. Silicone Adhesive: Provide liquid silicone adhesive (sealant) with a methanol or acetic cure as recommended by the sign fabricator.
- G. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
- a) Architectural Sealants: 250 g/L.
  - b) Sealant Primers for Nonporous Substrates: 250 g/L.
  - c) Sealant Primers for Porous Substrates: 775 g/L.

- H. Spacers: Provide Manufacturer's standard spacers when necessary.

## 2.6 GRAPHIC REQUIREMENTS, GENERAL

- A. General: Type style shall be as indicated in the Signage Detail Manual.
1. Typeface, numerals, icons and designs shall be consistent to the design intent shown in the Signage Detail Manual. Some variation in tracking and character width to ensure messages fit, may be acceptable. Any variations to be reviewed and approved by the Architect.
  2. Characters indicated on the Drawings are intended as guidelines for layouts and font size only, and are based on scale calculations of the message lengths within given and estimated sign areas. The actual copy required on individual signs is indicated in the signage message schedule. Should conflicts arise in the final message layout, notify the Architect before proceeding.
  3. Spelling and punctuation shall be correct. Should an error in spelling or punctuation be found, or the spelling appears questionable, notify the Architect before proceeding.
  4. Align letter forms to maintain a baseline parallel to the sign format, unless otherwise indicated. Maintain uniform margins in sign layouts.
  5. Suite Identification Signs, and Signs with Name Inserts: Owner will determine names for each individual suite or office.
  6. Provide digital proofs of final signage layouts to the Architect for approval before fabrication.
- B. Tactile and Braille Copy: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSI A117.1, TAS or CCR Title 24. Text shall be accompanied by Grade 2 braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.
1. Raised-Copy Thickness: Not less than .03125-inch (0.8 mm)(0.8 mm).
  2. For Grade 2 Braille copy, coordinate messages in conjunction with Graphic and Sign Schedule. Braille copy contained on drawings is for size and position only and shall not be used for full message.
  3. Symbols and other ADA required symbols, (International Symbol of Accessibility; Symbol of Access for Hearing Loss; International TDD Symbol; and Symbol of Volume Control), which are referenced in the documents, are available from Architect in Adobe Illustrator formats.
- C. Production-Ready Artwork: The Signage Detail Manual includes specifications for all visual elements including, but not limited to, type, symbols, logos, photography, artwork, and arrows. The Fabricator is to create final production-ready artwork necessary to complete all signs and graphics based on the design intent included in the Signage Detail Manual.
1. Production-ready artwork is to be high enough resolution to provide crisp edges and lines for all vector artwork, and to avoid any visible blurring or pixilation of photographic images. Fabricator to interpolate and up-sample photographic artwork as required for the installation location and viewing distance. Do not use the construction documents as production art. The Fabricator is to provide printed proofs of all graphics to ensure color and resolution are acceptable – samples to include a swatch of the 100% full size graphic as well as a scaled version of the entire artwork – printed on the specified substrate.
  2. Silkscreens shall be executed from photoscreens or negatives. Pattern cut screens may be used where non-repeat copy is required; however, copy mask shall be equivalent to photoscreen quality. Do not use the construction documents as production art.

## 2.7 FABRICATION, GENERAL

- A. General: Fabricate signs to comply with requirements indicated on drawings for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
1. Form exposed faces and sides of signs to produce surfaces free from warp, distortion, and "oil canning."



- a) Include internal bracing for stability and attachment of mounting accessories as required.
  - b) Cut metal edges on a continuous line and sand smooth. Seams shall be straight and symmetrical.
  - c) Form exposed connections with hairline joints, flush, and smooth.
  - d) Form exposed work true to line and level with sharp angles, surfaces, and edges. Ease exposed edges to a radius of approximately .03125-inch (0.8 mm) unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or cracking of applied finishes.
2. Welding, when necessary, shall be of the appropriate type to minimize permanent distortions of flat surfaces. Remove welding flux, oxides and discolorations by pickling or grinding, so that these areas match the finish of the adjacent areas. Repair damage caused by the fabrication by grinding, polishing, or buffing.
    - a) Weld corners and seams continuously, complying with AWS recommendations. At connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.
    - b) Unless otherwise specified, all seams to be indiscernible; filled, and ground smooth. Finishes requiring paint or other enamel are required to be primed and sanded prior to painting. Exposed alloy finishes (brushed, polished, etc.) to have tight tolerance seams that are indiscernible.
  3. Cut, reinforce, drill, and tap miscellaneous metal work as indicated to receive finish hardware and similar items.
  4. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus one percent measured diagonally from corner to corner.
  5. Fabricate, brackets and fittings for signs to suit sign panel construction and mounting conditions indicated. Connections, angles, shapes and details shown are suggestive and are to be sized, reinforced, detailed and engineered as required. Details not shown are to be equal in quality to those detailed. Factory paint brackets in color matching background color of sign panel.
  6. Provide concealed access to internally illuminated signs for relamping and service. Service access shall be waterproof and secured against vandalism.
  7. Conceal union, fabricator, or other labels.
  8. For sign panel units in exterior applications provide standard weatherproofing construction, including weather-stripping, weeping, and venting provisions for condensation control.
- B. Metal signs facing and cladding shall be aluminum unless otherwise indicated or specified in the Signage Detail Manual.
  - C. Where galvanized steel and aluminum meet, the materials shall be materially isolated from one another to prevent electrolytic action. Aluminum joints and connections shall be heli-arc welded and flush, true, ground, and polished smooth and without defects. Character forms shall be cut true to typeface with no burns or imperfections of any kind.
  - D. Internal Structure: Provide completely hidden, internal structures for support and anchorage, unless indicated otherwise on the drawings. Primary support structure shall be hot dipped galvanized steel or aluminum.

## 2.8 PANEL SIGNS

- A. Exterior Plaque Sign: Unless otherwise specified in the Signage Detail Manual, provide products fabricated from 0.125-inch aluminum plate with 0.030 inch thick double face tape mounting and silicone adhesive. Sign copy shall be raised 1/32 inch from plaque first surface by manufacturer's standard photochemical process. Provide opaque graphics and Braille to comply with ADA regulations. All exterior signage is to include weep/drain holes as required.
  1. Finish: As indicated in the Signage Detail Manual.
  2. Graphics: As indicated in the Signage Message Schedule.

- B. Interior Plaque Sign: Unless otherwise specified in the Signage Detail Manual, provide products fabricated from 0.125-inch-thick acrylic with exterior grade polyamide resin sign face and 0.011-inch carrier with 0.030-inch double face tape mounting and silicone adhesive. Sign copy shall be raised 1/32 inch from plaque first surface by manufacturer's standard photomechanical stratification process. Provide opaque graphics and Braille to comply with ADA regulations.
1. Finish: Manufacturer's custom color with matte texture.
  2. Graphics: As indicated on the Drawings.
- C. Chemically-etched Zinc Sign Panels: Unless otherwise specified in the Signage Detail Manual, sign copy shall be raised 1/32 inch from plaque first surface. Provide opaque graphics and Braille to comply with ADA regulations.
1. Thickness: 0.125 inch (3.2 mm) (3.2 mm).
  2. Zinc Finish: Manufacturer's sandblasted with horizontal grain.
  3. Background Texture: Smooth, matte finish.
  4. Graphics: As indicated on the Drawings.
  5. Manufacturer: Dixie Graphics.
- D. Framed Hollow-Box-Type Panels:
1. Panel Material: Unless otherwise specified in the Signage Detail Manual, 0.125-inch- (3.2-mm-) (3.2-mm-) thick aluminum sheet.
  2. Panel Finish: Unless otherwise specified in the Signage Detail Manual, baked enamel.
    - a) Panel Finish: Manufacturer's standard semigloss finish with UV inhibitors.
    - b) Provide clips welded to back of panels for installation without visible fasteners.
  3. Frame Material: Unless otherwise specified in the Signage Detail Manual, extruded aluminum, fabricated to profile indicated; comply with the following:
    - a) Frame Finish: High-performance organic coating.
    - b) Corner Condition: Corners rounded to radius indicated.
  4. Illuminated-Sign Units: Unless otherwise specified in the Signage Detail Manual, provide internal illumination using concealed, internally wired, LED system to illuminate message panels uniformly with minimum halation and without light leaks. Include LED's, transformers, and other components necessary for complete systems. Make provisions for servicing and concealing transformers and connections to building electrical system. Coordinate electrical characteristics with those of power supply provided.
    - a. All power drivers to be compatible with universal primary circuit voltage (120-277). Acceptable products include GE - GEPS12-60U-NA (for 12V LED systems), and GE - GEPS24-100U-NA (for 24V LED systems). Other universal power supplies from the same manufacturer with different wattage or 0-10v dimming features are acceptable when used with compatible LED systems.
      - a) Acceptable Manufacturers:
        - 1) GE Lighting
        - 2) Sloan LED
        - 3) Magnitude Lighting
      - b. Loading shall be verified by following the testing procedures recommended by the LED-systems manufacturer.
        - a) Color: refer to Signage Detail Manual for color temperature
        - b) Population: Maximum 4-inch spacing between LED strips or segments.
      - c. Electrical Requirements:
        - a) All LEDs to use constant current technology.
        - b) All LEDs to be IP67 rated for interior environments, and IP68 in exterior or open air environments.
        - c) Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that shall be incorporated into the Work include:
          - 1) Bitro Group
          - 2) Sloan LED
          - 3) GE Lighting

**2.9 FABRICATED LETTERS AND NUMBERS**

- A. Channel Characters: Fabricate letters and numbers to the required sizes and styles, using metals and thicknesses indicated below. Form exposed faces and sides of characters to produce surfaces free from warp and distortion. Include internal bracing for stability and attachment of mounting accessories as required. Fabricate by the heliarc welding process.
1. Aluminum Sheet: Not less than 0.090 inch thick.
  2. Finish: Manufacturer's custom color urethane.
    - a. Color: As indicated on the Drawings.
    - b. Unless otherwise specified, all seams to be indiscernible; filled, and ground smooth. Finishes requiring paint or other enamel are required to be primed and sanded prior to painting. Exposed alloy finishes (brushed, polished, etc.) to have tight tolerance seams that are indiscernible.
- B. Reverse Channel Characters: Fabricate letters and numbers to the required sizes and styles, using metals and thicknesses indicated below. Form exposed faces and sides of characters to produce surfaces free from warp and distortion. Include internal bracing for stability and attachment of mounting accessories as required. Fabricate by the heliarc welding process.
1. Aluminum Sheet: Not less than 0.090 inch thick.
  2. Finish: Manufacturer's custom color urethane.
    - a. Color: As indicated on the Drawings.
    - b. Unless otherwise specified, all seams to be indiscernible; filled, and ground smooth. Finishes requiring paint or other enamel are required to be primed and sanded prior to painting. Exposed alloy finishes (brushed, polished, etc.) to have tight tolerance seams that are indiscernible.
- C. Illuminated LED Channel Characters: Provide LED illuminated channel character systems for exterior applications as indicated on the drawings. Include LED's, transformers, and other components necessary for complete systems. Make provisions for servicing and concealing transformers and connections to building electrical system. Coordinate electrical characteristics with those of power supply provided.
- a. All power drivers to be compatible with universal primary circuit voltage (120-277). Acceptable products include GE - GEPS12-60U-NA (for 12V LED systems), and GE - GEPS24-100U-NA (for 24V LED systems). Other universal power supplies from the same manufacturer with different wattage or 0-10v dimming features are acceptable when used with compatible LED systems.
    - a) Acceptable Manufacturers:
      - 1) GE Lighting
      - 2) Sloan LED
      - 3) Magnitude Lighting
    - b. Loading shall be verified by following the testing procedures recommended by the LED-systems manufacturer.
      - a) Color: refer to Signage Detail Manual for color temperature
      - b) Population: Maximum 4-inch spacing between LED strips or segments.
    - c. Electrical Requirements:
      - a) All LEDs to use constant current technology.
      - b) All LEDs to be IP67 rated for interior environments, and IP68 in exterior or open air environments.
      - c) Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that shall be incorporated into the Work include:
        - 1) Bitro Group
        - 2) Sloan LED
        - 3) GE Lighting

**2.10 FINISHES, GENERAL**

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.
- D. Preparation: Substrates shall be smooth, clean and free of dust, grease, finger prints, or other foreign matter. If necessary to obtain true color application, surface shall be "primed" before final color application is applied. Artwork shall be accurately reproduced with all edges straight and true and all finishes smooth and with no visible imperfections
  - 1. Surface preparation: Follow paint manufacturer's instructions for preparing surfaces before applying primers or graphics.
- E. Corrosion Protection: Coat concealed surfaces which will be in contact with concrete, stone, masonry, wood, or dissimilar metals, in exterior work and work to be built into exterior and below grade walls and decks, with a heavy coat of bituminous paint. Do not extend coating onto exposed surfaces.
- F. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide custom color matches as selected by the Architect.
  - 1. Aluminum: Acrylic polyurethane paint as specified in this Section.

## 2.11 ALUMINUM FINISHES

- A. Aluminum: Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
  - 1. Class I, Clear Anodic Finish: AA-M12C22A41; Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.7 mil (18  $\mu$ m or thicker) complying with AAMA 611.
  - 2. Class I, Color Anodic Finish: AA-M12C22A42/A44; Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrodeposited color coating 0.7 mil (18  $\mu$ m or thicker) complying with AAMA 611.
    - a. Color: Match Architect's sample.
    - b. Color: As selected by Architect from the full range of industry colors and color densities.
- B. Baked-Enamel Finish: Manufacturer's standard baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
  - 1. Color: Match Architect's sample.

## 2.12 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines or blend into finish.
- B. Unless otherwise indicated, grind and polish surfaces to produce uniform finish indicated, free of cross scratches.
  - 1. Run grain of directionally textured finishes with long dimension of each piece, unless otherwise indicated in the Signage Detail Manual.
- C. Stainless Steel Finishes:
  - 1. Directional Satin Finish: No. 4
  - 2. Dull Satin Finish : No. 6
  - 3. Reflective, Directional Polish : No. 7

4. Mirrorlike Reflective, Non Directional Polish : No. 8
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

### 2.13 PAINT MATERIALS

- A. Primer: High build, two-part polyamide epoxy.
- B. Opaque Finish Coat: Two-part, satin finish acrylic polyurethane paint. Provide products equal to Matthews Paint Company's "Low VOC Satin MAP - Acrylic Polyurethane," custom colors with gloss between 11 and 19 units at 60 degrees. Apply a protective topcoat of Matthews Paint Company's MAP Low VOC Satin Clearcoat on all painted surfaces.
- C. Powder Coating: Polyester based powder coating type finish for sheet steel.
- D. Silkscreen: Use fast drying opaque enamel silkscreen ink.
  1. Colors and Sheen: High gloss color not limited to manufacturer's standard colors.
- E. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. General: Examine area, surfaces and conditions under which the work is to be installed. Notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Starting work implies acceptable surfaces and conditions.

### 3.2 INSTALLATION

- A. General: Locate signs, graphics and displays where shown on Sign Location Plan, and Signage Detail Manual, attaching to substrates in accordance with manufacturer's instructions, unless otherwise indicated.
  1. Install signs level, plumb, and at heights indicated, with surfaces free from distortion and other defects in appearance.
  2. Interior Room Identification Signs: Unless otherwise specified in the Signage Detail Manual, install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, and not otherwise indicated, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) (75 mm) of sign without encountering protruding objects or standing within swing of door.
  3. Install signs so they do not protrude or obstruct according to the ADAAG.
  4. Before installation, verify that wall and sign surfaces are clean and free of materials or debris that would impair installation.
  5. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Surfaces under adhesive applied units shall be smooth, clean, and free of dust, grease, fingerprints, or other foreign matter. All adhesives required shall be used in accordance with recommendations made by the manufacturer of the material to be laminated or adhered. No adhesives that will fade, discolor, or delaminate because of ultraviolet light or heat shall be used. Adhesives shall not change the color of or deteriorate the materials to which they are to be applied. The adhesives shall be of a non-staining, non-yellowing quality. All visible joints shall be free from air bubbles and other defects.
- C. Mill joints to a tight, hairline fit. Form joints exposed to the weather to exclude water penetration.
- D. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
    - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
  2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
    - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
  3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
  4. Z clips and Brackets: Remove loose debris from substrate surface and install Z clip or bracket supports in position so that signage is correctly located and aligned.
  5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
  6. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
- E. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using methods indicated below:
1. Flush-Mounting: Mount panel signs with backs in contact with wall surface.
  2. VHB Tape Mounting: Use VHB tape to mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
  3. Hook-and-Loop Tapes: Use hook-and-loop tapes to mount signs to smooth, nonporous surfaces.
  4. Magnetic Tape: Use magnetic tape to mount signs to smooth, nonporous surfaces.
  5. Silicone-Adhesive Mounting: Use liquid-silicone adhesive recommended in writing by sign manufacturer to attach signs to irregular, porous, or vinyl-covered surfaces. Use VHB tape where recommended in writing by sign manufacturer to hold sign in place until adhesive has fully cured.
  6. Shim Plate Mounting: Provide 1/8-inch-(3-mm)-(3-mm-) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
  7. Mechanical Fasteners: Use tamperproof mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
  8. Where panel signs are scheduled or indicated to be mounted on glass (As per the Signage Detail Manual and/or Signage Location Plan), provide opaque vinyl film on opposite side of glass to conceal mounting materials. Color of vinyl to be 3M Scotchcal 7725 "Pearl Grey" unless otherwise noted in the Signage Detail Manual.

- F. Dimensional Characters: Mount characters using standard fastening methods recommended in writing by manufacturer for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
  - 1. Pin Mounting: A minimum of three threaded studs (1/8 inch diameter by 1/2 inch long minimum) welded to back or bottom of character with no distortions or discolorations to sign face.
  - 2. Flush Mounting: Mount characters with backs in contact with wall surface.
  - 3. Projected Mounting: Mount characters at projection distance from wall surface indicated.
- G. Bracket-Mounted or Suspended Units: Use custom fabricated brackets, fittings and hardware as appropriate for mounting signs which project at right angles from supporting elements or suspended from structural members. Attach brackets and fittings with concealed fasteners and anchoring devices, unless otherwise indicated, to comply with the manufacturer's directions.
- H. Illuminated Panels, Displays & Signage:
  - 1. Run wires into wall construction through conduit, seal ends. Use insulators as necessary for neon lighting wiring. For conditions at Fire-rated walls – coordinate appropriate installation with Contractor.
  - 2. Exposed-to-view wiring or conduit is not permitted in any form.
  - 3. Engage a licensed electrician to connect wiring to power source.

### 3.3 FIELD QUALITY CONTROL

- A. Within one week of scheduled completion of installation, prepare a punch list itemizing:
  - 1. Uppercase letters instead of lowercase or vice-versa.
  - 2. Improper alignment of letters on sign panel.
  - 3. Improper alignment of signs.
  - 4. Chipped or scratched finishes.
  - 5. Unpainted exposed fasteners.
  - 6. Fabricator's label displayed.
  - 7. Improper cleaning of sign surfaces or surrounding wall areas.
  - 8. Damage to surrounding surfaces.
  - 9. Missing signs, graphics, displays.
  - 10. Incorrect install locations.
  - 11. Missing trim, corner guards, or other finishing.
  - 12. Any areas that require touch up paint.
- B. Repair or replace damaged units as required after Architect's final inspection.

### 3.4 PATCH AND ADJUST

- A. Patch existing surfaces damaged because of work under this section. Patch with same materials as existing. Fabricator shall paint and harmoniously blend and contour all repairs to match adjoining conditions so that they are not noticeable to view.
- B. Touch-up any mars or nicks in painted finishes of all signs and adjacent structures. Touch-up shall be the same paint product as used for this sign finish. Touch up areas should blend with surrounding areas and not be noticeable to view.
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.
- D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780, Annex A2.

### 3.5 CONSTRUCTION WASTE MANAGEMENT

- A. Construction Waste shall be managed in accordance with provisions of Section 01 74 19 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that section.

### **3.6 CLEANING AND PROTECTION**

- A. At completion of installation, clean exposed surfaces in accordance with the manufacturer's instructions. All items shall be free of glue, fingerprints, dirt, grease, or any other imperfections.
- B. Evidence of installation work or damages incurred on other surfaces shall be cleaned or repaired prior to completion of work. Protect units from damage until acceptance by Owner.
- C. Remove all packing and construction materials from site. Leave premises clean, ready for work under other contracts or ready for use.
- D. Instruct the Owner in writing as to the correct operation and maintenance of all signs and sign components.
- E. Demonstrate to the Owner the operation of all access panels, and replacement of lamps, ballasts, and transformers as applicable.
- F. Furnish Owner with a pint of each paint and finish material used on sign.

### **3.7 SCHEDULE OF MOCKUPS**

- A. Provide a mock-up (partial for large items; complete for smaller items) of each sign/display type requested at the fabrication facility for review. The requested mock-ups shall be coordinated with architect. Mock-ups once approved may be used towards final install count.
- B. When accepted, mock-up shall serve as the standard for materials, workmanship, and appearance for the work throughout the project.
- C. Provide work-in-progress sign elements reviews. Scheduled or unscheduled viewings at the Fabrication Facility may be initiated by the Owner's Representative as deemed necessary to ensure continued quality control and make any adjustments required during fabrication. Unsatisfactory items are to be corrected by the Fabricator as directed by the Owner or owner's representative.
- D. Samples: Submit three 6-inch (150 mm) (150 mm) square samples of each material showing finishes, colors, surface textures and qualities of manufacturer and design of each component including graphics. One sample set to be kept by Architect, contractor, and client as a record to later match against items in the field.
- E. Scaled mock up of graphic artwork + Full size print swatch of all graphic prints
  1. All printed pattern graphics and glass applied graphics.

### **3.8 WARRANTY**

- A. Submit to the Owner's Representative a 1-year written warranty (effective the date of final acceptance) covering all signs contractor will agree to repair or replace defective signs. Upon notification of such defective signs within the warranty period, make necessary repairs or replacement at the convenience of the Owner's Representative.
- B. Submit to the Owner's Representative a 1 year written warranty, warranting that the factory-applied finishes will not develop excessive fading or excessive non-uniformity of color or shade, and will not crack, peel, pit, corrode or otherwise fail because of defects in materials or workmanship within the following defined limits. Upon notification of such defects within the warranty period, make necessary repairs at the convenience of the owner's representative.

END OF SECTION



**SECTION 10 21 13.14 - STAINLESS STEEL TOILET COMPARTMENTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Stainless steel toilet compartments configured as toilet enclosures and urinal screens.
- B. Related Requirements:
  - 1. Section 10 28 00 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

**1.2 COORDINATION**

- A. Coordinate requirements for overhead supports, blocking, reinforcing, and other supports concealed within wall and ceiling to ensure that toilet compartments can be supported and installed as indicated.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.
- B. Shop Drawings: For toilet compartments.
  - 1. Include plans, elevations, sections, details, and attachment details.
  - 2. Show locations of cutouts for compartment-mounted toilet accessories.
  - 3. Show locations of reinforcements for compartment-mounted grab bars and locations of blocking for surface-mounted toilet accessories.
  - 4. Show locations of centerlines of toilet fixtures.
  - 5. Show locations of floor drains.
- C. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
  - 1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
  - 2. Each type of hardware and accessory.
- D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.
- E. Delegated Design Submittals: For grab bars mounted on toilet compartment panels, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Include structural design calculations indicating compliance with specified structural-performance requirements.

**1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For toilet compartments.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Stock Material: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Door Hinges: One hinge(s) with associated fasteners.
  - 2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
  - 3. Door Bumper: One door bumper(s) with associated fasteners.
  - 4. Door Pull: One door pull(s) with associated fasteners.
  - 5. Fasteners: 10 fasteners of each size and type.

**1.6 FIELD CONDITIONS**

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Obtain stainless steel toilet compartments from single source from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 75 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:
  - 1. Panels are able to withstand a concentrated load on grab bar of at least 250 lbf applied at any direction and at any point, without deformation of panel.
- C. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 for toilet compartments designated as accessible.

**2.3 STAINLESS STEEL TOILET COMPARTMENTS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Finish Legend on Drawings or comparable product by one of the following:
  - 1. Accurate Partitions Corporation.
  - 2. All American Metal Corp.
  - 3. American Sanitary Partition Corporation.
  - 4. Ampco, Inc.
  - 5. Bradley Corporation; Mills Partitions.
  - 6. Flush Metal Partition Corp.
  - 7. General Partitions Mfg. Corp.
  - 8. Hadrian Manufacturing Inc.
  - 9. Knickerbocker Partition Corporation.
  - 10. Marlite.
  - 11. Metpar Corp.
- B. Toilet-Enclosure Style: Floor mounted, overhead braced.
- C. Urinal-Screen Style: Wall hung flat panel.

- D. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.
  - 1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch for doors and panels and 1-1/4 inches for pilasters.
  - 2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units of size and material adequate for panel to withstand applied downward load on grab bar of at least 250 lbf, when tested according to ASTM F 446, without deformation of panel.
  - 3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.
- E. Entrance-Screen Construction: Matching panel construction.
- F. Urinal-Screen Construction:
  - 1. Flat-Panel Urinal Screen: Matching panel construction.
- G. Facing Sheets and Closures: Stainless steel sheet of nominal thicknesses as follows:
  - 1. Pilasters, Braced at Both Ends: Manufacturer's standard thickness, but not less than 0.038 inch.
  - 2. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than 0.050 inch.
  - 3. Panels: 0.038 inch.
  - 4. Doors: Manufacturer's standard thickness, but not less than 0.031 inch.
  - 5. Flat-Panel Urinal Screens: Thickness matching panels.
- H. Pilaster Shoes: Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- I. Pilaster Sleeves (Caps): Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- J. Brackets (Fittings):
  - 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.
- K. Stainless Steel Finish: No. 4 bright, directional polish on on exposed faces. Protect exposed surfaces from damage by application of strippable, temporary protective covering before shipment.

## 2.4 HARDWARE AND ACCESSORIES

- A. Door Hardware and Accessories: Manufacturer's operating hardware and accessories.
  - 1. Hinges:
    - a. Manufacturer's minimum 0.062-inch-thick stainless-steel continuous, cam type that swings to a closed or slightly open position, allowing emergency access by lifting door. Mount with through-bolts.
  - 2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
  - 3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
  - 4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors. Mount with through-bolts.

5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on
- B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel anchors compatible with related materials.

## 2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B 221.
- B. Stainless Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- C. Stainless Steel Castings: ASTM A 743/A 743M.

## 2.6 FABRICATION

- A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories and solid blocking within panel where required for attachment of toilet accessories.
- B. Floor-Mounted, Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide inswinging doors for standard toilet enclosures and 36-inch-wide outswinging doors with a minimum 32-inch-wide clear opening for toilet enclosures designated as accessible.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
  1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Coordinate layout and installation of supports, inserts, and anchors built into other units of work for toilet compartment anchorage.

### 3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  1. Maximum Clearances:
    - a. Pilasters and Panels or Screens: 1/2 inch.
    - b. Panels or Screens and Walls: 1 inch.
  2. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.
    - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.

- B. Floor-mounted, Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

### **3.3 ADJUSTING**

- A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 10 21 16 - SHOWER AND DRESSING COMPARTMENTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Shower compartments fabricated from stainless steel.
  - 2. Dressing compartments fabricated from stainless steel.
  - 3. Shower receptors.
- B. Related Sections:
  - 1. Section 05 50 00 "Metal Fabrications" for supports that attach floor-and-ceiling-anchored compartments to overhead structural system.
  - 2. Section 06 10 53 "Miscellaneous Rough Carpentry" for blocking.
  - 3. Section 10 28 00 "Toilet, Bath, and Laundry Accessories" for grab bars, purse shelves, and similar accessories.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For shower and dressing compartments. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Show locations of cutouts for compartment-mounted accessories.
  - 2. Show locations of reinforcements for compartment-mounted grab bars.
  - 3. Show locations of centerlines of drains.
  - 4. Show ceiling grid and overhead support or bracing locations.
- C. Samples for Initial Selection: For each type of compartment indicated. Include Samples of hardware and accessories for material and color selection.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
  - 1. Each type of material, color, and finish required for compartments, prepared on 6-inch-square Samples of same thickness and material indicated for the Work.
  - 2. Each type of hardware and accessory.
  - 3. Curtain Fabric: 12-inch-square swatch or larger as required to show complete pattern repeat, from dye lot used for the Work, with specified treatments applied. Mark top and face of material.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: For each type of shower and dressing compartment, from manufacturer.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For shower and dressing compartments to include in maintenance manuals.

**1.5 QUALITY ASSURANCE**

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural and Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and for shower and dressing compartments designated as accessible.

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with shower and dressing compartments by field measurements before fabrication.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: ASTM B 221.
- C. Brass Castings: ASTM B 584.
- D. Brass Extrusions: ASTM B 455.
- E. Steel Sheet: ASTM A 653/A 653M, either hot-dip galvanized or galvanized; mill phosphatized and selected for smoothness.
- F. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- G. Stainless-Steel Castings: ASTM A 743/A 743M.
- H. Particleboard: ANSI A208.1, Grade M-2 with 45-lb density, made with binder containing no urea formaldehyde.
- I. Plastic Laminate: NEMA LD 3, general-purpose HGS grade, 0.048-inch nominal thickness.
- J. Adhesives: Manufacturer's standard product that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

### 2.2 STAINLESS-STEEL COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. All American Metal Corp.
  2. General Partitions Mfg. Corp.
  3. Global Steel Products Corp.
  4. Metpar Corp.
  5. Rockville Partitions Incorporated.
  6. Sanymetal; a Crane Plumbing company.
- B. Configuration: As shown on Drawings.
- C. Enclosure Style: Overhead braced.



- D. Panel and Pilaster Construction: Seamless metal facing sheets, pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures and with corners secured by welding or clips and exposed welds ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.
  - 1. Core Material: Manufacturer's standard, sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch for panels and 1-1/4 inches for pilasters.
  - 2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on compartments.
  - 3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to compartments.
- E. Door Construction: Match panels; 1-inch finished thickness.
- F. Facing Sheets and Closures: Stainless-steel sheet of nominal thicknesses as follows:
  - 1. Pilasters, Braced at Both Ends: Manufacturer's standard thickness, but not less than 0.038 inch.
  - 2. Panels: Manufacturer's standard thickness, but not less than 0.031 inch.
  - 3. Doors: Manufacturer's standard thickness, but not less than 0.031 inch.
- G. Pilaster Shoes and Sleeves (Caps): Formed from stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- H. Brackets (Fittings):
  - 1. Full-Height (Continuous) Type: Manufacturer's standard design; clear-anodized aluminum.
  - 2. Stirrup Type: Ear or U-brackets; stainless steel.
  - 3. Dressing-Compartment Brackets: Match toilet-compartment brackets.
- I. Stainless-Steel Finish: Match stainless-steel toilet-compartment finish on exposed faces. Protect exposed surfaces from damage by applying strippable, temporary protective covering before shipment.

### 2.3 SHOWER RECEPTORS

- A. General: Manufacturer's standard, prefabricated, terrazzo receptor complete with integral drain.
  - 1. Curb: Not less than 2 inches and not more than 9 inches deep when measured from the top of the curb to the top of the drain; with curb threshold not less than 1 inch below the sides and back of the receptor; and with a ramped entrance surface for accessible compartments.
  - 2. Floor: Finished, sloping uniformly toward the drain and not less than 1/4 unit vertical in 12 units horizontal and not more than 1/2 inch.
  - 3. Drain Strainer: Manufacturer's standard, removable stainless-steel strainer.
  - 4. Drain Gasket: Manufacturer's standard gasket sized to fit waste pipe.
  - 5. Waterstop: Manufacturer's standard, continuous galvanized-steel flange or rabbeted groove to receive panels and create a waterstop when panels are in place.
- B. Finish: Manufacturer's standard finish on exposed surfaces, contrasting with the enclosure panels, as selected by Architect from manufacturer's full range and with slip-resistant floor surface texture.

### 2.4 ACCESSORIES

- A. Door Hardware and Accessories: Manufacturer's standard design, heavy-duty, operating hardware, and accessories.
  - 1. Material: Stainless steel.

2. Hinges: Manufacturer's standard, paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
  3. Latch and Keeper: Manufacturer's standard, surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at each compartment, accessible or not.
  4. Clothing Hooks: Manufacturer's standard clothing hooks in each dressing compartment; include one combination hook and rubber-tipped bumper at in-swinging doors, sized to prevent door from hitting wall panel or compartment-mounted accessories.
  5. Door Bumper: Manufacturer's standard, rubber-tipped bumper at out-swinging doors.
  6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard, continuous, extruded-aluminum head rail or cap with antigrip profile; in manufacturer's standard finish.
- C. Head Rail with Hooks: Manufacturer's standard, continuous, extruded-aluminum head rail or cap with curtain hooks running in concealed track; with antigrip profile; in manufacturer's standard finish.
- D. Curtain Rod with Hooks: Manufacturer's standard, 1-inch-diameter, stainless-steel curtain rod with matching hooks.
- E. Curtain: Flame-resistant, manufacturer's standard fabric that is stain resistant, self-sanitizing, antistatic, and antimicrobial; launderable to a temperature of not less than 90 deg F.
1. Flame Resistance: Passes NFPA 701 tests when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.
  2. Labeling: Identify fabrics with appropriate markings of applicable testing and inspecting agency.
  3. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches o.c.; machined into top hem.
  4. Length: Where curtain extends to a floor surface, size so that bottom hem clears finished floor by not more than 1 inch and not less than 1/2 inch above floor surface. Where curtains extend to a shower-receptor curb, size so that bottom hem hangs above curb line and clears curb line by not more than 1/2 inch.
  5. Color and Pattern: Match Architect's sample.
- F. Soap Holder: Surface-mounted, seamless [stainless-steel] <Insert material> soap dish.
- G. Seats: Manufacturer's standard, wall-mounted benches.
1. Material: Solid phenolic.
  2. Operation: Folding.
  3. Finish: As selected by Architect from manufacturer's full range.
- H. Anchorages and Fasteners: Manufacturer's standard, exposed fasteners of stainless steel, chrome-plated steel, or solid brass, finished to match the items they are securing; with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

## 2.5 FABRICATION

- A. Overhead-Braced Compartments: Provide manufacturer's standard, corrosion-resistant supports, leveling method, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling method.

- B. Floor-and-Ceiling-Anchored Compartments: Provide manufacturer's standard, corrosion-resistant anchoring assemblies at pilasters and walls with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.
- C. Door Sizes and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard shower and dressing compartments, and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. General: Comply with manufacturer's written installation instructions. Install compartments rigid, straight, level, and plumb. Secure compartments in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances for Dressing Compartment:
    - a. Pilasters and Panels: 1/2 inch.
    - b. Panels and Walls: 1 inch.
  - 2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.
    - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Compartments: Secure pilasters to floor, and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Curtains: Install curtains to specified length and verify that they hang vertically without stress points or diagonal folds.
- D. Shower Receptors: Install prefabricated shower receptors with drain gasket compression fit to outside diameter of waste pipe.

#### **3.2 ADJUSTING**

- A. Curtain Adjustment: After hanging curtains, test and adjust each track or rod to produce unencumbered, smooth operation. Steam and dress down curtains as required to produce crease- and wrinkle-free installation. Remove and replace curtains that are stained or soiled or that have stress points or diagonal folds.
- B. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 10 22 26.13 - ACCORDION FOLDING PARTITIONS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Manually operated, accordion folding partitions.
  - 2. Manually operated, fire-rated accordion folding partitions.
  - 3. Electrically operated, accordion folding partitions.
  - 4. Electrically operated, fire-rated accordion folding partitions.
- B. Related Sections:
  - 1. Section 05 50 00 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
  - 2. Section 08 35 13 "Folding Doors" for small-size, non-acoustically rated, fire-rated, and non-fire-rated accordion folding doors.
  - 3. Section 08 71 00 "Door Hardware" for hardware to the extent not specified in this Section.

**1.2 DEFINITIONS**

- A. NIC: Noise Isolation Class.
- B. NRC: Noise Reduction Coefficient.
- C. SAA: Sound Absorption Average.
- D. STC: Sound Transmission Class.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
  - a. .
- B. Shop Drawings: For accordion folding partitions.
  - 1. Include plans, elevations, sections, and attachment details to other work.
  - 2. Indicate storage and operating clearances.
  - 3. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
  - 4. Indicate facing-material seam locations if any.
  - 5. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of exposed material, facing material, and finish indicated.
  - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed material, facing material, and finish indicated, prepared on Samples of size indicated below:
  - 1. Textile Facing Material: Full width by not less than 36-inch-long section of fabric and carpet from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.

2. Facing Material Other Than Textile: Manufacturer's standard-size unit, not less than 3 inches square.
  3. Edge Material: Not less than full width by 3 inches long.
  4. Hardware: Manufacturer's standard exposed door-operating device.
- E. Delegated-Design Submittal: For seismic bracing of accordion folding partitions indicated to comply with performance requirements and design criteria, including analysis data and calculations signed and sealed by the qualified professional engineer responsible for their preparation.
1. Include design calculations for seismic restraints that brace tracks to structure above.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Partition track, track supports and seismic bracing, switches, turning space, and storage layout.
  2. Suspended ceiling components.
  3. Structural members to which suspension systems will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Items penetrating finished ceiling, including the following:
    - a. Lighting fixtures.
    - b. HVAC ductwork, outlets, and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Smoke detectors.
    - f. Access panels.
  6. Plenum fire, smoke and acoustical barriers.
- B. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.
- C. Qualification Data: For manufacturer, installer and testing agency.
- D. Seismic Qualification Certificates: For accordion folding partitions, accessories, and components, from manufacturer.
- E. Product Certificates: For each type of accordion folding partition, from manufacturer.
- F. Material Certificates: For each textile dye lot, signed by manufacturers.
- G. Product Test Reports: For each accordion folding partition, for tests performed by a qualified testing agency.
- H. Field quality-control reports.
- I. Sample Warranty: For manufacturer's special warranty.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For accordion folding partitions to include in maintenance manuals.
1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
    - a. Facing materials and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
    - b. Seals, hardware, track, carriers, and other operating components.
    - c. Electric operator and controls.

**1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

**1.8 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of accordion folding partitions that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Faulty operation of accordion folding partitions.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Period: Five years from date of Substantial Completion.
  - 3. Warranty Period for Pantographic Frames, Trolleys, and Tracks: 10 years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 GENERAL**

- A. General Requirements for Accordion Folding Partitions: Partitions shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

**2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design seismic bracing of tracks to structure above, according to the seismic performance requirements.
- B. Seismic Performance: Accordion folding partitions shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- C. Acoustical Performance: Provide accordion folding partitions tested by a qualified testing agency for the following acoustical properties, according to test methods indicated:
  - 1. Sound-Transmission Requirements: Accordion folding partition assembly tested in a laboratory for sound-transmission loss performance according to ASTM E 90, calculated according to ASTM E 413, and rated for not less than the STC value indicated.
  - 2. Noise-Reduction Requirements: Accordion folding partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C 423, and rated for not less than the NRC indicated.
  - 3. Noise-Isolation Requirements: Installed accordion folding partition assembly, identical to partition tested for STC, tested for NIC according to ASTM E336, determined by ASTM E413, and rated for [10 dB less than STC value indicated].
  - 4. Acoustical Performance Requirements: Installed accordion folding partition assembly, identical to partition tested for STC, tested for NIC according to ASTM E 336, determined by ASTM E 413, and rated for 10 dB less than STC value indicated.
- D. Fire-Test-Response Characteristics: Provide partitions with finishes complying with one of the following, as determined by testing identical products by a testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

- a. Flame-Spread Index: 25 or less.
- b. Smoke-Developed Index: 450 or less.
2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.
- E. Fire Resistance: Provide fire-rated accordion folding partitions complying with NFPA 80, based on testing according to UL 10B for fire-rated door assemblies.
  1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.3 ACCORDION FOLDING PARTITION

- A. Accordion Folding Partition: Accordion folding frame with hinged sections designed for horizontal extension and retraction, covered with decorative facing material, reinforced for hardware attachment, supported by overhead suspension system, and equipped with manufacturer's standard air-release method to prevent billowing.
  1. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
    - a. Cornell Iron Works, Inc.
    - b. Curtition; a division of T&C Industries, Inc.
    - c. Holcomb & Hoke Mfg. Co., Inc.
    - d. Hufcor, Inc.; a KWIK-Wall Company.
    - e. KWIK-WALL Company.
    - f. Moderco Inc.
    - g. Modernfold, Inc.; a DORMA Group company.
    - h. Panelfold Inc.
    - i. Won-Door Corporation.
    - j. Woodfold Mfg., Inc.
- B. Partition Type: As indicated on Drawings with the following hardware:
  1. Lead Post Latching Hardware: Latch on one side secured to recessed jamb striker.
  2. Lead Post Locking Hardware: Key-operated lock cylinder, keyed to master key system, operable from latch side of post.
  3. Lead Post Locking Hardware: Deadlock to receive cylinder, operable from latch side of post. See Section 08 71 00 "Door Hardware" and Section 08 71 11 "Door Hardware (Descriptive Specification)" for lock cylinder and keying requirements.
  4. Meeting Post: Attached, with meeting/closing arrangement as indicated on Drawings.
  5. Intermediate Post: For intersecting partition on one side of partition.
  6. Storage-End Hardware: Anchor post, secured to opening jamb.
  7. Pendant Pull: Near top of lead post in addition to standard pull handle/latch for units more than 10 feet high or 20 feet wide, or both.
  8. Foot Bolt: On lead post(s) where indicated; secured to post without interference with seals.
- C. STC: 45.
- D. NRC: Not less than 0.70.
- E. Dimensions: Fabricate partitions to form an assembled system of dimensions indicated on Drawings and verified by field measurements.
  1. Stack Width (Stored): Maximum 8-1/2-inch thickness from one side of the partition to the other.



2. Width When Extended: Maximum 5-inch thickness from one side of the partition to the other.
  3. Total Stack Depth (Stored): Maximum 38 inches.
- F. Electric Controls: Remote-control station, Obstruction-detection device and emergency release mechanism.
- G. Facing Material: Refer to Finish Schedule on Drawings.
1. Color/Pattern: As selected by Architect from manufacturer's full range.

## 2.4 FIRE-RATED ACCORDION FOLDING PARTITION

- A. Fire-Rated Accordion Folding Partition: Accordion folding frame with pantograph sections designed for horizontal extension and retraction, covered with decorative facing material, reinforced for hardware attachment, supported by overhead suspension system, and equipped with manufacturer's standard air-release method to prevent billowing.
1. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
    - a. Cornell Iron Works, Inc.
    - b. Modernfold, Inc.; a DORMA Group company.
    - c. Won-Door Corporation.
- B. Partition Type: As indicated on Drawings with the following hardware:
1. Lead Post Latching Hardware: Latch on one side secured to recessed jamb striker.
  2. Lead Post Locking Hardware: Key-operated lock cylinder, keyed to master key system, operable from latch side of post.
  3. Lead Post Locking Hardware: Deadlock to receive cylinder, operable from latch side of post. See Section 08 71 00 "Door Hardware" and Section 08 71 11 "Door Hardware (Descriptive Specification)" for lock cylinder and keying requirements.
  4. Storage-End Hardware: Sliding jamb within storage pocket.
  5. Pendant Pull: Near top of lead post in addition to standard pull handle/latch for units more than 10 feet high or 20 feet wide, or both.
  6. Foot Bolt: On lead post; secured to post to avoid interference with seals.
- C. Fire Rating: As indicated on Drawings.
- D. STC: 44.
- E. NRC: 70.
- F. Dimensions: Fabricate partitions to form an assembled system of dimensions indicated on Drawings and verified by field measurements.
1. Stack Width (Stored): Maximum 11-1/2-inch thickness from one side of the partition to the other.
  2. Width When Extended: Maximum 13-3/4-inch thickness from one side of the partition to the other.
  3. Total Stack Depth (Stored): Maximum 38 inches.
- G. Electric Controls: Remote-control station, Obstruction-detection device and emergency release mechanism.
- H. Facing Material: As indicate on Finish Schedule on Drawings.
1. Color/Pattern: As selected by Architect from manufacturer's full range.

## 2.5 COMPONENTS

- A. Posts and Seals: Provide types of posts and seals that produce accordion folding partitions complying with performance requirements.

1. Posts: Steel or aluminum; formed with deep-nesting and interlocking interfaces and fabricated to ensure rigidity of accordion folding partition.
  2. Perimeter Seals: Manufacturer's standard vinyl, neoprene, or woven silica vertical seals, horizontal top and bottom seals, and closures for lead posts and jams. Seals and closures at fire-rated partitions shall be identical to products tested for fire rating indicated and shall form an effective smoke and draft seal.
- B. Hardware: Manufacturer's standard manually operated pulls, latches, locks, and bolts as required to operate accordion folding partitions; with decorative, protective finish.
- C. Trim: Manufacturer's standard with decorative, protective finish.
- D. Tiebacks: As required to maintain accordion folding partitions in stacked position; with manufacturer's standard finish.

## 2.6 SUSPENSION SYSTEMS

- A. Tracks: Steel or aluminum, mounted directly to overhead structural support, designed for operation, size, and weight of accordion folding partition indicated. Size track to support partition operation and storage without damage to suspension system, accordion folding partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
1. Track: Recessed.
    - a. Head Closure Trim: Integral with track for protecting overhead surfaces; with factory-applied, decorative, protective finish.
    - b. Head Closure Trim and Track Channel Pocket: For protecting overhead surfaces and enclosing overhead track opening; with factory-applied, decorative, protective finish.
- B. Carriers: Trolley system as required for size and weight of partition and for easy, quiet operation; with manufacturer's standard] ball-bearing carriers at lead post and manufacturer's standard ball-bearing carriers at intermediate partition supports.
1. Wheels: Manufacturer's standard.
- C. Track Switches and Accessories: Manufacturer's standard switches as required for type of operation, storage, track configuration, and layout indicated.
- D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.
- E. Steel Finish: Factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

## 2.7 ELECTRIC OPERATORS

- A. Factory-assembled electric operation system of size and capacity recommended and provided by accordion folding partition manufacturer for partition specified; with electric motor and factory-prewired motor controls, speed reducer, chain drive, remote-control stations, control devices, and accessories required for operation. Include wiring from control stations to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
- B. Comply with NFPA 70.
- C. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor; complying with NEMA MG 1. Also comply with the following:
1. Voltage: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

2. Horsepower: Manufacturer's standard.
  3. Efficiency: Premium.
  4. Enclosure: Manufacturer's standard.
  5. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
  6. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
  7. Phase: Single.
- D. Motor Electrical Characteristics:
1. Horsepower: Manufacturer's standard.
  2. Volts: 115.
  3. Phase: Single phase.
  4. Hertz: 60.
- E. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.
- F. Remote-Control Station: For partitions indicated, provide manufacturer's standard key-operated, constant-pressure, three-position control station labeled "Open," "Close," and "Stop." Provide two keys per station.
- G. Obstruction-Detection Device: For partitions indicated, provide automatic safety sensor indicated that causes operator to immediately stop and reverse direction.
1. Sensor Edge: Contact-pressure-sensitive safety edge along partition's leading edge.
- H. Limit Switches: Provide each partition with adjustable switches, interlocked with motor controls and set to automatically stop accordion folding partition at fully extended and fully stacked positions.
- I. Electric Interlock: Provide each partition with safety interlocks to prevent operation of accordion folding partition under the following conditions:
1. On partition, to prevent operation when partition is extended and locked.
  2. On storage pocket door, to prevent partition operation if door is not in fully open position.
  3. On partitions, at location of convergence by another partition, to prevent operation if merging partitions are in place.
- J. Emergency Release Mechanism: For partitions indicated, provide quick disconnect-release of electric-motor drive system, permitting manual operation in event of operating failure.

## 2.8 FACING MATERIALS

- A. Provide facing materials with appropriate backing that comply with indicated fire-test-response characteristics, and that are factory attached to accordion folding partitions with concealed fasteners.
1. Factory-apply facing material free of air bubbles, wrinkles, blisters, and other defects; [in one piece, seamless; and with no gaps or overlaps. Tightly secure and conceal raw and selvage edges of facing material for finished appearance. Horizontal butted edges or seams are not permitted.
  2. Where facing material with directional or repeating patterns or directional weave are indicated, mark facing-material top and attach facing material in same direction.
  3. Match facing pattern 72 inches above finished floor unless otherwise indicated.
- B. Carpet Wall Covering: Manufacturer's standard nonwoven, needle-punched carpet with fibers fused to backing, from same dye lot, treated to resist stains.
- C. Woven Fabric: Manufacturer's standard 100 percent polyolefin woven fabric, from same dye lot, treated to resist stains.
- D. Fabric: Manufacturer's standard fabric, from same dye lot, treated to resist stains.
- E. Vinyl-Coated Fabric: Manufacturer's standard mildew-resistant, washable, vinyl-coated fabric wall covering; complying with WA-101, Type II-Medium Duty; Class A.

1. Total Weight: Refr to Drawings.
  2. Antimicrobial Treatment: Additives capable of inhibiting growth of bacteria, fungi, and yeasts.
- F. Vinyl Film: Manufacturer's standard vinyl film laminated to partition substrate.
- G. Plastic Laminate: High-pressure decorative laminate; NEMA LD 3, Grade HGS.
- H. Wood Veneer: Laminated to fire-retardant-treated wood core with moisture-resistant adhesive.
1. Wood Species and Finish: As selected by Architect from manufacturer's full range.
- I. Paint: Manufacturer's standard baked enamel.

## 2.9 STORAGE POCKET DOORS

- A. Storage Pocket Door : Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as partition; complete with operating hardware and acoustical seals at soffit, floor, and jambs. Hinges in finish to match other exposed hardware.
1. Pocket-door manufacturer's standard method to secure storage pocket door in closed position.
  2. Manufacturer's standard method to secure storage pocket door in closed position.
  3. Rim Lock: Key-operated lock cylinder, keyed to master key system, to secure storage pocket door in closed position. Include two keys per lock.
  4. Rim Lock: Deadlock to receive cylinder, to secure storage pocket door in closed position. See Section 08 71 00 "Door Hardware" for lock cylinder and keying requirements.
- B. Electric Interlock: Provide each pocket door for an electrically operated, accordion folding partition with electric interlocks to prevent operation of accordion folding partition if pocket door is not in fully open position.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine flooring, floor levelness, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of accordion folding partitions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Comply with ASTM E 557 except as otherwise required by accordion folding partition manufacturer's written installation instructions. Install accordion folding partitions level and plumb, with tight joints and uniform appearance, and free of deformation and surface and finish irregularities.
- B. Install accordion folding partitions, seismic bracing, and accessories after other finishing operations, including painting, have been completed in area of partition installation.
- C. Broken, cracked, chipped, deformed, or unmatched sections are unacceptable.
- D. Broken, cracked, deformed, or unmatched seals or seals with gaps at butted ends are unacceptable.
- E. Light-Leakage Test: Illuminate one side of partition installation, and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals. Perform test and make adjustments before NIC testing.

**3.3 FIELD QUALITY CONTROL**

- A. NIC Testing: Owner will engage a qualified testing agency to perform tests and inspections.
  - 1. Testing Extent: Testing agency shall randomly select one accordion folding partition installation(s) for testing.
  - 2. Testing Methodology: Perform testing of installed accordion folding partition for noise isolation according to ASTM E336, determined by ASTM E413, and rated for not less than NIC indicated. Adjust and fit partitions to comply with NIC test method requirements.
- B. Accordion folding partitions will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

**3.4 ADJUSTING**

- A. Adjust accordion folding partitions to operate smoothly, without warping or binding. Lubricate hardware and other moving parts as recommended by manufacturer.
- B. Adjust storage pocket doors to operate smoothly and easily, without binding or warping. Check and readjust operating hardware. Confirm that latches and locks engage accurately and securely without forcing or binding.
- C. Electrically Operated Partitions: Adjust electric interlocks to properly control partition operation.
- D. Verify that safety devices are properly functioning.

**3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain accordion folding partitions.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 10 22 29 - UPFOLDING PANEL PARTITIONS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Electrically operated vertical lift acoustical panel partitions.
- B. Related Requirements:
  - 1. Section 05 12 00 "Structural Steel Framing" for primary structural support and miscellaneous steel.
  - 2. Section 05 50 00 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
  - 3. Section 09 29 00 "Gypsum Board" for fire-rated assemblies and sound barrier construction above the ceiling at track.
  - 4. Section 10 22 26.13 "Accordion Folding Partitions" for accordion-type folding partitions having a pantograph mechanism and outer flexible covering, or narrow, vertically hinged segments.
  - 5. Section 10 22 39 "Folding Panel Partitions" for conventional horizontal-folding operable panel partitions.
  - 6. Section 10 22 39.13 "Folding Glass-Panel Partitions" for operable panel partitions made of glass panels.
  - 7. Electrical and communications Sections for electrical service and connections for motor operators, controls, and limit switches and for system disconnect switches.

**1.2 DEFINITIONS**

- A. NIC: Noise Isolation Class.
- B. NRC: Noise Reduction Coefficient.
- C. STC: Sound Transmission Class.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For upfolding panel partitions.
  - 1. Include plans, elevations, sections, details, numbered panel installation sequence, and attachments to other work.
  - 2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
  - 3. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.
  - 1. Include Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:
  - 1. Textile Facing Material: Full width by not less than 36-inch-long section of material from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.

2. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 inches square.
  3. Panel Edge Material: Not less than 3 inches long.
  4. Chair Rail: Manufacturer's standard-size unit, 6 inches long.
  5. Glass: Units 12 inches square.
  6. Hardware: One of each exposed door-operating device.
- E. Delegated-Design Submittal: For upfolding panel partitions.
1. Include design calculations for seismic restraints.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Partition track, track supports and bracing, switches, turning space, and storage layout.
  2. Suspended ceiling components.
  3. Structural members to which suspension systems are attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Items penetrating finished ceiling, including the following:
    - a. Lighting fixtures.
    - b. HVAC ductwork, outlets, and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Smoke detectors.
    - f. Access panels.
  6. Plenum fire, smoke and acoustical barriers.
- B. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.
- C. Qualification Data: For qualified Installer testing agency, manufacturer, and vendor.
- D. Seismic Qualification Certificates: For upfolding panel partitions, tracks, accessories, and components, from manufacturer. Include seismic capacity of partition assemblies to remain in vertical position during a seismic event and the following:
1. Basis for Certification: Indicate whether certification is based on analysis, testing, or experience data, according to ASCE/SEI 7.
  2. Detailed description of partition anchorage devices on which the certification is based and their installation requirements.
- E. Product Certificates: For each type of upfolding panel partition.
1. Include approval letter signed by manufacturer acknowledging Owner-furnished panel facing material complies with requirements.
- F. Product Test Reports: For each upfolding panel partition, for tests performed by a qualified testing agency.
- G. Field quality-control reports.
- H. Sample Warranty: For manufacturer's special warranty.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For upfolding panel partitions to include in maintenance manuals.
1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
    - a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
    - b. Seals, hardware, track, track switches, carriers, and other operating components.



- c. Electric operator and controls.

### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

### 1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.
- C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

### 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of upfolding panel partitions that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Faulty operation of upfolding panel partitions.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design seismic bracing of tracks to structure above.
- B. Seismic Performance: Upfolding panel partitions shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the partition panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."
- C. Acoustical Performance: Provide upfolding panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
  - 1. Sound-Transmission Requirements: Upfolding panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
  - 2. Noise-Reduction Requirements: Upfolding panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C 423, and rated for not less than the NRC indicated.

3. Noise-Isolation Requirements: Installed upfolding panel partition assembly, identical to partition tested for STC, tested for NIC according to ASTM E 336, determined by ASTM E 413, and rated for 10 dB less than STC value indicated.
- D. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.2 UPFOLDING ACOUSTICAL PANELS

- A. Upfolding Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Skyfold or comparable product by one of the following:
    - a. Advanced Equipment Corporation.
    - b. FolDoor.
    - c. Hufcor, Inc.; a KWIK-Wall Company.
    - d. KWIK-WALL Company.
    - e. Moderco Inc.
    - f. Modernfold, Inc.
    - g. Panelfold Inc.
- B. Basis of Design model:
  1. Skyfold® Zenith Premium 55™: System STC 55 (Rw 54), Panel Construction STC 61 (Rw 60)
- C. Panel Operation: Electrically operated, continuously hinged panels.
- D. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- E. Dimensions: Fabricate upfolding acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
  1. Panel Width: As indicated.
- F. STC: Not less than 50.
- G. NRC: Not less than 0.90.
- H. Panel Weight: 10 lb/sq. ft. maximum.
- I. Panel Thickness: Not less than 3 inches.
- J. Panel Materials:
  1. Steel Frame: Steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.

2. Steel Face/Liner Sheets: Tension-levleed steel sheet, manufacturer's standard minimum nominal thickness for uncoated steel.
  3. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B 221 for extrusions; manufacturer's standard strengths and thicknesses for type of use.
    - a. Frame Reinforcement: Manufacturer's standard steel or aluminum.
  4. Gypsum Board: ASTM C 1396/C 1396M, with moisture- and mold-resistant core and paper surfaces.
    - a. Mold Resistance: ASTM D 3273, score of 10.
  5. Cement Board: ASTM C 1288.
  6. Particleboard: ANSI A208.1, made with binder containing no urea formaldehyde.
  7. Medium-Density Fiberboard: ANSI A208.2, made with binder containing no urea formaldehyde.
  8. Plywood: DOC PS 1; made with adhesive containing no urea formaldehyde.
- K. Panel Closure: Manufacturer's standard unless otherwise indicated.
1. Initial Closure: Flexible, resilient PVC, bulb-shaped acoustical seal.
- L. Hardware: Manufacturer's standard as required to operate upfolding panel partition and accessories; with decorative, protective finish.
1. Hinges: Manufacturer's standard.

### 2.3 SEALS

- A. General: Provide seals that produce upfolding panel partitions complying with performance requirements and the following:
1. Manufacturer's standard seals unless otherwise indicated.
  2. Seals made from materials and in profiles that minimize sound leakage.
  3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between upfolding panel partition perimeter and adjacent surfaces, when upfolding panel partition is extended and closed.
- B. Horizontal Top Seals: Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track.
- C. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
1. Mechanically Operated for Acoustical Panels: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than 2-1/2 inches between retracted seal and floor finish.

### 2.4 PANEL FINISH FACINGS

- A. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to upfolding panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with no gaps or overlaps. Horizontal butted edges are not permitted. Tightly secure and conceal raw and salvage edges of facing for finished appearance.
  2. Where facings with directional or repeating patterns or directional weave are indicated, mark facing top and attach facing in same direction.
  3. Match facing pattern 72 inches above finished floor.
- B. Fabric Wall Covering: Manufacturer's standard fabric, from same dye lot, treated to resist stains.
1. Color/Pattern: As selected by Architect from manufacturer's full range.

- C. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:
  - 1. Steel, Painted: Finished with manufacturer's color as selected by Architect from manufacturer's full range.
  - 2. Aluminum: Finished with manufacturer's standard color anodic finish.
- D. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

## 2.5 SUSPENSION SYSTEMS

- A. Tracks: Steel or aluminum mounted directly to overhead structural support, with adjustable steel hanger rods for overhead support, designed for operation, size, and weight of upfolding panel partition indicated. Size track to support partition operation and storage without damage to suspension system, upfolding panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
  - 1. Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.
  - 2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.
- B. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.
- C. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

## 2.6 ELECTRIC OPERATORS

- A. General: Factory-assembled electric operation system of size and capacity recommended and provided by upfolding panel partition manufacturer for partition specified; with electric motor and factory-prewired motor controls, speed reducer, chain drive, control stations, control devices, and accessories required for operation. Include wiring from control stations to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
- B. Comply with NFPA 70.
- C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.
- D. Motor Electrical Characteristics:
  - 1. Horsepower: Manufacturer's standard.
  - 2. Volts: 120.
  - 3. Phase: Single.
  - 4. Hertz: 60.
- E. Control Stations: Two single-key-operated, constant-pressure control stations located remotely from each other on opposite sides and opposite ends of partition run. Wire in series to require simultaneous activation of both key stations to operate partition. Each three-position control station labeled "Open," "Close," and " Stop." Furnish two keys per station.
- F. Obstruction-Detection Devices: Equip each motorized upfolding panel partition with indicated automatic safety sensor that causes operator to immediately stop and reverse direction.
  - 1. Sensor Edge: Contact-pressure-sensitive safety edge along partition's leading edge.
  - 2. Sensor Mat: Electrically operated, contact-weight-sensitive safety mat in storage pocket area.

3. Infrared Sensor System: Designed to detect an obstruction in partition's path and sound an audible alarm, without obstruction contacting partition.
- G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop upfolding panel partition at fully extended and fully stacked positions.
- H. Emergency Release Mechanism: Quick disconnect-release of electric-motor drive system, permitting manual operation in event of operating failure.
- I. Electric Interlock: Equip each motorized upfolding panel partition with electric interlocks at locations indicated, to prevent operation of upfolding panel partition under the following conditions:
  1. On storage pocket door, to prevent operation if door is not in fully open position.
  2. On partitions at location of convergence by another partition, to prevent operation if merging partitions are in place.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of upfolding panel partitions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. General: Comply with ASTM E 557 except as otherwise required by upfolding panel partition manufacturer's written installation instructions.
- B. Install upfolding panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.
- C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.
- F. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals. Perform test and make adjustments before NIC testing.

#### **3.3 FIELD QUALITY CONTROL**

- A. NIC Testing: Owner will engage a qualified testing agency to perform tests and inspections.
  1. Testing Extent: Testing agency shall randomly select one upfolding panel partition installation(s) for testing.
  2. Testing Methodology: Perform testing of installed upfolding panel partition for noise isolation according to ASTM E 336, determined by ASTM E 413, and rated for not less than NIC indicated. Adjust and fit partitions to comply with NIC test method requirements.
- B. An upfolding panel partition installation will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

**3.4 ADJUSTING**

- A. Adjust upfolding panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.
- B. Verify that safety devices are properly functioning.

**3.5 MAINTENANCE SERVICE**

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper upfolding-partition operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

**3.6 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain upfolding panel partitions.

END OF SECTION

**SECTION 10 22 39 - FOLDING PANEL PARTITIONS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Manually operable acoustical panel partitions.
  - 2. Electrically operated, acoustical partitions.
  - 3. Manually operable fire-rated panel partitions.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
  - 2. Section 09 29 00 "Gypsum Board" for fire-rated assemblies and sound barrier construction above the ceiling at track.
  - 3. Section 10 22 39.13 "Folding Glass-Panel Partitions" for operable panel partitions made of glass panels.
  - 4. Electrical and communications Sections for electrical service and connections for motor operators, controls, and limit switches and for system disconnect switches.

**1.2 DEFINITIONS**

- A. NIC: Noise Isolation Class.
- B. NRC: Noise Reduction Coefficient.
- C. STC: Sound Transmission Class.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For operable panel partitions.
  - 1. Include plans, elevations, sections, attachment details, and numbered panel installation sequence.
  - 2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
  - 3. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.
  - 1. Include Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:
  - 1. Textile Facing Material: Full width by not less than 36-inch-long section of fabric and carpet from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.
  - 2. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 inches square.
  - 3. Panel Edge Material: Not less than 3 inches long.
  - 4. Chair Rail: Manufacturer's standard-size unit, 6 inches long.
  - 5. Glass: Units 12 inches square.
  - 6. Hardware: One of each exposed door-operating device.

- E. Delegated Design Submittals: For operable panel partitions.
  - 1. Include design calculations for seismic restraints that brace tracks to structure above.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Partition track, track supports and bracing, switches, turning space, and storage layout.
  - 2. Suspended ceiling components.
  - 3. Structural members to which suspension systems will be attached.
  - 4. Size and location of initial access modules for acoustical tile.
  - 5. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. HVAC ductwork, outlets, and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Smoke detectors.
    - f. Access panels.
  - 6. Plenum fire, smoke and acoustical barriers.
- B. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.
- C. Qualification Data: For Installer, testing agency, manufacturer, and vendor.
- D. Seismic Qualification Certificates: For operable panel partitions, tracks, accessories, and components, from manufacturer. Include seismic capacity of partition assemblies to remain in vertical position during a seismic event and the following:
  - 1. Basis for Certification: Indicate whether certification is based on analysis, testing, or experience data, in accordance with ASCE/SEI 7.
  - 2. Detailed description of partition anchorage devices on which the certification is based and their installation requirements.
- E. Product Certificates: For each type of operable panel partition.
  - 1. Include approval letter signed by manufacturer acknowledging Owner-furnished panel facing material complies with requirements.
- F. Product Test Reports: For each operable panel partition, for tests performed by a qualified testing agency.
- G. Field quality-control reports.
- H. Sample Warranty: For manufacturer's special warranty.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.
  - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
    - a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
    - b. Seals, hardware, track, track switches, carriers, and other operating components.
    - c. Electric operator and controls.



**1.7 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

**1.8 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.
- C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

**1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

**1.10 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Faulty operation of operable panel partitions.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design seismic bracing of tracks to structure above.
- B. Seismic Performance: Operable panel partitions are to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
  - 1. The term "withstand" means "the partition panels will remain in place without separation of any parts when subjected to the seismic forces specified."
- C. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties in accordance with test methods indicated:
  - 1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance in accordance with ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
  - 2. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance in accordance with ASTM C 423, and rated for not less than the NRC indicated.
  - 3. Noise-Isolation Requirements: Installed operable panel partition assembly, identical to partition tested for STC, tested for NIC in accordance with ASTM E 336, determined by ASTM E 413, and rated for 10 dB less than STC value indicated.

- D. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by a testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  - 2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested in accordance with NFPA 265 Method B Protocol.
- E. Fire Resistance: Provide fire-rated operable panel partition assemblies complying with NFPA 80, based on testing in accordance with UL 10B for fire-rated door assemblies.
  - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
  - 2. Pass doors in fire-rated operable panel partition assemblies are to meet positive-pressure requirements.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.2 OPERABLE ACOUSTICAL PANEL PARTITIONS

- A. Operable Acoustical Panel Partitions: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Modernfold, Inc. or comparable product by one of the following:
    - a. Advanced Equipment Corporation.
    - b. Hufcor, Inc.; a KWIK-Wall Company.
    - c. FolDoor.
    - d. KWIK-WALL Company.
    - e. Moderco Inc.
    - f. Panelfold Inc.
- B. Panel Operation: Manually operated, individual panels.
- C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
  - 1. Panel Width: As indicated.
- E. STC: Not less than 50.
- F. NRC: Not less than 0.90.
- G. Panel Weight: 10 lb/sq. ft. maximum.
- H. Panel Thickness: Minimum dimension of 3 inches

- I. Panel Materials:
  - 1. Steel Frame: Steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.
  - 2. Steel Face/Liner Sheets: Tension-levleed steel sheet, manufacturer's standard minimum nominal thickness for uncoated steel.
  - 3. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B221 for extrusions; manufacturer's standard strengths and thicknesses for type of use.
    - a. Frame Reinforcement: Manufacturer's standard steel or aluminum.
  - 4. Gypsum Board: ASTM C 1396/C 1396M, with moisture-and mold-resistant core and papers surfaces.
  - 5. Cement Board: ASTM C1288.
  - 6. Particleboard: ANSI A208.1, made with binder containing no urea formaldehyde.
  - 7. Medium-Density Fiberboard: ANSI A208.2.
  - 8. Plywood: DOC PS 1; made with adhesive containing no urea formaldehyde.
- J. Panel Closure: Manufacturer's standard unless otherwise indicated.
  - 1. Initial Closure: Resilient, bulb-shaped acoustical seal.
  - 2. Final Closure: Constant-force, lever-operated mechanical closure expanding from panel edge to create a constant-pressure acoustical seal.
- K. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.
  - 1. Hinges: Manufacturer's standard.
- L. Finish Facing: Refer to Finish Schedule on Drawings..

### 2.3 OPERABLE FIRE-RATED PANEL PARTITIONS

- A. Operable Fire-Rated Panel Partitions: Fire-rated, acoustical panel partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Modernfold, Inc. or comparable product by one of the following:
    - a. Advanced Equipment Corporation.
    - b. KWIK-WALL Company.
    - c. Moderco Inc.
    - d. Panelfold Inc.
- B. Panel Operation: Manually operated, individual panels.
- C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- D. Dimensions: Fabricate operable fire-rated panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
  - 1. Panel Width: As indicated.
- E. Fire Rating: 1 hour(s).
- F. STC: Not less than 50.
- G. NRC: Not less than 0.90.
- H. Panel Weight: 10 lb/sq. ft. maximum.
- I. Panel Thickness: Minimum dimension of 3 inches.
- J. Panel Materials:

1. Steel Frame: Steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.
  2. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard nominal thickness for uncoated steel.
- K. Panel Closure: Manufacturer's standard fire-rated closure unless otherwise indicated.
1. Initial Closure: Resilient, bulb-shaped acoustical seal.
  2. Final Closure: Fire-rated, constant-force, lever-operated mechanical closure expanding from panel edge to create a constant-pressure acoustical seal.
- L. Hardware: Manufacturer's standard as required to operate fire-rated operable panel partition and accessories; with decorative, protective finish.
1. Hinges: Manufacturer's standard.
- M. Finish Facing: Refer to Finish Schedule on Drawings.

## 2.4 SEALS

- A. Description: Seals that produce operable panel partitions complying with performance requirements and the following:
1. Manufacturer's standard seals unless otherwise indicated.
  2. Seals made from materials and in profiles that minimize sound leakage.
  3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.
- B. Vertical Seals: Deep-nesting, interlocking steel astragals mounted on each edge of panel, with continuous, resilient acoustical seal.
- C. Horizontal Top Seals: Continuous-contact, resilient seal exerting uniform constant pressure on track.
- D. Horizontal Bottom Seals:
1. Manufacturer's standard continuous-contact seal exerting uniform constant pressure on floor.
  2. Resilient, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
    - a. Mechanically Operated for Acoustical Panels: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than 2-1/2 inches between retracted seal and floor finish.
    - b. Mechanically Operated for Fire-Rated Panels: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than 2-1/2 inches between retracted seal and floor finish.

## 2.5 PANEL FINISH FACINGS

- A. Description: Finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with no gaps or overlaps. Horizontal butted edges seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
  2. Where facings with directional or repeating patterns or directional weave repeating are indicated, mark facing top and attach facing in same direction.
  3. Match facing pattern 72 inches above finished floor.

- B. Vinyl-Coated Fabric Wall Covering: Manufacturer's standard, mildew-resistant, washable, vinyl-coated fabric wall covering; complying with WA-101, Type II-Medium Duty; Class A.
  - 1. Antimicrobial Treatment: Additives capable of inhibiting growth of bacteria, fungi, and yeasts.
  - 2. Color/Pattern: As selected by Architect from manufacturer's full range.
- C. Carpet Wall Covering: Manufacturer's standard nonwoven, needle-punched carpet with fibers fused to backing, from same dye lot, treated to resist stains.
  - 1. Color/Pattern: As selected by Architect from manufacturer's full range.
- D. Fabric Wall Covering: Manufacturer's standard fabric, from same dye lot, treated to resist stains.
  - 1. Color/Pattern: As selected by Architect from manufacturer's full range.
- E. High-Pressure Decorative Laminate: ISO 4586-3, Horizontal grade.
  - 1. Color/Pattern: As selected by Architect from manufacturer's full range.
- F. Wood Veneer: Laminated to fire-retardant-treated wood core with moisture-resistant adhesive.
  - 1. Species and Cut: As selected by Architect from manufacturer's full range.
  - 2. Matching of Adjacent Veneer Leaves: Book match.
  - 3. Veneer Matching within Panel Face: Running match.
  - 4. Panel-Matching Method: Select and arrange panels for similarity of grain pattern and color between adjacent panels.
  - 5. Vertical Panel-Matching Method: Continuous match; veneer leaves of upper panels are continuations of veneer leaves of lower panels.
  - 6. Wood-Veneer Finish:
    - a. As selected by Architect from manufacturer's full range, as follows:
      - 1) Type: Transparent finish over stain over wood variety indicated.
- G. Paint: Manufacturer's standard factory-painted finish.
  - 1. Color: As selected by Architect from manufacturer's full range.
- H. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:
  - 1. Steel, Painted: Finished with manufacturer's color as selected by Architect from manufacturer's full range.
  - 2. Aluminum: Finished with manufacturer's standard color anodic finish.
- I. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

## 2.6 SUSPENSION SYSTEMS

- A. Tracks: Steel or aluminum mounted directly to overhead structural support, designed for operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
  - 1. Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.
  - 2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.
- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
  - 1. Multidirectional Carriers: Capable of negotiating intersections without track switches.

- C. Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.
  - 1. Curve-and-Diverter Switches: Allow radius turns to divert panels to an auxiliary track.
  - 2. L Intersections: Allow panels to change 90 degrees in direction of travel.
  - 3. T Intersections: Allow panels to pass through or change 90 degrees to another direction of travel.
  - 4. X Intersections: Allow panels to pass through or change travel direction full circle in 90-degree increments, and allow one partition to cross track of another.
  - 5. Multidirectional Switches: Adjustable switch configuring track into L, T, or X intersections and allowing panels to be moved in all pass-through, 90-degree change, and cross-over travel direction combinations.
  - 6. Center carrier stop.
- D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.
- E. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

## 2.7 ELECTRIC OPERATORS

- A. Factory-assembled electric operation system of size and capacity recommended and provided by operable panel partition manufacturer for partition specified; with electric motor and factory-prewired motor controls, speed reducer, chain drive, control stations, control devices, and accessories required for operation. Include wiring from control stations to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
- B. Comply with NFPA 70.
- C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.
- D. Motor Electrical Characteristics:
  - 1. Horsepower: Manufacturer's standard.
  - 2. Volts: 115.
  - 3. Phase: Single phase.
  - 4. Hertz: 60.
- E. Control Stations: Two single-key-operated, constant-pressure control stations located remotely from each other on opposite sides and opposite ends of partition run. Wire in series to require simultaneous activation of both key stations to operate partition. Each three-position control station labeled "Open," "Close," and "Stop." Furnish two keys per station.
- F. Obstruction-Detection Devices: Equip each motorized operable panel partition with indicated automatic safety sensor that causes operator to immediately stop and reverse direction.
  - 1. Sensor Edge: Contact-pressure-sensitive safety edge along partition's leading edge.
  - 2. Sensor Mat: Electrically operated, contact-weight-sensitive safety mat in storage pocket area.
  - 3. Infrared Sensor System: Designed to detect an obstruction in partition's path and sound an audible alarm, without obstruction contacting partition.
- G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop operable panel partition at fully extended and fully stacked positions.
- H. Emergency Release Mechanism: Quick disconnect-release of electric-motor drive system, permitting manual operation in event of operating failure.
- I. Electric Interlock: Equip each motorized operable panel partition with electric interlocks at locations indicated, to prevent operation of operable panel partition under the following conditions:

1. On storage pocket door, to prevent operation if door is not in fully open position.
2. On partitions at location of convergence by another partition, to prevent operation if merging partitions are in place.

## 2.8 ACCESSORIES

- A. Pass Doors: Swinging door built into and matching panel materials, construction, acoustical qualities, fire rating, finish and thickness, complete with frames and operating hardware. Hinges finished to match other exposed hardware.
  1. Accessibility Standard: Fabricate doors to comply with applicable provisions in [the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
  2. Single Pass Door: 36 by 84 inches.
  3. Double Pass Door: 72 by 84 inches.
  4. Pass-Door Hardware: Equip pass door with the following:
    - a. Door Seals: Mechanically operated floor seal on panels containing pass doors.
    - b. Panic hardware.
    - c. Concealed door closer.
    - d. Door Viewer: Installed with view in direction of swing.
    - e. Exit Sign: Recessed, self-illuminated.
    - f. Latchset: Passage set.
    - g. Lock, Key Operated: Key-operated lock with cylinder, keyed to master key system, operable from both sides of door. Include two keys per lock.
    - h. Lock, Deadlock: Deadlock to receive cylinder, operable from both sides of door. See Section 08 71 00 "Door Hardware" for lock cylinder and keying requirements.
- B. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware and acoustical seals at soffit, floor, and jambs. Hinges in finish to match other exposed hardware.
  1. Manufacturer's standard method to secure storage pocket door in closed position.
  2. Rim Lock, Key Operated: Key-operated lock cylinder, keyed to master key system, to secure storage pocket door in closed position. Include two keys per lock.
  3. Rim Lock, Deadlock: Deadlock to receive cylinder, to secure storage pocket door in closed position. See Section 08 71 00 "Door Hardware" for lock cylinder and keying requirements.
- C. Windows: Manufacturer's standard.
  1. Glass: Safety glass as selected by Architect from manufacturer's full range.
  2. Safety Glass Standard for Partition Panels: Glass products complying with testing requirements in 16 CFR 1201, Category II, or in ANSI Z97.1, Class A.
  3. Safety Glass Standard for Pass Doors: Glass products complying with testing requirements in 16 CFR 1201, Category II.
- D. Work Surfaces: Quantities, placement, and size indicated.
  1. Surface: Porcelain steel marker/projection surface.
  2. Surface Color: As selected by Architect from manufacturer's full range.
  3. Size: As indicated on Drawings.
  4. Trim: Aluminum slip-on or snap-on trim with no visible screws or exposed joints and with corners mitered to a neat, hairline joint.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine flooring, floor levelness, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION OF OPERABLE PANEL PARTITIONS**

- A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.
- B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.
- C. Install panels in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.
- F. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals. Perform test and make adjustments before NIC testing.

### **3.3 FIELD QUALITY CONTROL**

- A. NIC Testing: Owner will engage a qualified testing agency to perform tests and inspections.
  - 1. Testing Extent: Testing agency is to randomly select one operable panel partition installation(s) for testing.
  - 2. Testing Methodology: Perform testing of installed operable panel partition for noise isolation in accordance with ASTM E336, determined by ASTM E413, and rated for not less than NIC indicated. Adjust and fit partitions to comply with NIC test method requirements.
- B. An partition installation will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.4 ADJUSTING**

- A. Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust pass doors and storage pocket doors to operate smoothly, without binding or warping.
- C. Verify that safety devices are properly functioning.

### **3.5 MAINTENANCE SERVICE**

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service is to include 12 months' full maintenance by manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operable-partition operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.

### **3.6 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION



**SECTION 10 26 00 - WALL AND DOOR PROTECTION****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Corner guards.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for steel angle corner guards and pipe guards.
  - 2. Section 05 73 00 "Decorative Metal Railings" for metal handrails without plastic bumpers.
  - 3. Section 06 40 23 "Interior Architectural Woodwork" for solid-wood handrails, bumper rails, chair rails, or corner moldings without plastic bumpers.
  - 4. Section 08 71 00 "Door Hardware" for protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For each type of wall and door protection showing locations and extent.
  - 1. Include plans, elevations, sections, and attachment details.
- C. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:
  - 1. Corner Guards: 12 inches long. Include example top caps.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: For each type of handrail.
- B. Material Certificates: For each type of exposed plastic material.
- C. Sample Warranty: For special warranty.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
  - 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, 48-inch- long units.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
  - a. Store corner-guard covers in a vertical position.

**1.7 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
    - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
  - 2. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 50 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

**2.3 CORNER GUARDS**

- A. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Floor Products Company, Inc.
    - b. Babcock-Davis.
    - c. Balco, Inc.
    - d. Boston Retail Products.
    - e. Construction Specialties, Inc.
    - f. Hiawatha, Inc; a division of the Activar Construction Products Group.
    - g. InPro Corporation (IPC).
    - h. JL Industries, Inc.; a division of the Activar Construction Products Group.
    - i. Korogard Wall Protection Systems; a division of RJF International Corporation.
    - j. Nystrom, Inc.
    - k. Pawling Corporation.
    - l. Tepromark International, Inc.

2. Material: Stainless-steel sheet, Type 304.
  - a. Thickness: Minimum 0.0500 inch.
  - b. Finish: Directional satin, No. 4.
3. Material: Extruded aluminum, minimum 0.0625 inch thick, with clear anodic finish.
4. Wing Size: Nominal 3/4 by 3/4 inches or 1 by 1 inches.
5. Corner Radius: 1/8 inch.
6. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

## 2.4 MATERIALS

- A. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- B. Adhesive: As recommended by protection product manufacturer and with a VOC content of 70 g/L or less.

## 2.5 FABRICATION

- A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

## 2.6 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
  1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

**3.3 INSTALLATION**

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
  - 1. Provide anchoring devices and suitable locations to withstand imposed loads.
  - 2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.

**3.4 CLEANING**

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

**SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Washroom, shower, and custodial accessories.
  - 2. Baby changing stations.
  - 3. Underlavatory guards.
- B. Related Requirements:
  - 1. Section 08 83 00 "Mirrors" for frameless mirrors.
  - 2. See Division 10, Toilet Compartments, for hooks on toilet partitions unless hooks are noted otherwise within this Section.
  - 3. Section 22 07 00 "Plumbing Insulation" for piping insulation used as underlavatory guards to prevent direct contact with and burns from piping.

**1.2 COORDINATION**

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 3. Include electrical characteristics.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated.
  - 2. Identify accessories using designations indicated.
- C. Delegated Design Submittals: For grab bars and shower seats.
  - 1. Include structural design calculations indicating compliance with specified structural-performance requirements.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Sample Warranty: For manufacturer's special warranties.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For accessories to include in maintenance manuals.

**1.6 WARRANTY**

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, visible silver spoilage defects.
  - 2. Warranty Period: Fifteen (15) years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Toilet-Compartment Occupancy-Indicator Systems: Manufacturer agrees to repair or replace toilet-compartment occupancy-indicator systems that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five (5) years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five (5) years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 OWNER-FURNISHED MATERIALS**

- A. Owner-Furnished Materials: To be Determined.

**2.2 MANUFACTURERS**

- A. Source Limitations: Obtain accessories from single source from single manufacturer.
  - 1. When Basis of Design product is listed below, provide comparable quality and aesthetically consistent product from the available manufacturers listed below.
- B. Washrooms, Showers, and Custodial Accessories Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AJW Architectural Products.
  - 2. American Specialties, Inc.
  - 3. Bobrick Washroom Equipment, Inc.
  - 4. Bradley Corporation.
  - 5. Brey-Krause Manufacturing Co.
  - 6. GAMCO Specialty Accessories; a division of Bobrick.
  - 7. InPro Corporation
  - 8. Seachrome Corporation.
  - 9. Tubular Specialties Manufacturing, Inc.
  - 10. Sloan Valve Company
- C. Baby Changing Station Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Specialties, Inc.
  - 2. Diaper Deck & Company, Inc.
  - 3. Foundations Children's Products.
  - 4. GAMCO Specialty Accessories; a division of Bobrick.
  - 5. Global Industrial.
  - 6. Koala Kare Products.
  - 7. SafeStrap Company, Inc. (SSC, Inc.).
  - 8. Tubular Specialties Manufacturing, Inc.
- D. Under Lavatory Guard Manufacturers: Subject to compliance with requirements, provide products by one of the following
  - 1. Plumberex Specialty Products, Inc.
  - 2. Truebro by IPS Corporation.

**2.3 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:
  - 1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
  - 2. Shower Seats: Installed units are able to resist 360 lbf concentrated load applied in any direction and at any point.

**2.4 WASHROOM, SHOWERS, AND CUSTODIAL ACCESSORIES**

- A. Source Limitations: Obtain accessories from single source from single manufacturer.
- B. Not all numbers are used.
- C. TA01 to TA08 Paper Towel Dispensers and Waste Receptacles
  - TA01 Recessed Paper Towel (Folded) Dispenser:
    - 1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-359 ClassicSeries.
    - 2. Mounting: Recessed.
    - 3. Minimum Capacity: 300 C-fold or 475 multifold towels.
    - 4. Material and Finish: Stainless steel, No. 4 finish (satin).
    - 5. Lockset: Tumbler type.
  - TA02 Surface Mounted Paper Towel (Folded) Dispenser:
    - 1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-262 ClassicSeries.
    - 2. Mounting: Surface mounted.
    - 3. Minimum Capacity: 400 C-fold or 525 multifold towels.
    - 4. Material and Finish: Stainless steel, No. 4 finish (satin).
    - 5. Lockset: Tumbler type.
    - 6. Refill Indicators: Pierced slots at sides.
  - TA03 Recessed Combination Paper Towel (Folded) Dispenser:
    - 1. Basis-of-Design Product: Bradley Corp.; Elvari, 2B5.
    - 2. Mounting: Surface mounted.
    - 3. Minimum Capacity: 800 C-fold.
    - 4. Material and Finish: Brushed Brass (BR).
    - 5. Lockset: Bradlock, magnetic key system.
  - TA04 Recessed Combination Paper Towel (Folded) Dispenser:
    - 1. Basis-of-Design Product: Bradley Corp.; Elvari, 2B5.
    - 2. Mounting: Surface mounted.
    - 3. Minimum Capacity: 800 C-fold.
    - 4. Material and Finish: Stainless steel, Brushed Black (BB).
    - 5. Lockset: Bradlock, magnetic key system.
  - TA05 Recessed Combination Towel (Folded) Dispenser:
    - 1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-3944 ClassicSeries.
    - 2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
    - 3. Mounting: Recessed with projecting receptacle.
      - a. Designed for nominal 4-inch wall depth.
    - 4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
    - 5. Minimum Waste-Receptacle Capacity: 12 gal.
    - 6. Material and Finish: Stainless steel, No. 4 finish (satin).
    - 7. Liner: Reusable, vinyl waste-receptacle liner.
    - 8. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.

TA06 Not Used

TA07 Semi-Recessed Waste Receptacle:

1. Basis-of-Design Product: Bradley Corp.; Elvari, 3B1-10.
2. Mounting: Semi-recessed.
3. Minimum Capacity: 12 gal.
4. Material and Finish: Stainless steel, Brushed Brass (BR).
5. Liner: Reusable vinyl liner.
6. Lockset: Tumbler type for waste-receptacle.

D. TA20 to TA23 Toilet Tissue Dispensers

TA20 Multi-Roll Toilet Tissue Dispenser:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-2888 ClassicSeries.
2. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.
3. Mounting: Surface mounted.
4. Operation: Noncontrol delivery with heavy duty, theft-resistant spindle.
5. Capacity: Designed for up to 5-1/4-inch-diameter tissue rolls.
6. Material and Finish: Stainless steel, No. 4 finish (satin).
7. Lockset: Tumbler type.

TA21 Recessed Multi-Roll Toilet Tissue Dispenser:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-3888 ClassicSeries.
2. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.
3. Mounting: Recessed.
4. Operation: Noncontrol delivery with heavy duty, theft-resistant spindle.
5. Capacity: Designed for up to 5-1/4-inch-diameter tissue rolls.
6. Material and Finish: Stainless steel, No. 4 finish (satin).
7. Lockset: Tumbler type.

TA22 Surface Mounted Double Roll Toilet Tissue Holder:

1. Basis-of-Design Product: Kohler; K-78384.
2. Mounting: Surface mounted.
3. Capacity: Designed for 5-1/8 inch-diameter tissue rolls (two rolls).
4. Material and Finish: Stainless steel, Vibrant Brushed Moderne Brass.

TA23 Surface Mounted Double Roll Toilet Tissue Holder:

1. Basis-of-Design Product: Kohler; K-78384.
2. Mounting: Surface mounted.
3. Capacity: Designed for up to 5-1/8 inch-diameter tissue rolls (two rolls).
4. Material and Finish: Stainless steel, Matte Black.

E. TA26 to TA32 Seat Cover Dispensers; Napkin/Tampon Vendors and Disposal Units; and Tissue Dispensers

TA26 Surface Mounted Toilet Seat-Cover Dispenser:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-221 ClassicSeries.
2. Mounting: Surface Mounted.
3. Minimum Capacity: 500 seat covers.
4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
5. Lockset: N/A

TA27 Recessed Toilet Seat-Cover Dispenser:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-301 ClassicSeries.
2. Mounting: Recessed.
3. Minimum Capacity: 500 seat covers.
4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
5. Lockset: Tumbler type.

TA28 Recessed Toilet Seat-Cover Dispenser:

1. Basis-of-Design Product: Bradley Corp.; Elvari, 5B-0-36.



2. Mounting: Recessed.
3. Capacity: 500 seat covers.
4. Exposed Material and Finish: Stainless steel, Brushed Brass (BR).
5. Lockset: BradLock, magnetic key system.

TA29 Recessed Toilet Seat-Cover Dispenser

1. Basis-of-Design Product: Bradley Corp.; Elvari, 5B-0-36.
2. Mounting: Recessed.
3. Capacity: 500 seat covers.
4. Exposed Material and Finish: Stainless steel, Brushed Black (BB).
5. Lockset: BradLock, magnetic key system.

TA30 Partition Mounted Sanitary-Napkin Disposal Unit:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-354 ClassicSeries.
2. Mounting: Partition mounted, dual access.
3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

TA31 Surface Mounted Sanitary-Napkin Disposal Unit:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-254 ClassicSeries.
2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

TA32 Surface Mounted Sanitary-Napkin Disposal Unit:

1. Basis-of-Design Product: Bradley Corp.; Elvari, 4B2-11.
2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, Brushed Brass (BR).

F. TA39 to TA49 Grab Bars

TA39 Grab Bars:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-6806 Series.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, No. 4 finish (satin).
4. Outside Diameter: 1-1/2 inches.
5. Configuration and Length: As indicated on Drawings.

TA40 Grab Bar, Shower:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-6806 Series.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
4. Outside Diameter: 1-1/2 inches.
5. Configuration and Length:
  - a. Horizontal: 2-wall right angle for shower stall; 19-3/4 by 34-3/4 inches overall. (B-6861).
  - b. Vertical: 18 inches tall. (B-6806x18).

TA41 Grab Bars (18 inches):

1. Basis-of-Design Product: Bradley Corp.; Elvari 8B1 Series.
2. Mounting: Flanges with concealed fasteners.

3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, No. 4 finish (satin).
4. Outside Diameter: 1-1/2 inches.
5. Configuration: As indicated on Drawings.
6. Length: 18 inches.

## TA42 Grab Bars (42 inches):

7. Basis-of-Design Product: Bradley Corp.; Elvari 8B1 Series.
8. Mounting: Flanges with concealed fasteners.
9. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, No. 4 finish (satin).
10. Outside Diameter: 1-1/2 inches.
11. Configuration: As indicated on Drawings.
12. Length: 42 inches.

## TA43 Grab Bars (48 inches):

1. Basis-of-Design Product: Bradley Corp.; Elvari 8B1 Series.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, No. 4 finish (satin).
4. Outside Diameter: 1-1/2 inches.
5. Configuration: As indicated on Drawings.
6. Length: 48 inches.

## TA44 Grab Bars (18 inches):

1. Basis-of-Design Product: Bradley Corp.; Elvari 8B1 Series.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, Brushed Brass (BR).
4. Outside Diameter: Oval, 1-9/16 x 1-3/64 inches.
5. Configuration: As indicated on Drawings.
6. Length: 18 inches.

## TA45 Grab Bars (42 inches):

1. Basis-of-Design Product: Bradley Corp.; Elvari 8B1 Series.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, Brushed Brass (BR).
4. Outside Diameter: Oval, 1-9/16 x 1-3/64 inches.
5. Configuration: As indicated on Drawings.
6. Length: 42 inches.

## TA46 Grab Bars (48 inches):

1. Basis-of-Design Product: Bradley Corp.; Elvari 8B1 Series.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, Brushed Brass (BR).
4. Outside Diameter: Oval, 1-9/16 x 1-3/64 inches.
5. Configuration: As indicated on Drawings.
6. Length: 48 inches.

## TA47 Grab Bars (18 inches):

1. Basis-of-Design Product: Bradley Corp.; Elvari 8B1 Series.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, Brushed Black (BB).
4. Outside Diameter: Oval, 1-9/16 x 1-3/64 inches.
5. Configuration: As indicated on Drawings.
6. Length: 18 inches.

## TA48 Grab Bars (42 inches):

1. Basis-of-Design Product: Bradley Corp.; Elvari 8B1 Series.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, Brushed Black (BB).
4. Outside Diameter: Oval, 1-9/16 x 1-3/64 inches.
5. Configuration: As indicated on Drawings.
6. Length: 42 inches.

## TA49 Grab Bars (48 inches):

1. Basis-of-Design Product: Bradley Corp.; Elvari 8B1 Series.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, Brushed Black (BB).
4. Outside Diameter: Oval, 1-9/16 x 1-3/64 inches.
5. Configuration: As indicated on Drawings.
6. Length: 48 inches.

## A. TA50 to TA56 Soap Dispensers and Dishes

## TA50 Wall Mounted Liquid-Soap Dispenser:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-42 ClassicSeries.
2. Description: Designed for dispensing soap in liquid or lotion form.
3. Mounting: Vertically oriented, surface mounted.
4. Capacity: 40 oz.
5. Material and Finish: Stainless steel, No. 4 finish (satin).
6. Lockset: Hinged lid with special key.
7. Refill Indicator: Window type.

## TA51 Counter Mounted Liquid-Soap Dispenser:

1. Basis-of-Design Product: Bradley Corp.; Metro Series, Verge Soap Dispenser 6-3300.
2. Description: Designed for dispensing soap in liquid or lotion form.
3. Mounting: Deck mounted on lavatory.
4. Capacity: 70.5 oz.
5. Material and Finish: Stainless steel, Brushed Stainless (BS).
6. Lockset: Hinged lid with special key.
7. Refill Indicator: Translucent glow ring at base to indicate low battery or low soap.

## TA52 Counter Mounted Liquid-Soap Dispenser:

1. Basis-of-Design Product: Bradley Corp.; Metro Series, Verge Soap Dispenser 6-3300.
2. Description: Designed for dispensing soap in liquid or lotion form.
3. Mounting: Deck mounted on lavatory.
4. Capacity: 70.5 oz.
5. Materials: Stainless steel, Brushed Brass (BR).
6. Refill Indicator: Translucent glow ring at base to indicate low battery or low soap

## TA53 Counter Mounted Liquid-Soap Dispenser:

1. Basis-of-Design Product: Bradley Corp.; Metro Series, Verge Soap Dispenser 6-3300.
2. Description: Designed for dispensing soap in liquid or lotion form.
3. Mounting: Deck mounted on lavatory.
4. Capacity: 70.5 oz.
5. Material Stainless steel, Brushed Black (BB).
6. Refill Indicator: Translucent glow ring at base to indicate low battery or low soap.

## TA54 Surface Mounted Soap Dish:

1. Basis-of-Design Product: GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc. 76807.
2. Description: Without washcloth bar.

3. Mounting: Surface mounted.
4. Material and Finish: Stainless steel, No. 4 finish (satin).

TA55 Counter Mounted Liquid-Soap Dispenser:

1. Basis-of-Design Product: Kohler; Components K-28293.
2. Description: Designed for dispensing soap in liquid or lotion form.
3. Mounting: Deck mounted on lavatory.
4. Capacity: 16 oz.
5. Material Stainless steel, Vibrant Brushed Moderne Brass.

TA56 Counter Mounted Liquid-Soap Dispenser:

6. Basis-of-Design Product: Kohler; Components K-35761.
7. Description: Designed for dispensing soap in liquid or lotion form.
8. Mounting: Deck mounted on lavatory.
9. Capacity: 16 oz.
10. Material Stainless steel, Matte Black.

B. TA61 to TA63 Changing Stations

TA61 Surface Mounted Stainless Steel Changing Station, Horizontal:

1. Basis-of-Design Product: Koala Kare Products KB310-SSWM.
2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
  - a. Engineered to support a minimum of 100-lb static load when opened.
3. Mounting: Surface Mounted.
4. Operation: By pneumatic shock-absorbing mechanism.
5. Material and Finish: Stainless steel, No. 4 finish (satin), exterior shell with rounded plastic corners; HDPE interior in manufacturer's standard color.
6. Liner Dispenser: Built in.

TA62 Recessed Stainless Steel Changing Station, Horizontal:

1. Basis-of-Design Product: Koala Kare Products KB310 SSRE.
2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
3. Engineered to support a minimum of 200-lb static load when opened.
4. Mounting: Recessed, with unit projecting not more than 1 inch from wall when closed.
5. Operation: By pneumatic shock-absorbing mechanism.
6. Material and Finish: Stainless steel, No. 4 finish (satin), exterior shell with rounded plastic corners; HDPE interior in manufacturer's standard color.
7. Liner Dispenser: Built in.

TA63 Surface Mounted Adjustable Height Changing Station, Horizontal:

1. Basis-of-Design Product: Koala Kare Products KB3000-AHL.
2. Description: Horizontal unit that opens by folding down from stored position with electronically height adjustable surface with integral controls.
  - a. Engineered to support up to 500-lb static load when opened.
3. Mounting: Surface Mounted
4. Operation: By pneumatic shock-absorbing mechanism and electronically controlled height.
5. Material and Finish: White UHMW PE sheet bed surface, with stainless steel retaining bars. Powder coated 2 inch square steel tube changing surface frame, Stainless steel wall unit covering, with 6 mm thick plastic cover hinge mechanism.

C. TA70 to TA77 Mirrors

TA70 and TA71 Glass Mirror with Stainless Steel Angle Frame:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-290 Series.
2. Frame: Stainless-steel angle, 0.05 inch thick, beveled inside edge.
  - a. Corners: Welded and ground smooth.

3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
  - a. Manufacturer's screw locking design wall bracket.
4. Size:
  - a. TA70: 18 by 36 inches.
  - b. TA71: 24 by 72 inches.

## TA72 Metal Framed Mirror (No Shelf):

1. Basis-of-Design Product: Bradley Corp.; Elvari 7B1.
2. Frame: Brushed Stainless (BS)
3. Size: 24 by 36 inches.

## TA73 Metal Framed Mirror (No Shelf):

1. Basis-of-Design Product: Bradley Corp.; Elvari 7B1.
2. Frame: Brushed Brass (BR)
3. Size: 24 by 36 inches.

## TA74 Metal Framed Mirror (No Shelf):

1. Basis-of-Design Product: Bradley Corp.; Elvari 7B1.
2. Frame: Brushed Black (BB)
3. Size: 24 by 36 inches.

## TA75 Metal Framed Mirror:

1. Basis-of-Design Product: Rejuvenation, Capsule Metal Framed Mirror.
2. Frame: Aged Brass
3. Size: 24 by 36 inches.

## TA76 Metal Framed Mirror:

1. Basis-of-Design Product: Rejuvenation, Capsule Metal Framed Mirror.
2. Frame: Oil Rubbed Bronze
3. Size: 24 by 36 inches.

## TA77 Metal Framed Mirror:

1. Basis-of-Design Product: Kohler, Capsule Framed Mirror, K-26051.
2. Frame: Moderne Brushed Gold
3. Size: 24 by 40 inches.

## D. TA78 to TA79 Shelves

## TA78 Stainless Steel Shelf:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-295 x 16.
2. Description: With exposed edges turned down not less than 3/4 inch and supported by two triangular brackets welded to shelf underside.
3. Size: 16 inches long by 5 inches deep.
4. Material and Finish: Not less than nominal 0.05-inch-thick stainless steel, No. 4 finish (satin).

## TA79 Stainless Steel Shelf:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-298 x 18.
2. Description: With exposed edges turned down not less than 1/2 inch and supported by two triangular brackets welded to shelf underside.
3. Size: 18 inches long by 8 inches deep.
4. Material and Finish: Not less than nominal 0.05-inch-thick stainless steel, No. 4 finish (satin).

## E. TA80 to TA87 Hooks, Mop Holder, Laundry Pass Through, and Shower Accessories

## TA80 Towel Pin:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-6777.
2. Description: Projecting minimum of 3 inches from wall surface.
3. Mounting: Unit secured to concealed wall plate with setscrews.

4. Material and Finish: Stainless steel, No. 4 finish (satin).

TA81 Utility Hook (At family toilets and back-of-house showers):

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-6827.
2. Description: Single-prong unit.
3. Mounting: Unit secured to concealed wall plate with setscrews.
4. Material and Finish: Stainless steel, No. 4 finish (satin).

TA82 Mop and Broom Holder:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-223 x 36.
2. Length: 36 inches.
3. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
4. Material and Finish: Stainless steel, No. 4 finish (satin).

TA83 Laundry Pass-Through Unit:

1. Custom fabricated through-wall angle frame with top hinged inward acting gravity-return door.
2. Interior Size: 12 inches by 12 inches.
3. Configuration: Unit placed within wall opening with full-depth sleeves and 2 inch wide angle returns on both sides of wall. Provide 6 inch long by 12 inch wide "laundry deflector" along bottom of opening.
4. Material: Minimum 0.0475-inch thick stainless steel, No. 4 finish (satin).

TA84 Folding Shower Seat:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-517 (Right-Hand) and B-518 (Left-Hand).
2. Configuration: Rectangular shaped seat, designed for wheelchair access.
3. Seat: Matte finish melamine on phenolic core.
4. Mounting Mechanism: Stainless steel, No. 4 finish (satin).
5. Dimensions: Size varies per plan configuration.

TA85 Shower Curtain Rod:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-6047 ClassicSeries.
2. Description: 1-1/4-inch OD; fabricated from nominal 0.05-inch-thick stainless steel.
3. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
4. Finish: No. 4 (satin).
5. Length: As indicated on Drawings.

TA86 Shower Curtain and Hooks:

1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-204 Series.
2. Size: Minimum 12 inches wider than opening by 72 inches high.
3. Material: Vinyl, minimum 0.008 inch thick, opaque, matte, with integral antibacterial and flame retardant agents.
4. Color: White.
5. Grommets: Corrosion resistant at minimum 6 inches o.c. through top hem.
6. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

TA87 Robe Hook:

1. Basis-of-Design Product: Kohler; Purist K-14443
2. Description: 1-3/8 inch OD; Solid Brass Construction.
3. Mounting Flanges: Unit secure to concealed wall plate with setscrews.
4. Material and Finish: Solid Brass Construction, Matte Black Finish.

TA87 Robe Hook:

1. Basis-of-Design Product: Kohler; Purist K-14443
2. Description: 1-3/8 inch OD; Solid Brass Construction.
3. Mounting Flanges: Unit secure to concealed wall plate with setscrews.
4. Material and Finish: Solid Brass Construction, Moderne Brushed Gold.

**2.5 UNDERLAVATORY GUARDS**

- A. Underlavatory Guard:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. Plumberex Specialty Products, Inc.
    - b. Truebro by IPS Corporation.
  - 2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
  - 3. Material and Finish: Antimicrobial, molded plastic, white.

**2.6 MATERIALS**

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch-minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- D. Fasteners: Screws, bolts, and other devices of same material as accessory unit, , and tamper and theft resistant where exposed, and of galvanized steel where concealed.
- E. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- F. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- G. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

**2.7 FABRICATION**

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Coordinate cutouts in reinforced CMU walls to avoid structural grouted cells. Relocate unit as necessary. Verify required relocation with Architect.
- C. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.
- D. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.
- E. Shower Seats: Install to comply with specified structural-performance requirements.

**3.2 ADJUSTING AND CLEANING**

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION



**SECTION 10 28 19 - TUB AND SHOWER ENCLOSURES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Framed shower doors and enclosures.
  - 2. Frameless shower doors and enclosures.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for shower doors and enclosures.
- B. Shop Drawings: For tub and shower doors and enclosures.
  - 1. Include plans, elevations, sections, and attachment details.
- C. Samples for Initial Selection: For each type of exposed finish.
- D. Samples for Verification: For tub and shower doors and enclosures.
  - 1. Each type of mounting and operating hardware; full size.
  - 2. Glass and glazing; 12 inches square.
  - 3. Trim; 12-inch lengths.
- E. Product Schedule: For tub and shower doors and enclosures. Use same designations indicated on Drawings.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Sample Warranty: For manufacturer's special warranty.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For tub and shower doors and enclosures to include in maintenance manuals.

**1.5 QUALITY ASSURANCE**

- A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
  - 1. Build mockup of tub and shower doors and enclosure as shown on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.6 FIELD CONDITIONS**

- A. Verify dimensions by field measurements before fabrication and indicate on Shop Drawings.

**1.7 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of tub and shower doors and enclosures that fail in materials or workmanship within specified warranty period, without monetary limitation.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including excessive deflection.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Period: Three years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 FRAMED ENCLOSURES**

- A. Glass panels with full perimeter frames of extruded aluminum with screw-fastened corners. Minimum 3/8-inch penetration of glass into frame. Framing members of thickness required to support imposed loads.
- B. Frames, Hardware, and Trim: Manufacturer's standard units as indicated and as required for a complete installation.
  - 1. Materials: Aluminum; ASTM B 221.
  - 2. Finish: As indicated on Drawings.
  - 3. Color: As indicated on Drawings.
- C. Bypassing Doors: Sliding units suspended from top track by fully adjustable ball-bearing rollers. Self-draining sill tracks with nylon panel guides. Molded jamb bumpers with concealed fasteners.
  - 1. Door Pulls: Full-door-width, single-sided towel bars.
- D. Swinging Doors: Full-height piano hinge. Manufacturer's standard pulls and latch.
- E. Glazing:
  - 1. Clear fully tempered. Comply with requirements in Section 08 80 00 "Glazing."
  - 2. Safety glazing materials complying with 16 CFR 1201, Category II, with permanently etched identification acceptable to authorities having jurisdiction.
    - a. Glass Nominal Thickness: 6 mm.
    - b. Clear Glass: ASTM C 1048, Type I, Quality-Q3, Class I (clear), Kind FT.
    - c. Protective, Self-Cleaning, Glass Coating: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.
- F. Fasteners: Manufacturer's standard stainless steel or other noncorrosive fasteners.
- G. Sealant: Mildew-resistant, single-component, nonsag, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

**2.2 FRAMELESS ENCLOSURES**

- A. Frameless glass panels with mounting and operating hardware of types and sizes required to support imposed loads.
- B. Hardware and Trim: Manufacturer's standard units as indicated and as required for complete installation.
  - 1. Materials:
    - a. Aluminum:
      - 1) Finish: Baked enamel or powder coat.
      - 2) Color: As selected by Architect.
    - b. Brass:
      - 1) Finish: As selected by Architect.

- c. Stainless Steel Sheet and Plate:
  - 1) Finish: As selected by Architect.
- d. Stainless Steel Tubing:
  - 1) Finish: As selected by Architect.
    - a) Polished and Buffed Finish: Buff to match Architect's sample.
- C. Bypass Doors: Sliding units suspended from extruded-aluminum header track by fully adjustable, sealed, heavy-duty ball-bearing rollers. Self-draining sill tracks with nylon panel guides. Molded jamb bumpers with concealed fasteners.
  - 1. Door Pulls: Full-door-width, single-sided towel bars.
  - 2. Safety Clip System: Manufacturer's standard safety device designed to prevent doors from falling off sliding track.
- D. Sliding Door and Fixed In-Line Panel: Sliding unit with exposed, adjustable, heavy-duty rollers operating above full-span header bar. Door bottom guide, antilift fittings, stoppers, and mounts for fixed panel and header bar.
  - 1. Door Pulls: Back-to-back, D-pull.
  - 2. Sill Strip: Manufacturer's standard sill strip designed to direct dripping water back into the enclosure.
- E. Swinging Doors: Hinged for 90 degrees outwards swing, self-closing. Soft bulb seal or wipes; affixed to door to direct water back into enclosure and provide a tight water seal.
  - 1. Hinges: Full-height piano.
  - 2. Door Pulls: Back-to-back.
    - a. Towel Bar Length: 24 inches.
- F. Fixed Panels: Sidemounts; match hinges in material and finish.
- G. Ventilating Transom: Rotating clamps centered on transom.
- H. Glazing:
  - 1. Clear fully tempered. Comply with requirements in Section 08 80 00 "Glazing."
  - 2. Safety glazing materials complying with 16 CFR 1201, Category II, with permanently etched identification acceptable to authorities having jurisdiction.
    - a. Glass Nominal Thickness: As determined by manufacturer based on panel size.
    - b. Clear Glass: ASTM C 1048, Type I, Quality-Q3, Class I (clear), Kind FT.
      - 1) Obscured Panels: Acid etched.
    - c. Tinted Glass: ASTM C 1048, Type I, Quality-Q3, Class II, Kind FT.
      - 1) Color: Bronze.
    - d. Patterned Glass: ASTM C 1048, Kind FT (fully tempered), Type II, Class 1 (clear), Form 3; Quality-Q6, Finish F1 (patterned, one side).
      - 1) Pattern: Manufacturer's standard.
    - e. Protective, Self-Cleaning, Glass Coating: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.
- I. Fasteners: Manufacturer's standard stainless steel or other noncorrosive fasteners.
- J. Sealant: Mildew-resistant, single-component, nonsag, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
- K. Materials:
  - 1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    - a. Sheet and Plate: ASTM B 209.
    - b. Extrusions: ASTM B 221.
  - 2. Stainless Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 302 or 304.
  - 3. Stainless Steel Bars and Shapes: ASTM A 276/A 276M, Type 302 or 304.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Prepare and install per manufacturer's written instructions unless more stringent requirements are contained in NGA's "GANA Glazing Manual."
- B. Clean substrates, removing projections, filling voids, and sealing joints.
- C. Set units level, plumb, and true to line, without warp or rack of frames and panels, and anchor securely in place.
- D. Fasten components securely in place, with provisions for thermal movement. Install with concealed fasteners unless otherwise indicated.
- E. Install components to drain and return water to tub or shower.
- F. Install doors to produce smooth operation and tight fit at contact points.
- G. Repair, refinish, or replace components damaged during installation.

**3.2 ADJUSTING AND CLEANING**

- A. Adjust operating parts and hardware for smooth, quiet operation and watertight closure. Lubricate hardware and moving parts.
- B. Remove nonpermanent labels, and clean surfaces immediately after installation.

END OF SECTION

**SECTION 10 35 00 - FLAGPOLES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Related work specified elsewhere includes:
  - 1. Section 033100 - "Concrete"

**1.2 SUMMARY**

- A. Extent and location of each type of flagpole is shown on drawings; Two (2) required.
- B. Work under this Section includes ground set flagpole, base, lightning protection and ground, fittings, accessories, concrete footing, and all other items necessary or required for a complete and properly functioning installation.

**1.3 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical data accessories, finishes and installation instructions for each type of flagpole required.

**1.4 QUALITY ASSURANCE**

- A. Manufacturing Standards: Provide each flagpole as a complete unit produced by a single manufacturer, including fittings accessories, bases and anchorage devices.
- B. Design Criteria: Provide flagpoles and installations constructed to withstand a **140-mph** wind velocity minimum when flying one flag of appropriate size. Use heavy pipe sizes if required for flagpole type and height shown.
- C. Pole Construction: Construct pole and ship to site in one piece if possible. If more than one piece is necessary, provide snug- fitting, precision joints with self-aligning, internal splicing sleeve arrangement for weather-tight, hairline field joints.

**1.5 DELIVERY, STORAGE AND HANDLING**

- A. Spiral wrap flagpoles with heavy Kraft paper or other protective wrapping and prepare for shipment in hard fiber tube or other protective container.
- B. Deliver flagpoles and accessories completely identified for installation procedure. Handle and store flagpoles to prevent damage or soiling.

**PART 2 - PRODUCTS****2.1 ACCEPTABLE MANUFACTURERS**

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
  - 1. Aabec Pole Div., Morgan-Francis Div., ICC Mfg., Inc.
  - 2. Acme Flagpole Div., Lingo Inc.
  - 3. American Flagpole, Div. of Kearney-National, Inc.
  - 5. Concord Industries, Inc.
  - 6. Eder Flag Manufacturing Co.

7. Morgan and Co.

## 2.2 FLAGPOLE TYPE

- A. Aluminum Flagpoles: Fabricate aluminum flagpoles from seamless extruded tubing complying with ASTM B 241, alloy 6063-T6, having a minimum wall thickness indicated, tensile strength not less than 35,000 psi and a yield point of 30,000 psi. Heat-treat and age-harden flagpoles after fabrication.
1. Provide cone tapered aluminum flagpoles; For flying one flag.
  2. Exposed Height/Quantity: Two (2) each at 30'-0" finished / exposed height.
  3. Manufacturer - Basis of Design: American Flagpole, Abingdon, VA; Phone: 1-800-368-7171 or (540) 628-4188, or equivalent by another manufacturer named above. Provide complete with all standard and specified accessories.

<b>30' HEIGHT</b>
Catalog number: <b>ESR30D52-AA</b>
Exposed height: 30 ft.
Butt diameter: 5 in.
Wall thickness: 0.188 in.
Set depth: 3 ft.
Total length: 33 ft.
Taper: 11'-0"
Top diameter: 3"
Wind speed: 110 mph
Flag size: US Flag, 5' x 8'
Standard Finish:
Satin, 80 Grit, Clear Anodized

## 2.3 FLAGPOLE MOUNTING

- A. Provide manufacturer's standard base system for the type of flagpole installation required.
1. Foundation Tube: For ground-set flagpoles, provide 16 gage minimum galvanized corrugated steel tube, or 12 gage minimum rolled steel tube, sized to suit flagpole and installation. Furnish complete with welded steel bottom base and support plate, lighting ground spike, and steel centering wedges, all welded construction. Provide loose hardwood wedges at top for plumbing pole after erection. Galvanize steel parts after assembly, including foundation tube.
    - a. Provide manufacturer's standard flash collar, finished to match flagpole.

## 2.4 SHAFT FINISH

- A. Aluminum: Fine, directional, mechanical SATIN polish (NAAMM-32), finished as follows:
1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, or thicker.

## 2.5 FITTINGS

- A. Finial Ball: Manufacturer's standard flush seam ball, size as indicated or, if not indicated, to match pole butt diameter.
1. Spun aluminum, with Class I gold anodized finish.
- B. Truck: Ball-bearing non-fouling, revolving, double-track assembly of cast metal, finished to match pole shaft.
- C. Cleats: One 9" cast aluminum cleats with stainless steel fasteners, finished to match pole shaft.
- D. Halyards: Provide one continuous halyard for each flagpole, as follows:
1. Nylon, braided, with metal core; Size: 3/8" (No. 12).
- E. Halyard Flag Snaps: Provide 2 swivel snaps per halyard; Chromium-plated bronze.

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Excavation: Excavate for foundation concrete to neat clean lines in undisturbed soil. Provide forms where required due to unstable soil conditions. Remove wood, loose soil, rubbish and other foreign matter from excavation, and moisten earth before placing concrete.
- B. Concrete: Refer to Section 033100 - "Concrete," for 3,000 psi concrete and related requirements.
  - 1. Place concrete immediately after mixing. Perform chuting to avoid segregation of mix. Compact concrete in place by use of vibrators to consolidate. Moist-cure exposed concrete for not less than 7 days, or use a non-staining curing compound in freezing weather.
  - 2. Finish trowel exposed concrete surfaces to smooth, dense surface. Provide positive slope for water runoff to base perimeter.
- C. Flagpole Installation: Install flagpoles as shown and in compliance with final shop drawings and manufacturer's current written instructions and recommendations.
  - 1. Provide positive lightning ground for each flagpole installation.
    - a. Paint portions of ground-set flagpole below grade with a heavy coat of bituminous paint, and allow to properly dry and cure, prior to setting in place and pouring concrete base.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 10 43 13 - DEFIBRILLATOR CABINETS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes defibrillator cabinets.
- B. Related Requirements:
  - 1. Section 10 43 14 "Automated External Defibrillators" for AEDs.

**1.2 PREINSTALLATION CONFERENCE**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to defibrillator cabinets including, but not limited to, the following:
    - a. Schedules and coordination requirements.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
- B. Shop Drawings: For defibrillator cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Product Schedule: For defibrillator cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final defibrillator cabinet schedule with defibrillator schedule to ensure proper fit and function. Use same designations indicated on Drawings.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For defibrillator cabinets to include in maintenance manuals.

**1.5 COORDINATION**

- A. Coordinate size of defibrillator cabinets to ensure that type and capacity of automated external defibrillators indicated are accommodated.
- B. Coordinate sizes and locations of defibrillator cabinets with wall depths.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Rated Defibrillator Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

**2.2 DEFIBRILLATOR CABINET**

- A. Cabinet Type: Suitable for automated external defibrillators.

1. Products: Subject to compliance with requirements, provide products by one of the following:
  - a. JL Industries, Inc.; a division of the Activar Construction Products Group.
  - b. Modern Metal Products, Division of Technico Inc.
- B. Cabinet Construction: Nonrated and fire rated for fire-resistance rating of walls where they are installed.
  1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-thick cold-rolled steel sheet lined with minimum 5/8-inch-thick fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Cold-rolled steel sheet.
- D. Semi-recessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
  1. Square-Edge Trim: 1-1/2-inch backbend depth.
- E. Cabinet Trim Material: Stainless-steel sheet.
- F. Door Material: Stainless-steel sheet.
- G. Door Style: Fully glazed panel with frame.
- H. Door Glazing: Acrylic sheet.
  1. Acrylic Sheet Color: Clear transparent acrylic sheet.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
  1. Provide projecting door pull and friction latch.
  2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Accessories:
  1. Identification: Lettering and graphic complying with authorities having jurisdiction.
    - a. Identify defibrillator cabinet with words and graphic applied to cabinet glazing.
  2. Alarm Contacts: Manufacturer's standard contact device for connecting to building security system that actuates when defibrillator cabinet door is opened.
- K. Materials:
  1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
    - a. Finish: Baked enamel or powder coat.
    - b. Color: Manufacturers standard white.
  2. Stainless Steel: ASTM A 666, Type 304.
    - a. Finish: No. 4 directional satin finish.
  3. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 6 mm thick, with Finish 1 (smooth or polished).

### 2.3 FABRICATION

- A. Defibrillator Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
  1. Weld joints and grind smooth.
  2. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
  1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
  2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

**2.4 GENERAL FINISH REQUIREMENTS**

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of defibrillator cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish defibrillator cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Prepare recesses for semi-recessed defibrillator cabinets as required by type and size of cabinet and trim style.

**3.3 INSTALLATION**

- A. General: Install defibrillator cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- B. Defibrillator Cabinets: Fasten cabinets to structure, square and plumb.
  - 1. Fasten mounting brackets to inside surface of defibrillator cabinets, square and plumb.
- C. Identification: Apply decals at locations indicated.

**3.4 ADJUSTING AND CLEANING**

- A. Remove temporary protective coverings and strippable films, if any, as defibrillator cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust defibrillator cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of defibrillator cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace defibrillator cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by defibrillator cabinet and mounting bracket manufacturers.
- E. Replace defibrillator cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 10 43 14 - AUTOMATED EXTERNAL DEFIBRILLATORS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes automated external defibrillators (AEDs).
- B. Related Requirements:
  - 1. Section 10 43 13 "Defibrillator Cabinets" for cabinets housing AEDs.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**1.3 CLOSEOUT SUBMITTALS**

- A. Operation and maintenance data.

**1.4 WARRANTY**

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of AEDs that fail in materials or workmanship within specified warranty period.
  - 1. Device: 10 years from date of Substantial Completion.
  - 2. Accessories: 1 year from date of Substantial Completion.
  - 3. Batteries: 4 years from date of Substantial Completion.
  - 4. Defibrillator pads: Expiration date indicated on pads package.

**PART 2 - PRODUCTS****2.1 AUTOMATED EXTERNAL DEFIBRILLATORS**

- A. Automated External Defibrillators (AEDs): Designed for use by layperson first responders with no training, on patients of any age.
  - 1. Products: Subject to compliance with requirements, available products include, but are not limited to, the following:
    - a. Phillips Medical Systems; HeartSmart OnSite Defibrillator.
    - b. Physio Control; Lifepak.
    - c. Zoll; AED Plus.
  - 2. Weight: 3.3 lbs.
  - 3. Guided audio instructions for device use and CPR coaching.
  - 4. Senses application of pads to patient, and changes voice instructions.
  - 5. Patient Analysis: Evaluates patient ECG to determine if a rhythm is shockable.
  - 6. Shock Time: 8 seconds after CPR interval; less than 20 seconds shock-to-shock.
  - 7. Preinstalled pads cartridge; spare pads cartridge in case.
  - 8. Retrievable summary of care from internal memory: First 15 minutes of ECG and the entire incident's events and analysis decisions.

9. Self-Tests: Automatic, daily.
  - a. Internal circuitry.
  - b. Waveform delivery system.
  - c. Pads cartridge.
  - d. Battery capacity.
10. Battery: 9 Volt DC, non-rechargeable lithium.
11. Meets AAMI DF80 guidelines and AHA recommendations for adult defibrillation.

### **PART 3 - EXECUTION**

#### **3.1 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

**SECTION 10 44 13 - FIRE PROTECTION CABINETS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Fire-protection cabinets for the following:
    - a. Portable fire extinguisher.
- B. Related Requirements:
  - 1. Section 10 44 16 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets

**1.2 PREINSTALLATION CONFERENCE**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to fire-protection cabinets, including, but not limited to, the following:
    - a. Schedules and coordination requirements.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
  - 2. Show location of knockouts for hose valves.
- B. Shop Drawings: For fire-protection cabinets.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
- C. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

**1.5 COORDINATION**

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers, fire hoses, hose valves, and hose racks indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.3 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Guardian Fire Equipment, Inc.; Series 1800.
    - b. JL Industries, Inc.; a division of the Activar Construction Products Group; Panorama Series.
    - c. Larsens Manufacturing Company; Architectural Series.
    - d. Potter Roemer LLC; Alta Series.
  - 2. Slim profile Extinguisher Cabinet: For use with slim profile fire extinguishers. Cabinet must fit into 3 5/8" stud wall. Constructed of powder coated, cold rolled steel with acrylic glazed door.
    - a. JL Activar, FX2 Fire Rated Extinguisher Cabinet.
    - b. Oval Fire Products, Inc.; Flush Recessed Cabinet.
- B. Cabinet Construction: Rated and nonrated cabinets matching fire-resistance rating of walls where they are installed]
  - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-thick cold-rolled steel sheet lined with minimum 5/8-inch-thick fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Cold-rolled steel sheet with manufacturer's standard baked enamel or powder coat.
- D. Recessed Cabinet:
  - 1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
- E. Semi-recessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
  - 1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.
  - 2. Rolled-Edge Trim: 2-1/2-inch backbend depth.
- F. Cabinet Trim Material: Same material and finish as color.
- G. Door Material: Aluminum sheet.
- H. Door Style: Fully glazed panel with frame.
  - 1.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
  - 1. Provide projecting lever handle with cam-action latch or projecting door pull and friction latch.
  - 2. Provide continuous hinge, of same material and finish as trim,, permitting door to open 180 degrees.
- J. Accessories:
  - 1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
    - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."



- 1) Location: Applied to cabinet glazing.
  - 2) Application Process: Pressure-sensitive vinyl letters.
  - 3) Lettering Color: White.
  - 4) Orientation: Vertical.
2. Alarm: Manufacturer's standard alarm that actuates when fire-protection cabinet door is opened and that is powered by low voltage, complete with transformer.
- K. Materials:
1. Aluminum: ASTM B 221 for extruded shapes and aluminum sheet, with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet.
    - a. Finish: Clear anodic.
  2. Stainless Steel: ASTM A666, Type 304.
    - a. Finish: ASTM A480/A480M No. 4 directional satin finish,.
  3. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 1.5 mm thick, with Finish 1 (smooth or polished).
  4. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

## 2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
  1. Weld joints and grind smooth.
  2. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
  1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
  2. Miter and weld perimeter door frames and grind smooth.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

## 2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare recesses for fire-protection cabinets as required by type and size of cabinet and trim style.

### **3.3 INSTALLATION**

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- C. Identification:
  - 1. Apply vinyl lettering at locations indicated.

### **3.4 ADJUSTING AND CLEANING**

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

**SECTION 10 44 16 - FIRE EXTINGUISHERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Requirements:
  - 1. Section 10 44 13 "Fire Protection Cabinets."

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:
    - a. Schedules and coordination requirements.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Warranty: Sample of special warranty.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

**1.6 COORDINATION**

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

**1.7 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
    - b. Faulty operation of valves or release levers.
  - 2. Warranty Period: Six years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
  - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

**2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS**

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and indicated.
  - 1. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
  - 2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type: UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.
- C. Wet-Chemical Type: UL-rated 2-A:K, 2.5-gal. nominal capacity, with potassium acetate-, potassium citrate-, or potassium carbonate-based chemical in stainless-steel container; with pressure-indicating gage.
  - 1. Cabinet or Surface Mounted:
    - a. JL Orbit, Model Saturn 25; Class K.
    - b. Badger, Model WC-250-1.

**2.3 SLIM PROFILE PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS**

- A. Definition:
  - 1. Fire extinguisher that when wall mounted on a bracket projects less than 4 inches from the face of wall. Complies with protruding object guidelines from ADA and ANSI A117.1.
  - 2. Recessed wall cabinet and extinguisher that projects less than 1 inch from the face of wall and overall depth is less than 4" deep to fit in gypsum board wall assembly using 3 5/8" studs. Complies with protruding object guidelines from ADA and ANSI A117.1.
- B. Location: As indicated on Drawings.
- C. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
  - 1. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- D. Multipurpose Dry-Chemical Type: UL-rated 4-A:80-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container. See Drawings for mounting types.
  - 1. Surface Mounted:
    - a. Oval Brand Model 10HABC.
    - b. JL Orbit, Model FE10V or FE10VB.
  - 2. Cabinet Mounted:
    - a. Oval Brand Model 10JABC.
    - b. JL Orbit, Model FE10V.

**2.4 MOUNTING BRACKETS**

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
  - 1. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
  - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
    - a. Orientation: Vertical.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
  - 1. Mounting Height: As indicated on Drawings.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 10 51 13 - METAL LOCKERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Wardrobe Locker Configurations, as shown on the Drawings, or:
    - a. Three-tier wardrobe lockers; 12 inch wide by 12 inch deep by 72 inch high units.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.
- B. Shop Drawings: For metal lockers.
  - 1. Include plans, elevations, sections, and attachment details to other Work.
  - 2. Show locker fillers, trim, base, slopping tops, and accessories.
  - 3. Include locker identification system and numbering sequence.
- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of standard and premium colors available for units with factory-applied color finishes.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes, showing the full range of color, texture, and pattern variations expected. Prepare Sample from the same material to be used for the Work.
  - 1. Lockers and equipment.
  - 2. Locker benches.
- E. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals specified in Division 01.
- F. Warranty: Sample of special warranty.
- G. Product Schedule: For lockers. Use same designations indicated on Drawings.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Sample Warranty: For special warranty.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

**1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. The following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:
  - a. Locks.
  - b. Blank identification plates.
  - c. Hooks.

### **1.7 QUALITY ASSURANCE**

- A. Regulatory Requirements: Where metal lockers and benches are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
  1. Provide not less than 1 shelf located no higher than 54 inches (1372 mm) above the floor for side reach.
  2. Provide 1 shelf located at bottom of locker no lower than 9 inches (230 mm) above the floor for side reach.
  3. Provide hardware that does not require tight grasping, pinching, or twisting of the wrist, and that operates with a force of not more than 5 lbf (22.2 N).

### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.
- B. Protect lockers from damage during delivery, handling, storage, and installation.
- C. Deliver master and control keys and combination control charts to Owner.

### **1.9 FIELD CONDITIONS**

- A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

### **1.10 COORDINATION**

- A. Coordinate sizes and locations of concrete bases for metal lockers. Concrete, reinforcement, and formwork requirements are specified in other Sections to ensure that metal lockers can be supported and installed as indicated.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

### **1.11 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Structural failures.
    - b. Faulty operation of latches and other door hardware.
  2. Damage from deliberate destruction and vandalism is excluded.
  3. Warranty Period for Welded Metal Lockers: 10 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**



**2.1 MANUFACTURERS**

- A. Source Limitations: Obtain metal lockers, locker benches, and accessories from single source from single locker manufacturer.
  - 1. Obtain locks from single lock manufacturer.
- B. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
  - 1. All Welded Wardrobe Lockers (Heavy Duty Applications):
    - a. Art Metal Products; Bulldog or Champ Corridor Lockers.
    - b. DeBourgh Mfg. Co.; Sentry Corridor/Personnel Lockers.
    - c. List Industries Inc.; Marquis Protector.
    - d. Lyon Workspace Products, LLC; All-Welded Lockers.
    - e. Penco Products, Inc.; All-Welded Lockers.
  - 2. Accessible Lockers: Provide accessible lockers as indicated on the Drawings, but at least one locker in each Locker Room.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Accessibility Standard: For lockers and locker benches indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design", IBC, and ICC A117.1 or other locally enforced accessibility standards.

**2.3 MATERIALS**

- A. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.
- B. Expanded Metal: ASTM F 1267, Type II (flattened), Class I, 3/4-inch (19-mm) steel mesh, with at least 70 percent open area.
- C. Steel Tube: ASTM A 500, cold rolled.
- D. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.
- E. Anchors: Material, type, and size required for secure anchorage to each substrate.
  - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls, and elsewhere as indicated, for corrosion resistance.
  - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

**2.4 WARDROBE LOCKERS**

- A. Body: Assembled by welding body components together. Fabricate from unperforated, cold-rolled steel sheet with thicknesses as follows:
  - 1. Tops, Bottoms, and Sides: 0.0528 inch (1.35 mm) thick.
  - 2. Backs: 0.0428 inch (1.1 mm) thick.
  - 3. Shelves: 0.0528 inch (1.35 mm) thick, with double bend at front and single bend at sides and back.
  - 4. Size: 12" wide x 12" deep x 72" tall Three tier or as shown on the Drawings.

- B. Frames: Channel formed; fabricated from 0.0528-inch- (1.35-mm-) thick, cold-rolled steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
- C. Locker Base: Structural channels, formed from 0.0528-inch- (1.35-mm-) thick, cold-rolled steel sheet; welded to front and rear of side-panel frames.
- D. Doors: One-piece; fabricated from 0.0677-inch- (1.7-mm-) thick, cold-rolled steel sheet; formed into channel shape with double bend at vertical edges, and with right-angle single bend at horizontal edges. Fabricate to prevent springing when opening or closing, and to swing 180 degrees. Comply with the following:
- E. Hinges: Welded to door and attached to door frame with not less than 2 factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
  - 1. Continuous Hinges: Manufacturer's standard, steel continuous hinge.
- F. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry resistant.
  - 1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks or padlocks; positive automatic and prelocking.
    - a. Latch Hooks: Equip doors less than 48 inches (1219 mm) high with 2 latch hooks; fabricated from minimum 0.1116-inch- (2.8-mm-) thick steel; welded to full-height door strikes; with resilient silencer on each latch hook.
    - b. Latching Mechanism: Manufacturer's standard rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

## 2.5 LOCKER ACCESSORIES

- A. Interior Equipment: Furnish each locker with the following items, unless otherwise indicated:
  - 1. Hooks: Manufacturer's standard zinc-plated, ball-pointed steel. Provide one double-prong ceiling hook, and not fewer than two single-prong wall hooks for single-, double-, and triple-tier units. Attach hooks with at least two fasteners.
  - 2. Coat Rods: Fabricated from 1-inch-(25-mm-) diameter steel; chrome finished.
- B. Number Plates: Manufacturer's standard aluminum number plates with numerals at least 3/8 inch (9 mm) high. Number lockers in sequence indicated. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
- C. Continuous Metal Base: Minimum 0.0598-inch- (1.50-mm-) thick steel sheet, channel or zee profiled for stiffness, fabricated in lengths as long as practicable to enclose base and base ends of lockers, and finished to match lockers.
  - 1. Height: 4 inches (102 mm).
- D. Continuously Sloping Tops: Manufacturer's standard, fabricated from minimum 0.0359-inch- (0.90-mm-) thick steel sheet, for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practicable, without visible fasteners at splice locations, finished to match lockers. Provide fasteners, filler plates, supports, and closures, as follows:
  - 1. Closures: Vertical-end type.
  - 2. Sloped top corner fillers, mitered.
- E. Recess Trim: Manufacturer's standard; fabricated from minimum 0.0478-inch- (1.20-mm-) thick steel sheet, minimum 2-1/2-inch (64-mm) face width, and finished to match lockers. Fabricate trim in lengths as long as practicable.

- F. Filler Panels: Manufacturer's standard; fabricated from minimum 0.0478-inch- (1.20-mm-) thick steel sheet in an unequal leg angle shape, and finished to match lockers. Provide slip joint filler angle formed to receive filler panel.
- G. Finished End Panels: Manufacturer's standard; fabricated from minimum 0.0239-inch- (0.60-mm-) thick steel sheet, finished to match lockers, and designed for concealing exposed ends of nonrecessed lockers.
  - 1. Provide one-piece panels for double-row (back-to-back) locker ends.
- H. Boxed End Panels: Manufacturer's standard; fabricated from minimum 0.0598-inch- (1.50-mm-) thick steel sheet, with 1-inch- (25-mm-) wide edge dimension, finished to match lockers, and designed for concealing exposed ends of nonrecessed lockers

## 2.6 FABRICATION

- A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
  - 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
  - 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Unit Principle: Fabricate each locker with an individual door and frame, individual top, bottom, back, and shelves, and common intermediate uprights separating compartments.
- C. All-Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.
- D. Accessible Lockers: Fabricate as follows:
  - 1. Locate bottom shelf no lower than 15 inches above the floor.
  - 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

## 2.7 FINISHES, GENERAL

- A. Finish all steel surfaces and accessories, except prefinished stainless-steel and chrome-plated surfaces.
- B. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.8 STEEL SHEET FINISHES

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.
- B. Powder Coated Finish: Immediately after cleaning and pretreating, apply manufacturer's standard powder coated finish consisting of a thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film

thickness of 1.4 mils (0.036 mm) on doors, frames, and legs, and 1.1 mils (0.028 mm) elsewhere.

1. Colors and Gloss: As selected by Architect from manufacturer's full range of standard colors.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install lockers level, plumb, and true; shim as required, using concealed shims.
  1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
  2. Anchor single rows of metal lockers to walls near top of lockers and to floor.
  3. Anchor back-to-back metal lockers to floor.
- B. Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
  1. Attach recess trim to recessed lockers with concealed clips.
  2. Attach sloping top units to lockers.
- C. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed lockers.
- D. Attach boxed end panels with concealed fasteners to conceal exposed ends of nonrecessed lockers.
- E. Anchor locker benches pedestals to floors and uniformly space pedestals not more than 36 inches (915 mm) apart. Securely fasten bench top to pedestal.

#### **3.3 ADJUSTING**

- A. Adjust doors and latches to operate easily without binding.
- B. Clean interior and exposed exterior surfaces and polish stainless-steel surfaces.
- C. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

#### **3.4 PROTECTION**

- A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

**SECTION 10 51 19 - PHENOLIC LOCKERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes phenolic open-front athletic lockers .

**1.2 REFERENCES**

- A. American Society for Testing and Materials:
1. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Material
  2. ASTM D 6578 Standard Practice for Determination of Graffiti Resistance
  3. ASTM D 1037 Direct Screw Withdrawal Test
  4. ASTM D 570 Standard Test Method for Water Absorption

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of phenolic locker.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of phenolic locker and bench.
- B. Shop Drawings: For phenolic lockers and benches.
1. Include plans, elevations, sections, details, and attachments to other work.
  2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  3. Show locations and sizes of cutouts and holes for items installed in phenolic lockers.
  4. Show phenolic locker fillers, trim, base, sloping tops, and accessories.
  5. Show phenolic locker numbering sequence.
- C. Samples for Initial Selection: For the following:
1. Thermoset decorative overlay panels.
- D. Samples for Verification: For the following products:
1. Thermoset decorative-overlay-surfaced panels, not less than 8 by 10 inches, for each type, color, pattern, and surface finish.
  2. Corner pieces of phenolic locker front frame joints between stiles and rail, as well as exposed end pieces, not less than 18 inches wide by 18 inches high by 6 inches deep.
  3. Exposed cabinet hardware and accessories, one unit for each type and finish.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer.
- B. Sample Warranty: For special warranty.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For adjusting, repairing, and replacing phenolic locker doors and latching mechanisms to include in maintenance manuals.

**1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Stock: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Full-size phenolic locker doors, complete with specified door hardware. Furnish no fewer than five doors of each type and color installed.
  - 2. Full-size units of the following phenolic locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:
    - a. Hinges.
    - b. Pulls.
    - c. Shelf rests.
    - d. Cylinder locks.
- B. Locker body: The locker, including shelves, shall incorporate shrink pin or comparable construction and shall be mechanically fastened with stainless steel fasteners.
- C. Water absorption requirements: When tested in accordance with ASTM D 570, locker materials shall have a water absorption rate of less than 0.37%.
- D. Graffiti resistance requirements: When tested in accordance with ASTM D 6578, locker materials shall prove resistant to all chemicals tested for a period of 1 to 10 minutes and shall leave no mar or blemish on the surface when cleaned. Locker materials shall have guaranteed surface clean ability from permanent markers and shall have non-ghosting properties.
- E. Scratch resistance requirements: When tested in accordance with ASTM D 2197, locker materials shall prove to be scratch resistant when maximum load values in excess of 10 kilograms.
- F. Flame spread: When tested in accordance with ASTM E 84, lockers, athletic lockers, wardrobe cabinets, school cubbies and locker bench materials shall meet or exceed all requirements for Class B flame spread rating and smoke developed.
- G. Flame spread shall not exceed 75.
- H. Smoke developed shall not exceed 450.
- I. Impact resistance requirements: When tested in accordance with ASTM D 2794, locker materials shall withstand an impact force value in excess of 45 inch/lbs.
- J. Screw holding strength: When tested in accordance with ASTM D 1037, direct screw withdrawal test, locker materials shall withstand a direct pull force that exceeds 2,500 lbs per fastener.
- K. Tensile strength: locker materials shall have a modulus of elasticity of 1.55 million psi.
- L. Shear strength: locker materials shall have a shear strength of 2,000 psi minimum.
- M. Compression strength: locker materials shall have a compression strength of 24,000 PSI minimum.
- N. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Do not deliver phenolic lockers until painting and similar operations that could damage phenolic lockers have been completed in installation areas. If phenolic lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are the same as those in final installation location, and comply with requirements specified in "Field Conditions" Article.

**1.8 FIELD CONDITIONS**

- A. Environmental Limitations: Do not deliver or install phenolic lockers until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during the remainder of the construction period.
- B. Field Measurements: Where phenolic lockers are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Locate concealed framing, blocking, and reinforcements that support phenolic lockers by field measurements before being enclosed, and indicate measurements on Shop Drawings.

**1.9 COORDINATION**

- A. Coordinate sizes and locations of concealed phenolic support bases.
  - 1. Requirements are specified in Section 06 10 53 "Miscellaneous Rough Carpentry."
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that phenolic lockers can be supported and installed as indicated.

**1.10 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of phenolic lockers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.
    - b. Faulty operation of locks or hardware.
    - c. Deterioration of phenolic, phenolic finishes, and other materials beyond normal use.
  - 2. Warranty Period: 20 years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Accessibility Requirements: For phenolic lockers indicated to be accessible, comply with The Department of Justice 2010 ADA Standards, and IBC and ICC/ANSI A117.1 or other locally enforced accessibility standards.

## 2.2 PHENOLIC LOCKERS

- A. Basis-of-Design Manufacturer: Phenolic lockers are based on products of Columbia Lockers. Subject to compliance with requirements, provide products by the basis-of-design manufacturer or comparable products by one of following:
  - 1. Foreman Locker Systems.
  - 2. ASI Storage Solutions.
  - 3. Summit Lockers.
- B. Construction Style: As indicated.
  - 1. Reveal Dimension: As indicated.

## 2.3 LOCKER TYPES

- A. Player's and Coach's Lockers: Open front athletic lockers- Refer to Drawings for configurations. Lockers are to be integrated into surrounding wall and ceiling construction. Lockers are to include top & bottom shelves, clothes rod, coat hooks; size 24" W x 24" D x 72" H; curb mounted.
- B. Official's Lockers: Open front athletic lockers- Refer to Drawings for configurations. Lockers are to be integrated into surrounding wall and ceiling construction. Lockers are to be two-tier and include lockable storage compartment, top & bottom shelves, clothes rod, coat hooks; size 18" W x 18" D x 72" H; curb mounted.

## 2.4 MATERIALS

- A. Panel Material: Decorative papers impregnated with the melamine resin on faces with a clear protective overcoat and integrally compression molded within a core consisting of solid phenolic impregnated kraft papers.
  - 1. Required Fire Resistance Rating: ASTM E 84, Class B.
- B. Material Thicknesses:
  - 1. Doors, End Panels, and Toe Kick Plates – Minimum .50" (13 mm) inches.
  - 2. Locker boxes, tops, bottoms, and shelves – Minimum .375" (10 mm) inches.
  - 3. Sides and Locker Backs – Minimum .3125" (8 mm) inches.
  - 4. Bench Tops – Minimum .75" (19 mm) inches.
- C. Colors and Patterns: As selected by Architect from manufacturer's full range.
- D. Locker Doors: Locker door shall be the full width of the locker box and shall be frameless, allowing access to the entire width of the Locker.
- E. Locker Body: Locker shall incorporate Shrink Pin or comparable construction for alignment and will be mechanically fastened with stainless steel fastener. Hinges will be attached to the locker box with stainless steel theft proof torx-head screws. Lockers shall arrive at construction site fully assembled.
- F. End panels, and toe kick plates: shall be manufactured of the same color, thickness, and material as the locker doors.
- G. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- H. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- I. Wood Support Base: 2-by-4-inch, nominal-size lumber treated with manufacturer's standard preservative-treatment, pressure process.



**2.5 HARDWARE**

- A. General: Provide manufacturer's standard phenolic locker hardware complying with the requirements in this Section.
- B. Digital Keypad Locks (Players and Coaches Lockers): Battery-powered electronic keypad with reprogrammable manager and owner codes that override access. Three consecutive incorrect code entries shall disable lock for three minutes.
  - 1. Designed for shared or temporary access by multiple users, with user-defined code to lock and unlock. Provide LED indicator to show when lock is in use.
- C. Cylinder Locks (Officials Lockers): Built-in, flush cam locks with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and two master keys.
  - 1. Key Type: Flat, with minimum 2-by-2.68-inch key head for accessible lockers.
- D. Hinges: hinges shall be concealed and shall be made of 14 gauge type 304 stainless steel and have a satin finish. Hinge shall have five (5) knuckles and shall allow door to open 90°.
- E. Wire Pulls: Back mounted; 4 inches long, 5/16 inch in diameter.
- F. Shelf Rests: BHMA A156.9, B04013.
- G. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, and rated for a load of 75 lbf.
- H. Hooks: Manufacturer's standard, ball-pointed aluminum or steel; finished to match other phenolic locker hardware. Attach hooks with at least two fasteners.
  - 1. Provide hooks as indicated on Drawings.
- I. Coat Rods: 3/4-inch- diameter steel; finished to match other phenolic locker hardware.
  - 1. Provide coat rods as indicated on Drawings.
- J. Exposed Hardware Finishes: Satin chrome unless otherwise indicated.

**2.6 ACCESSORIES**

- A. Number Plates: 1-1/2-inch-diameter, etched, embossed, or stamped, aluminum plates with black numbers and letters at least 1/2 inch high. Identify phenolic lockers in sequence indicated on Drawings. Finish plates to match other phenolic locker hardware.

**2.7 FABRICATION**

- A. Fabricate each phenolic locker as a single unit with shelves, an individual door and frame, an individual top, a bottom, and a back, and with individual uprights.
  - 1. Fabricate phenolic lockers to dimensions, profiles, and details indicated.
  - 2. Ease edges of corners of solid-phenolic members to 1/16-inch radius.
- B. Fabricate components square, rigid, without warp, and with finished faces flat and free of scratches and chips. Accurately factory machine components for attachments. Make joints tight and true.
  - 1. Fabricate phenolic lockers using manufacturer's standard construction.
- C. Accessible Lockers: Fabricate as follows:
  - 1. Locate bottom shelf no lower than 15 inches above the floor.
  - 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.
- D. Venting: Fabricate phenolic lockers with space between doors and locker assembly of not less than 3/4 inch, with painted metal security screen attached to each shelf between doors.
- E. Number Plates: Inlay plates flush in each phenolic locker, locations as indicated.

- F. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
  - 1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended, and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- G. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that furring is attached to concrete and masonry walls that are to receive phenolic lockers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Condition phenolic lockers to average prevailing humidity conditions in installation areas before installation.
- B. Before installing phenolic lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

#### **3.3 INSTALLATION**

- A. Install wood support base with 1/2-inch-thick plywood top.
- B. Install phenolic lockers level, plumb, and true; use concealed shims.
- C. Connect groups of phenolic lockers together with manufacturer's standard fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit phenolic lockers accurately together to form flush, tight, hairline joints.
- D. Install phenolic lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 1. Installation Tolerance: No more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.
- E. Locker Anchorage:
- F. Comply with manufacturer's recommendations for attachment of lockers to floors, walls, bases, and adjacent lockers. Provide concealed fasteners unless exposed fasteners are standard fastening method.

#### **3.4 ADJUSTING, CLEANING, AND PROTECTION**

- A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding. Verify that integral locking devices operate properly.
- B. Protect phenolic lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- C. Touch up marred finishes, or replace phenolic lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by phenolic locker manufacturer.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 10 51 20 – CUSTOM WOOD LOCKERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. This section includes the following:
  - 1. Custom Wood Lockers, filler panels, operable stainless steel panels with full-length stainless steel hinges, perforated stainless steel inserts, built-in USB ports, magnetic plate with stainless steel finish, stainless steel shoulder pad bracket, and accessories.

**1.2 RELATED SECTIONS**

- A. Section 01 33 00 – Submittal Procedures: Shop Drawings and product data.

**1.3 REFERENCES**

- A. Architectural Woodwork Institute: AWI - Quality Standards Illustrated.

**1.4 SUBMITTALS**

- A. Product Data: Available upon request, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
  - 4. Product data specific to materials used in construction of locker.
- B. Shop Drawings: Indicate locker plan layout for locker installations, component profiles and elevations, schedule of finishes, and accessories.
- C. Mock-Up: After shop drawings have been reviewed and approved by Architect, provide a full-sized mock-up of a typical locker unit consisting of two lockers with a shared bench seat. Include all specified accessories. Deliver the mock-up to the jobsite. The mock-up may be incorporated into the work if it is determined to be acceptable.

**1.5 QUALITY ASSURANCE**

- A. Perform work in accordance with AWI (Architectural Woodwork Institute) Architectural Woodwork Quality Standards Illustrated.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in a dry, ventilated area until ready for installation.
- B. Protect finishes from moisture, soiling, and damage during handling.

**1.7 PROJECT CONDITIONS**

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. During and after installation, maintain same temperature and humidity conditions in building spaces as will occur after occupancy.
- C. Protect locker finish and adjacent surfaces from damage.

**PART 2 - PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Acceptable Manufacturers:
  - 1. Dains Custom Athletic Lockers, Shell City, MO, Phone: (417) 432-1190, Fax: (417) 432-1041, Contact: Mike Dains or Steve Dains.
  - 2. Legacy Lockers, 4433 Bronze Way, Dallas, TX, 75236, Toll Free (866) 937-1088, Local (972) 937-1088, Fax (972) 937-1089.
  - 3. Broward Custom Woodwork, Inc., 17520 SW 103 Place, Archer, FL, 32618, Contact Bill Koebel, (312) 495-9490, Fax (352) 495-9532.
  - 4. Columbus Cabinet Co., 6047 Coca Cola, Columbus, GA 31909, (706) 561-6497.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01330.

**2.2 LOCKER**

- A. Materials: Exposed Surfaces: NIST PS 1; APA A-A Grade, 3/4" thick, hardwood veneer panels.
- B. Hardwood Faced Panels: HPVA HP-1; graded in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, hardwood face veneer, interior rated adhesives, core of medium density fiberboard or engineered plywood.
  - 1. Exposed Surfaces: Grade AA, Maple, plain sliced, book-matched.
  - 2. Semi-Exposed Surfaces: Grade A, Maple, plain sliced, random-matched.
  - 3. Concealed Surfaces: Grade B, Maple, rotary cut, random-matched.
- C. Wood Veneer: Provide solid wood edge banding to closely match wood veneer.
- D. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
- E. Finish: Custom Finish. All wood surfaces are to be finished with a stain, catalyzed lacquer applied in two coats with hand sanding between coats, and sealed with a moisture resistant top coat.
  - 1. Color: Finish stain shall be "Cherry". Match architect's sample.
- F. Accessories:
  - 1. Hardware: SS Hook (2 per locker), SS Retractable Jersey Hook (1 per locker), (2) Port USB Outlet, SS Pulls and Continuous Hinges, SS Shoulder Pad Bracket, Perforated SS Insert and Magnetic Face with SS Finish.
  - 2. Grommets: Provide precut openings and finished grommets at locations indicated for shoe dryers. Shoe dryers shall be provided by the Owner. Coordinate with electrical drawings for exact outlet locations.
  - 3. Details: Refer to drawings for further locker details and dimensions. Refer to contract drawings for locker layout and filler panel locations.

**2.3 FABRICATION**

- A. Locker shall be fabricated using doweled and glued assembly process.
- B. Fabricate locker parts square, rigid and without warp, with the finished faces flat and free of scratches and chips.
- C. Machine attachment holes accurate and free of chips. Attach fasteners as standard with manufacturer.
- D. Fabricate corners and fillers as required for installation.

**PART 3 - PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Do not begin installation until adjacent substrates and finishes have been properly prepared.
- B. Verify prepared bases are in correct position and configuration.
- C. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

**3.2 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Verify adequacy of backing and support framing.

**3.3 INSTALLATION**

- A. Work in this section requires close coordination with Work specified in Division 16. Coordinate all Work to assure an orderly progress in the Project, without removal of previously installed Work, and so as to prevent damage to finishes and products.
- B. Install in accordance with manufacturer's instructions.
- C. Install, plumb, level, true and straight with no distortions. Shim as required, using concealed shims. Scribe tops as necessary for close and accurate fit.
- D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 lb.
- E. Install end panels, filler panels, tops and bases as indicated on the approved shop drawings. Where required, assemble units into one integral unit with joints flush, tight, and uniform. Align similar adjoining units to a tolerance of 1/16 inch.
- F. Install accessories as indicated and as recommended by manufacturer.
- G. Use concealed joint fasteners to align and secure adjoining cabinet units.
- H. Conceal screw heads to match locker finish

**3.4 ADJUSTING**

- A. Adjust moving or operating parts to function smoothly and correctly.

**3.5 CLEANING**

- A. Clean locker interiors and exterior surfaces.

**3.6 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 10 53 00 - WALKWAY COVERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
  - 1. Section 03 31 00 - "Concrete"
  - 2. Section 05 50 00 - "Metal Fabrications"
  - 3. Section 06 10 00 - "Rough Carpentry"
  - 4. Section 07 60 00 - "Flashing and Sheet Metal"
  - 5. Section 07 90 00 - "Joint Sealers"

**1.2 SUMMARY**

- A. This Section includes prefinished, preformed, aluminum, manufactured walkway assemblies and all related work, as indicated on the Drawings and including in part the following:
  - 1. Water-tight canopy system, including in part, extruded aluminum columns, support system, combination structural fascia/gutter system, with integral internal drainage, "Flat" roof deck, vertical closures between columns at canopy steps, related flashings and trim, accessories, and all related work.
  - 2. Standard or custom color, non-metallic baked enamel finish; color(s) selected by Architect after bidding; See "Metal Finishes" article below.
- B. Scope: The work in the Section includes all labor, materials, accessories, services and incidentals necessary for designing, supplying, installing and testing of the metal roofing, drainage, and systems described herein. Provide all flashing, fascia, caps, closures, trim, etc., which are associated with and/or come in contact with walkway canopy systems, in same metal and finish as roofing panels where exposed and where concealed, and make watertight junctions with work of other trades.
  - 1. Finish for concealed sides of all metal shall be manufacturer's standard color baked enamel, in color(s) selected by Architect after bidding; See "Metal Finishes" article below.

**1.3 SYSTEM PERFORMANCE REQUIREMENTS**

- A. Provide certified test results by a recognized testing laboratory or agency in accordance with specified test methods for each system, upon request.
- B. Water Penetration: Provide roof and similar wall panel systems with no water penetration as defined in the test method, when tested in accordance with ASTM E 331 at a static air pressure differential of not less than 6.24 psf and not more than 12.0 psf.
- C. Structural Performance: Manufacturer shall design and supply walkway canopies to withstand severe icing, heavy hail, and project site design wind loads required by applicable building codes and regulations.

**1.4 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data including manufacturer's complete and current product specifications, standard details, certified product test results, installation instructions, and general recommendations, as applicable to materials and finishes for each component and for total walkway canopy system.

- C. Samples for Verification Purposes of Roof Panels, Vertical Panels and Trim, and Fascia/Gutter Sections.
  - 1. Provide sample panels 12-inches long by actual panel width, in the profile, style, color, and texture indicated. Include clips, battens, fasteners, closures, and other panel accessories.
- D. Shop Drawings showing layouts of structural support system and canopy system, roof and vertical panels, details of edge conditions, joints, corners, panel profiles, miscellaneous supports, anchorages, trim, flashings, closures, and special details. Distinguish between factory and field assembly work. The manufacturer's design Structural Engineer and technical engineering department shall approve the drawings before they are submitted.
  - 1. Shop Drawings shall be certified by manufacturer's Structural Engineer and bear his/her current, signed and dated Alabama registration seal.
- E. Qualification data for Professional Engineer, fabricator, and installer.

### 1.5 QUALITY ASSURANCE

- A. Wind Uplift: Provide roof and vertical panel systems including supports meeting requirements of Underwriters Laboratories, Inc. for Class 90 wind uplift resistance.
  - 1. Minimum Code Wind Load at Site: **120 mph minimum**, unless higher wind load is indicated on Structural Drawings or required by applicable Codes.
  - 2. Uniform pressure of **20 psf minimum**, acting upward or downward.
- B. Field Measurements: Where possible, prior to fabrication of walkway canopy system and panels, take field measurements of structure or substrates to receive panel system. Allow for trimming panel units where final dimensions cannot be established prior to fabrication.
- C. Refer to Division 1 Section "Special Conditions" for additional information and minimum experience requirements.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's current written instructions and recommendations.
- B. Deliver panels and other components so they will not be damaged or deformed. Package extruded components, vertical and roof panels for protection against transportation damage.
- C. Handling: Exercise care in unloading, storing, and erecting support system, panels, and other system components to prevent bending, warping, twisting, and surface damage.
- D. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal panels so that they will not accumulate water. Do not store panels or other system components in contact with other materials that might cause staining, denting, or other surface damage.
- E. Deliver accessories, such as reglets, inserts, etc., which are to be installed by other trades and/or in conjunction with the work of other trades, far enough in advance so as not to delay the Work on the project.
- F. Refer to Division 1 Sections "Summary of Work" and "Special Conditions" for additional information and requirements regarding stored materials.

### 1.7 WARRANTIES

- A. Warranty: The manufacturer and installer shall jointly and severably, in writing, warrant that the walkway canopy system shall remain intact (without perceptible deformation) and completely leak free for a period of **10-years** from the date of acceptance of the project (this warranty need not cover damage from winds exceeding the velocities and/or loading required by the International Building Code as generated by a design velocity based on the 100-year probability wind speed).
  - 1. Paint Finish Warranty, "Kynar 500": **20 years** from date of Substantial Completion. Failures include, but are not limited to, cracking, deforming, fading, or otherwise deteriorating beyond

normal weathering, and as otherwise indicated. Fading is defined as loss of color, after cleaning with product recommended by manufacturer, of more than 4 color-difference units as measured according to ASTM D 2244, and as otherwise indicated.

2. Repairs that become necessary, such as for leaks, wind damage or temperature stress while sunshade system is under warranty, shall be performed by the installer or manufacturer within 7-days of notification. Should for any reason, the installer not be able to perform the repairs, it shall be incumbent upon the manufacturer to do so. If repairs are not begun on time, Owner shall have work done by others and costs will be charged to the Contractor, with no detrimental effect or cancellation of the warranty.
- B. This warranty shall be in addition to, shall be in effect simultaneously with, and shall not alter other required project or product warranties or guarantees, and shall not limit other remedies available to the Owner.

## 1.8 PROJECT CONDITIONS

- A. Weather: Proceed with walkway canopy system work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturers' current written instructions, recommendations, and warranty requirements.
- B. Substrate Conditions: Do not begin roofing or vertical panel installation until substrates have been inspected and are determined to be in satisfactory condition.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following, equivalent in quality and design as "Basis of Design" canopy system, and as otherwise indicated:
1. American Walkway Covers, LLC
  2. Mapes Industries, Inc.
  3. Mason
  4. Mitchell Metals, LLC
  5. Peachtree Protective Covers, Inc.
  6. Polyvision Corporation
  7. Superior Metal Products Co.
  8. Tennessee Valley Metals, Inc. (*Basis of Design, and quality standard*)
  9. Texas Aluminum Industries, Inc.
- B. Product/Manufacturer: Subject to compliance with requirements, provide water-tight walkway canopy system and all related components equivalent to standard "20-lb Live Load Unit System", **increased as required for project site wind loads**, as manufactured by Tennessee Valley Metals, Inc.; Birmingham, Alabama; Phone: (205) 853-1125, by one of the above named manufacturers, or other pre-approved manufacturer - properly submitted at least ten (10) days prior to original bid date in accordance with requirements of Section 01015 - "Special Conditions," and subsequently accepted in writing or by addendum, and as follows:
1. Flat Pan Roof Deck Panels: Roll-formed aluminum, nominal 6-inches wide x approximately 3-inches high, with minimum thickness of 0.025-inch. All panels shall interlock together with no exposed fasteners. Finish shall be factory baked enamel, in non-metallic standard color(s) selected by Architect from manufacturer's standard full line of color selections, including in part, dark or medium bronze.
  2. Vertical Panels: Similar to traditional Flat-Pan roof deck panels, except 2-inches high.
  3. Fascia/Gutter: Extruded aluminum, at least 7-inches high x 4-inches wide. Minimum metal thickness of 0.094-inch. Finish shall be factory baked enamel, in non-metallic standard color(s) selected by Architect from manufacturer's standard full line of color selections, including in part, dark or medium bronze.

4. Columns: Extruded aluminum, at least 4-inches x 4-inches, with minimum metal thickness of 0.125-inch thick. Corners shall be rounded. Finish shall be factory baked enamel, in non-metallic standard color(s) selected by Architect from manufacturer's standard full line of color selections, including in part, dark or medium bronze.
5. Drainage: All drainage shall drain internally from the deck to the fascia/gutter to the columns, spouting out at ground level with a deflector plate. The hole for the deflector plate shall be cut in the column with the cut straight and neat. Prior to setting deflector plate, fill any internal voids of column with non-metallic non-shrink grout product acceptable to walkway canopy system manufacturer.
6. Flashings and Trim: Same metal and finish as roof deck, unless other metal thickness not less than 0.040-inch is permitted by walkway canopy manufacturer.
7. Sealants: As recommended in writing by walkway canopy manufacturer, or if not recommended by walkway canopy manufacturer, as specified in Section 07900 - "Joint Sealers."

## 2.2 MATERIALS

- A. Fasteners: All fasteners in the plane of the roof deck, wall panels and fascia/gutter shall be concealed wherever possible. No exposed fasteners which would penetrate the panels, flashings, etc., will be permitted. Penetrating type fasteners will be allowed only in the vertical plane (i.e. fastening of flashings, battens, trim, etc., and then only if neoprene washers are used externally). Materials used in all fasteners shall be non-magnetic (stainless steel). All exposed fasteners shall match adjacent material, finish and/or color. Length and diameter of screws shall be sufficient to meet design criteria.
- B. Closures: Precut closures as standard with walkway canopy manufacturer, fabricated from same metal as that receiving closure(s), or from gray cross-linked closed-cell polyethylene composition foam, to the exact profile of the members with which it is to function.
- C. Sealants: Non-skinning, non-hardening, non-oxidizing butyl sealant, designed for metal-to-metal concealed joints. Field applied adhesive tape sealants shall be extruded polymeric butyl tape, non-skinning. Use no exposed sealants. Comply with minimum installation requirements of sealant manufacturer and Section 07900 - "Joint Sealers."
- D. Bituminous Coating: Cold-Applied asphalt mastic, SSPC-12, compounded for 15-mil dry film thickness per coat, and approved for the intended use by both the mastic and roofing manufacturers.
- E. Aluminum Extrusions (minimum): Alloy and temper recommended by manufacturer for use intended and as required for proper application of finish indicated but not less than the strength and durability properties specified in ASTM B 221 for 6063-T6.
- F. Aluminum Sheet (minimum): Alloy and temper recommended by manufacturer for use intended and as required for proper application of finish indicated but with not less than the strength and durability properties specified in ASTM B 209 for 5005-H15.
- G. Non-Metallic Shrinkage-Resistant Grout:
  1. Pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CRD-621.
  2. Products offered by manufacturer to comply with requirements for non-metallic, non-shrink grout include the following:
    - a. Euco N.S.; Euclid Chemical Company
    - b. Crystex; L & M Construction Chemicals.
    - c. Masterflow 713; Master Builders.
    - d. Five Star Grout; U.S. Grout Corp.
    - e. Upcon; Upco Chemical Division, USM Corp.
    - f. Propak; Protex Industries, Inc.

### 2.3 METAL FINISHES

- A. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
- C. Finishes:
  - 1. High Performance Organic Coating: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below); Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instructions.
  - 2. Fluorocarbon Coating System - Fluoropolymer Coating: Manufacturer's standard **2-COAT** (i.e.: primer and color coat), and note that the finish system may be a traditional liquid or powder coat, complying with AAMA 2605; thermo-cured, full-strength 70 percent resin "Kynar 500" coating and 30 percent reflective gloss when tested in accordance with ASTM D 523; Dry film thickness of 1.6-mils, minimum. Provide 2-coat finish on underside of panels where exposed to view in the finished work, and manufacturer's standard primer and wash coating at concealed locations.
  - 3. Color and Gloss: As selected by Architect, from manufacturer's full line of standard non-metallic colors; 15 colors to select from minimum, to include white, silver (similar to clear anodized), and color(s) to match storefront framing or metal roofing.

### 2.4 FABRICATION

- A. General: Fabricate and finish panels, extrusions, and accessories at the factory, by manufacturer's standard procedures and processes, as required to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and dimensional requirements and with structural requirements.
- B. Apply bituminous coating or other permanent separation materials on concealed panel surfaces where panels would otherwise be in direct contact with substrate materials that are noncompatible or could result in corrosion or deterioration of either material or finishes.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Installer shall examine all substrates and verify that they are acceptable, which will be acknowledged and accepted by his beginning work. Installer shall verify that all expansion joints, blocking, etc., are securely anchored into place, and that substrate is clean and free of all debris or other substance detrimental to the walkway canopy system work.
  - 1. Notify the Contractor in writing of conditions requiring corrections, for proper completion of the Work. Do not proceed until unsatisfactory conditions have been satisfactorily completed.
- B. The use of square head nails, staples, and pneumatic or electric nail guns are strictly prohibited.

### 3.2 PANEL SUPPORTS AND ANCHORAGE

- A. All volume, fascia/gutter, and other secondary structural panel support members and anchorage shall be installed in strict accordance with manufacturer's current written instructions and recommendations, and their Structural Engineer's Shop Drawings.

### 3.3 INSTALLATION

- A. General: Comply with manufacturer's current written instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the work securely in place, with provisions for thermal and structural movement.
  - 1. Field cutting of panels and any other component by torch is not permitted.
- B. Accessories: Install all components required for a complete walkway canopy, roof and vertical panel system, including in part, trim, copings, fascia/gutters, soffits, stops, mullions, corner units, closures, clips, seam covers, battens, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  - 1. Install water-tight flashing and counterflashings at all locations where canopy system abuts buildings.
- C. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of walkway canopy panel systems and accessories. Provide types of gaskets, sealants, and fillers indicated or, if not otherwise indicated, types recommended by walkway canopy manufacturer.
  - 1. Flash and seal panels to exclude weather.
  - 2. Counter flash over otherwise exposed flashings with metal and finish to match adjacent metal.
  - 3. Refer to other sections of these specifications for product and installation requirements applicable to indicated joint sealers.
- D. Installation Tolerances: Shim and align panel units within installed tolerance of 1/4-inch in 20'-0" on level/plumb/slope and location/line as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.4 CLEANING AND PROTECTION

- A. Damaged Units: Replace panels and other components of the work that have been damaged or have deteriorated beyond successful repair by means of finish touch-up or similar minor repair procedures, as determined solely by the Architect.
- B. Cleaning: Remove temporary protective coverings and strippable films as soon as each panel is installed. Upon completion of panel installation, clean finished surfaces as recommended in writing by walkway canopy system manufacturer, and maintain in a clean condition during construction.

END OF SECTION

**SECTION 11 13 13 - LOADING DOCK BUMPERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes loading dock bumpers.
- B. Related Requirements:
  - 1. Section 11 13 19 "Stationary Loading Dock Equipment" for loading dock bumpers that are integral with dock levelers.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of loading dock bumper.
- B. Shop Drawings: For dock bumpers. Include plans, elevations, sections, and attachment details.

**PART 2 - PRODUCTS****2.1 LOADING DOCK BUMPERS**

- A. General: Surface-mounted bumpers; of type, size, and construction indicated; designed to absorb kinetic energy and minimize damage to loading dock structure.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Beacon Industries, Inc.
    - b. Chalfant Dock Equipment.
    - c. Kelley; 4Front Engineered Solutions, Inc.
    - d. Pioneer Dock Equipment.
    - e. Rite-Hite Holding Corporation.
    - f. Rotary Products Inc.
    - g. Serco; Entrematic.
    - h. Super Seal Mfg. Ltd.
    - i. Vestil Manufacturing Corp.
  - 2. Source Limitations: Obtain from single source from single manufacturer.
- B. Laminated-Tread Loading Dock Bumper: Fabricated from multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch-diameter, steel supporting rods that are welded at one end to 1/4-inch-thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch of tread plies extending beyond the face of closure angles.
  - 1. Thickness: 6 inches.
  - 2. Horizontal Style: 12 inches high by length indicated on Drawings.
- C. Anchorage Devices: Galvanized-steel anchor bolts, nuts, washers, bolts, sleeves, cast-in-place plates, and other anchorage devices as required to fasten bumpers securely in place and to suit installation type indicated. Hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329/F 2329M.
- D. Materials: ASTM A 36/A 36M for steel plates, shapes, and bars. Hot-dip galvanize according to ASTM A 123/A 123M.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION, GENERAL**

- A. Loading Dock Bumpers: Attach loading dock bumpers to face of loading dock in a manner that complies with requirements indicated for spacing, arrangement, and position relative to top of platform and anchorage.
  - 1. Welded Attachment: Plug-weld anchor holes in contact with steel inserts and fillet weld at other locations.
  - 2. Bolted Attachment: Attach dock bumpers to preset anchor bolts embedded in concrete or to cast-in-place inserts or threaded studs welded to embedded-steel plates or angles. If preset anchor bolts, cast-in-place inserts, or threaded studs welded to embedded-steel plates or angles are not provided, attach dock bumpers by drilling and anchoring with expansion anchors and bolts.
  - 3. Screw Attachment: Attach dock bumpers to wood construction with lag bolts as indicated.

**3.3 ADJUSTING**

- A. After completing installation of exposed, factory-finished dock bumpers, inspect exposed finishes and repair damaged finishes.

END OF SECTION



**SECTION 11 13 16 - LOADING DOCK SEALS AND SHELTERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Frame-type loading dock shelters.

**1.2 COORDINATION**

- A. Coordinate sizes and configurations of dock seals with finish grade slopes, walls, dock configuration, doors, dock bumpers, and other adjacent construction.
- B. Coordinate sizes, configurations, and mounting of transparent-strip door curtains with walls, doors, dock levelers, and other adjacent construction.
- C. Electrical System Roughing-in: Coordinate layout and installation of motor/blower and activation switch with connections to power supplies and interlock to other dock equipment.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include electrical characteristics of inflatable blower motor.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Detail assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of anchors and field connection.
  - 3. Include diagrams for power, signal, and control wiring of inflatable blower motor.
- C. Samples: For each exposed product and for each color and texture specified.

**1.4 FIELD CONDITIONS**

- A. Field Measurements: Verify actual dimensions of dock openings and contiguous construction by field measurements before fabrication.

**PART 2 - PRODUCTS****2.1 FRAME-TYPE LOADING DOCK SHELTERS**

- A. General: Dock shelters designed to form a seal with sides and top of truck body while leaving entire width and height of truck's rear opening unobstructed; of type, size, and construction indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Beacon Industries, Inc.
    - b. Chalfant Dock Equipment.
    - c. Kelley; Entrematic.
    - d. Pioneer Dock Equipment.
    - e. Rite-Hite Holding Corporation.

- f. Rotary Products Inc.
  - g. Serco; Entrametic.
  - h. Super Seal Mfg. Ltd.
  - i. Vestil Manufacturing Corp.
2. Source Limitations: Obtain from single source from single manufacturer.
- B. Rigid-Frame Type: Fabricated from fabric-covered side and top panels attached to fixed supporting framework. Provide head and side curtains with built-in flexible stays, wind straps between head curtain and side frame, pleated protectors, reinforcing, and guide strips. Slope head frame from center for drainage. Provide replaceable, fabric-covered, tapered, foam-bottom pads and protective steel bumpers of size and type required for application shown.
- C. Construction: Fabricate framework, pads, bumpers, fabric for curtains and panels, and other components to sizes and shapes indicated or required to fit door-opening sizes shown, and allow for not less than 18 inches of truck-body penetration when truck is docked.
- 1. Steel Framework: Zinc-plated steel tubing of size and thickness standard with manufacturer, with joints welded.
  - 2. Top and Side Panels: White, translucent vinyl, weighing 14 oz./sq. ft..
  - 3. Tapered Side Panels: Taper side panels to angle required to accommodate sloped loading dock approach grades, and make sealing edge of dock shelter parallel to back edge of truck. Taper for approach indicated on Drawings.
  - 4. Guide Strips: 4-inch-wide, coated, nylon guide strips on side curtains.
  - 5. Pleated Protectors: On head curtain of overlapping layers of coated fabric attached to base fabric.
  - 6. Reinforcing: Manufacturer's standard reinforcing over cover fabric on side curtains [and top cover ]of dock shelter.
- D. Fabric:
- 1. Vinyl-Coated Nylon Cover Fabric: Minimum total weight of 40 oz./sq. yd..
    - a. Color: As selected by Architect from manufacturer's full range.
  - 2. Pleated Protectors: Same fabric as cover.
- E. Accessories:
- 1. Buffer flaps.
  - 2. Bottom filler curtain.
  - 3. Bottom seal pads.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION, GENERAL**

- A. Coordinate electrical connections with Division 26 Sections.

#### **3.3 INSTALLATION OF FRAME-TYPE LOADING DOCK SHELTERS**

- A. Attach dock shelters securely to building structure in proper relation to openings, dock bumpers, and dock levelers to ensure an effective seal of dock-shelter curtains with sides and top of truck body when trucks are positioned against dock bumpers.

**3.4 ADJUSTING**

- A. After completing installation, inspect exposed factory finishes and repair damaged finishes.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 11 13 19 - STATIONARY LOADING DOCK EQUIPMENT****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Recessed loading dock levelers.
  - 2. Truck restraints.
  - 3. Light communication systems.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for curb angles at edges of recessed pits and loading dock platform edge channels.
  - 2. Section 08 33 23 "Overhead Coiling Doors" for coiling overhead doors electrically interlocked to dock levelers.
  - 3. Section 11 13 13 "Loading Dock Bumpers" for loading dock bumpers that are not integral with loading dock levelers.
  - 4. Section 11 13 16 "Loading Dock Seals and Shelters" for loading dock seals and shelters.

**1.2 DEFINITIONS**

- A. Operating Range: Maximum amount of travel above and below the loading dock level.
- B. Working Range: Recommended amount of travel above and below the loading dock level for which loading and unloading operations can take place.

**1.3 COORDINATION**

- A. Coordinate size and location of loading dock equipment indicated to be attached to or recessed into concrete or masonry, and furnish anchoring devices with templates, diagrams, and instructions for their installation
- B. Coordinate installation of cast-in-place items. Furnish setting drawings and templates.
- C. Electrical System Roughing-in: Coordinate layout and installation of loading dock equipment with connections to power supplies and interlocked equipment.

**1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
  - 2. Review sequence of operation for each type of loading dock equipment.
  - 3. Review coordination of interlocked equipment specified in this Section and elsewhere.
  - 4. Review required testing, inspecting, and certifying procedures.

**1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for stationary loading dock equipment.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Shop Drawings: For stationary loading dock equipment.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of anchors and each field connection.
  - 3. Include diagrams for power, signal, and control wiring.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Product Test Reports: For each dock leveler, for tests performed by manufacturer and witnessed by a qualified testing agency.
  - 1. Indicate compliance of dock levelers with requirements in MH 30.1 for determining rated capacity based on comprehensive testing within last two years of current products.
  - 2. Submittal Form: According to MH 30.1.
- D. Sample Warranty: For manufacturer's special warranty.

## 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For stationary loading dock equipment to include in operation and maintenance manuals.

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
  - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

## 1.9 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with stationary loading dock equipment, including recessed pit dimensions slopes of driveways and heights of loading docks, by field measurements before fabrication.

## 1.10 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace dock levelers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including cracked or broken structural support members, load-bearing welds, and front and rear hinges.
    - b. Faulty operation of operators, control system, or hardware.
    - c. Deck plate failures including cracked plate or permanent deformation in excess of 1/4 inch between deck supports.
    - d. Hydraulic system failures including failure of hydraulic seals and cylinders.
  - 2. Warranty Period for Structural Assembly: 10 years from date of Substantial Completion.
  - 3. Warranty Period for Hydraulic System: Five years from date of Substantial Completion.

4. Warranty shall be for unlimited usage of leveler for the specified rated capacity over the term of the warranty.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.2 RECESSED LOADING DOCK LEVELERS

- A. General: Recessed, hinged-lip-type dock levelers designed for permanent installation in concrete pits preformed in the edge of loading platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide 4Front Engineered Solutions - KELLEY; HK Series Hydraulic Dock Leveler or comparable product by one of the following:
    - a. Beacon Industries, Inc.
    - b. Dock Equipment.
    - c. Pioneer Dock Equipment.
    - d. Rite-Hite Corporation.
    - e. Rotary Products Inc.
    - f. Serco; Entrematic.
    - g. Super Seal Mfg. Ltd.
    - h. Vestil Manufacturing Company.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity.
- D. Rated Capacity: Capable of supporting total gross load of 80,000 lb without permanent deflection or distortion.
- E. Platform: Not less than 3/8- inch-thick, nonskid steel plate.
  1. Platform Width: As indicated on Drawings.
  2. Platform Length: As indicated on Drawings.
  3. Frame: Manufacturer's standard.
  4. Toe Guards: Equip open sides of dock leveler over range indicated with steel toe guards.
    - a. Toe-Guard Range: Entire upper operating range.
- F. Hinged Lip: Not less than 3/4- inch-thick, nonskid steel plate.
  1. Hinge: Full-width, piano-type hinge with heavy-wall hinge tube and grease fittings, with gussets on lip and ramp for support.
  2. Safety Barrier Lip: Designed to protect material-handling equipment from an accidental fall from loading platform edge of the dock leveler when the leveler is not in use.
- G. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.
  1. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:
    - a. Above Adjoining Platform: 18 inches.
    - b. Below Adjoining Platform: 14 inches.
  2. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.

3. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 4 inches over width of ramp.
  4. Lip Operation: Manufacturer's standard mechanism, which automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck and automatically retracts lip when truck departs.
    - a. Length of Lip Extension: Not less than 12 inches 20 inches measured from ramp edge.
  5. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs.
  6. Interlock: Leveler does not operate while truck restraint is not engaged.
- H. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Include means for lowering ramp below platform level with lip retracted behind dock bumpers. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 inches.
1. Remote-Control Station with Emergency Stop: Weatherproof multi-button control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, Type 4 box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. Ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.
    - a. Master Panel: Control panel with integral fused disconnecting means for operating dock leveler, dock door, and truck restraints.
  2. Independent Lip Operation: Electric-powered hydraulic raising and hydraulic lowering of lip, controlled independent of raising and lowering of ramp.
- I. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.
1. Cross-Traffic Support: Manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
  2. Maintenance Strut: Integral strut to positively support ramp in up position during maintenance of dock leveler.
- J. Integral Laminated-Tread Dock Bumpers: Fabricated from 6- inch-thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch-diameter, steel supporting rods that are welded at one end to 1/4-inch-thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch of tread plies extending beyond the face of closure angles.
- K. Materials:
1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
  2. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade 55.
  3. Steel Tubing: ASTM A 500/A 500M, cold formed.
  4. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.



- L. Dock-Leveler Finish: Manufacturer's standard finish.
  - 1. Toe Guards: Paint toe guards to comply with ANSI Z535.1.
- M. Accessories:
  - 1. Curb Angles: 3-by-3-by-1/4-inch galvanized-steel curb angles for edge of recessed leveler pit, with 1/2-inch-diameter by 6-inch-long concrete anchors welded to angle at 6 inches o.c.
  - 2. Self-Forming Pan: Manufacturer's standard prefabricated, self-forming steel form system for poured-in-place construction of concrete pit.
  - 3. Night Locks: Manufacturer's standard means to prevent extending lip and lowering ramp when overhead doors are locked.
  - 4. Side and rear weatherseals.
  - 5. Foam insulation under dock-leveler platform.
  - 6. Abrasive skid-resistant surface.

### 2.3 TRUCK RESTRAINTS

- A. General: Manufacturer's standard device designed to engage truck's rear-impact guard and hold truck at loading dock. Restraint shall consist of an iron or steel restraining arm that raises until contacting rear-impact guard. Arm shall move vertically, automatically adjusting to varying height of truck due to loading and unloading operations.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide 4Front Engineered Solutions – KELLEY; Star 4 Vehicle Restraint System with Integrated Trailer Restraint Controls or comparable product by one of the following:
    - a. Beacon Industries, Inc.
    - b. Chalfant Sewing Fabricators, Inc.
    - c. Pioneer Dock Equipment.
    - d. Rite-Hite Corporation.
    - e. Rotary Products Inc.
    - f. Serco; Entrematic.
    - g. Super Seal Mfg, Ltd.
    - h. Vestil Manufacturing Company.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Standard: Comply with MH 30.3.
- D. Rated Capacity: Capable of supporting total gross load of 32,000 lb without permanent deflection or distortion.
- E. Operating Range: Capable of restraining rear-impact guards within a range from:
  - 1. Vertical Range: Minimum of 30 inches above driveway.
  - 2. Horizontal Range: 12 inches in front of dock bumpers.
- F. Power Operating System: Manufacturer's standard electromechanical or hydraulic unit.
  - 1. Remote-Control Station: Single-button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 12 box. Restraint is engaged by depressing and holding button; restraint is released by releasing button.
  - 2. Interlock: Leveler does not operate while truck restraint is not engaged.
- G. Mechanical Operating System: Restraint operates by use of a lifting rod or hook to raise engagement device.
- H. Rear-Impact-Guard Sensor: Detects presence of rear-impact guard and automatically returns to stored position if rear-impact guard is not engaged.

- I. Caution Signs: Exterior, surface mounted; designed to inform both dock attendant and truck driver; with sign copy as follows. Provide one sign at each truck-restraint location.
  - 1. Sign Copy in Forward and Reverse Text: Manufacturer's standard text permitting truck movement with green light.
  - 2. Interior Sign Copy: Manufacturer's standard text permitting truck movement with green light.
- J. Light Communication System: Red and green illuminated signal-light sets, with lens approximately 4 inches in diameter, designed to indicate status to both dock attendant and truck driver. Equip system with steel control panel located at interior of dock that includes illuminated lights indicating status of exterior signal lights. Provide signal-light set and control panel at each location indicated for light communication system. Enclose exterior signal-light sets in steel or plastic housing with sunshade.
  - 1. Automatic Operation: System is activated automatically when device engages rear-impact guard. Provide on-off switch located on truck-restraint control panel.
  - 2. Mounting: Wall.
- K. Alarm: Audible system indicating that rear-impact guard is not engaged, with manual reset.
- L. Materials:
  - 1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
  - 2. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade 55.
  - 3. Steel Tubing: ASTM A 500/A 500M, cold formed.
  - 4. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- M. Truck-Restraint Finish: Manufacturer's standard finish.
- N. Accessories: Interlock to dock leveler and key switch.

## 2.4 LIGHT COMMUNICATION SYSTEMS

- A. General: Communication system consisting of signal-light sets, caution signs, alarms, and controls for each location indicated.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Kelley; 4Front Engineered Solutions, Inc. or comparable product by one of the following:
    - a. Beacon Industries, Inc.
    - b. Nordock Inc.
    - c. Rite-Hite Corporation.
    - d. Serco; 4Front Engineered Solutions, Inc.
    - e. Vestil Manufacturing Company.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Caution Signs: Surface mounted; designed to inform both dock attendant and truck driver; with sign copy as follows:
  - 1. Exterior Sign Copy in Forward and Reverse Text: [Manufacturer's standard text permitting truck movement with green light] <Insert text>.
  - 2. Interior Sign Copy: Manufacturer's standard text permitting truck movement with green light.
  - 3. Mounting: Wall

- D. Signal-Light Sets: Red and green illuminated signal-light sets, with lens approximately 4 inches in diameter, designed to indicate status to both dock attendant and truck driver. Equip system with steel control panel that includes illuminated lights indicating status of exterior signal lights; locate control panel at interior of dock. Provide signal-light set and control panel at each location indicated for light communication system. Enclose signal lights in steel or plastic housing, with exterior signal-light sets equipped with sunshade.
1. Manual Operation: Lights are activated by push button or switch located on interior signal-light enclosure.
  2. Automatic Operation: Lights are activated automatically by limit switch mounted on overhead door track. Provide on-off switch located on control panel.
  3. Mounting: Wall
- E. Materials:
1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
  2. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade 55.
  3. Steel Tubing: ASTM A 500/A 500M, cold formed.
  4. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

## 2.5 FINISH REQUIREMENTS

- A. Finish loading dock equipment after assembly and testing.
- B. Hot-Dip Galvanizing: Comply with the following:
1. ASTM A 123/A 123M for iron and steel loading dock equipment.
  2. ASTM A 153/A 153M or ASTM F 2329/F 2329M for iron and steel hardware for loading dock equipment.
- C. Baked-on Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
1. Color: Manufacturer's standard.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical systems for loading dock equipment to verify actual locations of connections before equipment installation.
- C. Examine walls and floors of pits for suitable conditions where recessed loading dock equipment is to be installed. Pits shall be plumb and square and properly sloped for drainage from back to front of loading dock.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Coordinate size and location of loading dock equipment indicated to be attached to or recessed into concrete or masonry, and furnish anchoring devices with templates, diagrams, and instructions for their installation.
- B. Set curb angles in concrete edges of dock-leveler recessed pits with tops flush with loading platform. Fit exposed connections together to form hairline joints.

- C. Place self-forming pan system for recessed dock levelers in proper relation to loading platform before pouring concrete.
- D. Clean recessed pits of debris.

### **3.3 INSTALLATION, GENERAL**

- A. Install loading dock equipment as required for a complete installation.
  - 1. Rough-in electrical connections.

### **3.4 INSTALLATION OF RECESSED LOADING DOCK LEVELERS**

- A. Attach dock levelers securely to loading dock platform, flush with adjacent loading dock surfaces and square to recessed pit.

### **3.5 INSTALLATION OF TRUCK RESTRAINTS**

- A. Attach truck restraints in a manner that complies with requirements for arrangement and height required for device to engage vehicle rear-impact guard. Interconnect control panel and signals with dock leveler.
  - 1. Driveway-Mounted Units: Anchor truck restraints to driveway with expansion anchors and bolts.

### **3.6 ADJUSTING**

- A. Adjust loading dock equipment to function smoothly and safely, and lubricate as recommended by manufacturer.
- B. Test dock levelers for vertical travel and adjust to maintain operating range indicated.
- C. After completing installation of exposed, factory-finished loading dock equipment, inspect exposed finishes and repair damaged finishes.

### **3.7 MAINTENANCE SERVICE**

- A. Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of loading dock equipment Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper loading dock equipment operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

### **3.8 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain loading dock equipment.

END OF SECTION

**SECTION 11 23 00 - COMMERCIAL LAUNDRY EQUIPMENT****PART 1 - GENERAL****1.1 DESCRIPTIONS****A. Definitions**

1. The extent of the Laundry Equipment is shown on the drawings, equipment schedule, and specification of this Section of Contract Documents.
  - a. This typed Specification will be closely correlated with the Drawings and Schedule. Each complements the other and cross reference will be necessary to fulfill the requirements of the Specifications,
  - b. All information shown on Drawings and listed in schedules shall be incorporated as part of the written Specifications.
2. The plans indicate the location of the equipment, and slight changes due to the varying dimensions of equipment and wall construction will be permitted with approval by the Architect.
  - a. Conflict in plans and specifications where changes, alterations, additions, or deductions are necessary, or where exceptions are taken with regard to sizes, locations, and other details shown on plans, shall be reported for decision by the Architect.
3. The Laundry Equipment Contractor shall be responsible in seeing that the equipment can be entered through openings before doors and walls are finished.

**B. Interface**

1. The Building Contractor shall furnish all water lines and other necessary work as specified in Mechanical Sections, including final connections to equipment.
2. The Building Contractor shall furnish all electrical supply lines and other work as specified in Electrical Sections, as well as making final connections to equipment.
3. The Building Contractor shall furnish all ducts to exhaust fan as specified in (HVAC) Mechanical Sections, including those specified in this section of Specifications.
4. The Building Contractor shall furnish all faucets, special switches, valves, traps, labor and materials to make final connection to equipment, as so specified in other sections of the Architect's Contract Specifications, unless specifically specified herein this section.

**C. Performance**

1. At the start of operation of equipment, the LEC is to devote one full working day, showing personnel the operation and adjusting of equipment supplied.
2. The LEC is to supply the Architect with an affidavit, signed by Owner(s) and Laundry Manager, that this service was rendered and performed.

**1.2 QUALITY ASSURANCE****A. Permits and Certificates:**

1. All laws, codes, ordinances and regulations relating to the conduct of the work as drawn and specified shall be complied with by the Laundry Equipment Contractor and they shall give all notices required.

2. Any work upon which an inspection certificate by local authorities, and/or any governing body is required, such inspection certificate or certificates shall be obtained and paid by Owners.
- B. Certificates of acceptance or of completion as required and issued by the State, Municipal, or other authorities shall be procured and delivered to the Owner; and the Owner may withhold payments which are due, or which may become until the necessary certificates are procured and delivered to him.
- C. Safety devices are required to comply with the aforementioned regulations shall be furnished, regardless of whether or not specifically specified or called for in the following technical divisions of the equipment list schedule.
- D. Where applicable electrical equipment shall conform to the standards of the National Electrical Manufacturers' Association,
  1. This equipment shall have conveniently located control switches, enclosed case type, and shall comply with State of Alabama Electric Codes and bear the UL or approved Electrical Testing Laboratory (ETL) label.
- E. Electrically heated and motor driven fixtures shall be for the current shown in the Mechanical and Electrical plans, and these items of equipment shall have mounted motor starters, switches and controls.
  1. All the above shall be required for each fixture or complete section of a fixture, or as specified.
- F. Gas burning equipment shall be designed for operation with the type of gas supplied and shall be approved by the American Gas Association.
  1. The label or listing of the American Gas Association will be accepted as conforming to this requirement.
  2. Installation of equipment shall conform to the standards as set forth by the American Gas Association.
  3. All gas equipment shall be furnished with electronic ignition or with a safety pilot and one hundred percent safety cut-off protection where required.
- G. The Laundry Equipment Contractor shall be held responsible and liable for any and all changes or variances from Contract Documents, i.e. Plans, Specs, Addendums, without written authorization from Architect for said changes or variances.

### 1.3 REFERENCES

- A. The drawings indicate the desired basic arrangement and dimensions of the equipment
- B. Minor deviations may be substituted for approval provided basic requirements are met and no major rearrangement of services to the equipment is required to affect the proposed alteration.
  1. Such deviations shall be made without expense to the Owners.
  2. Should there be any questions, Architects shall be contacted for written instructions.
- C. The Laundry Equipment Contractor shall be responsible for the satisfactory operation of the assembled equipment.
  1. Tests of the installed equipment shall be required.
    - a. Defects or deficiencies noted as a result of tests shall be corrected at the expense of the LEC.
- D. LEC is to consult the mechanical and electrical drawings and their accompanying specifications to determine additional requirements of the work and shall cooperate with all trades to insure a completely satisfactory installation.
  1. Verify all electrical requirements form electrical plans and specifications.

**1.4 SUBMITTALS**

- A. Refer to Division 01 requirements for Submittals
- B. LEC shall verify all field measurements on the job site to insure proper fitting of all equipment. Within four (4) weeks after award of contract,
- C. LEC is to electronically submit PDF format to the Architect, for tentative approval, all dimensioned rough-in drawings, equipment submittal brochures, fabrication and manufacturer's shop drawings.
  - 1. Partial submittals will not be accepted and will be stamped Revise / Resubmit. Reproduction of original contract documents are not acceptable for use as submittal.
- D. After initial review of submittal data, revise and resubmit only the data sheet, coversheets or rough-in and shop drawings that have been modified or revised.
  - 1. The entire submittal is not required for a resubmission.
- E. After two resubmissions, the LEC may be charged a fee for Camacho's continuous re-evaluation.
  - 1. This will be billed as an additional service.
- F. Field Measurements:
  - 1. Measurements required to size and place Laundry Equipment are to be verified with onsite field dimensions.
    - a. Do not rely on or measure drawings for actual on-site dimensions.
    - b. Dimensions shall be taken from the actual structure, giving due consideration to any architectural, structural or mechanical discrepancies that may occur during construction of building.
    - c. Field dimensions shall be taken at the earliest opportunity so as not to delay deliveries.
    - d. Notify Laundry Equipment Consultant of the earliest date and time.
    - e. The LEC shall be responsible for proper fit of all equipment furnished under this section of the contract.
      - 1) Gaps over ¼" wide are not acceptable.
- G. Rough-In Drawings:
  - 1. Prepare and submit, rough-in drawings showing all utility rough-ins for kitchen equipment items including items listed as "Future, Existing-Relocate, and/or Owner Furnished" (min. scale of 1/4"=1'-0").
  - 2. Drawings to indicate size and location of all utilities, floor depressions, raised bases and wall openings for equipment.
  - 3. The item numbers shown on the rough-in drawings shall be the same as shown on contract documents.
  - 4. Drawings shall be dimensioned to the stub up or stub out, not to the connection on the equipment.
    - a. The LEC shall be responsible for conforming to these conditions with equipment and connections; in the event rough-in has been completed before award of contract,
    - b. The LEC shall thoroughly investigate, and field verify the provided rough-in locations and provide equipment to suit building conditions.
  - 5. The LEC to provide equipment floor plan with itemized equipment, to include all utility loads.
  - 6. Electrical rough-in plans are to be dimensioned to indicate above finished floor (AFF) height.

- a. Verify all NEMA plug types, length of cords, equipment connections lengths. Length is to be of adequate distance for outlets available and to allow equipment to be placed as shown on contract documents.
  - 1) 90° plug heads are recommended where available.
- b. Show convenience receptacle locations on the MEP plans & Elevations.
7. Plumbing rough-in plans are to be dimensioned to indicate above finished floor (AFF) height.
8. Ventilation rough-in plans are to be dimensioned and indicate above finished floor (AFF) height.
9. Special conditions plan indicating dimensions and locations of:
  - a. Mechanical plan, not special conditions.
  - b. Raised pads.
  - c. Wall openings for pass through equipment.
  - d. Floor drains.
  - e. Electrical plan, not special conditions.
  - f. Wall backing.
  - g. Recessed or wall mounted control panels.
10. Provide a refrigeration system schematic piping plan indicating line size, elevation, trap locations and all specified components required for the refrigeration system installation.
  - a. The plan is to include equipment and parts provided by the Refrigeration Equipment Manufacturer.
  - b. Verify refrigeration sizing is proper for line lengths determined by actual field conditions.
11. Equipment Cut Sheets:
12. The following instructions for Rough-In and Equipment submittal are in addition to any requirements given elsewhere in the Documents.
  - a. Prepare and submit equipment cutsheets showing all manufacturer's data sheets describing equipment as specified. Include items listed as "Future, Existing-Relocate, and/or Owner Furnished".
    - 1) The item numbers shown on the submittal shall be the same as shown on contract documents.
  - b. The equipment cut sheets are to be provided using Auto Quotes format or similar including coversheets for each item.
  - c. Where a piece of equipment is used and specified with multiple item numbers assigned, the first item is to be provided with a cover sheet and data sheet.
    - 1) For additional identical items provide cover sheets only.
  - d. Provide the following information on the coversheets:
    - 1) Project name.
    - 2) LEC name.
    - 3) Consultant name.
    - 4) Item Number.
    - 5) Equipment description.
    - 6) Quantity.
    - 7) Written Specification / Description of equipment provided.
    - 8) Accessories.
    - 9) Utilities.

H. LEED Submittals:



1. Provide product cutsheets noting ENERGY STAR rating for ENERGY STAR eligible equipment.
- I. Shop Drawings
  1. Shop drawings shall be provided on similar size drawing sheets as contract documents.
    - a. All shop drawings shall be detailed and fully dimensioned to a minimum scale of  $3/4" = 1'-0"$ .
    - b. Elevations and sections to be detailed to a minimum scale of  $1-1/2" = 1'-0"$ .
  2. Show all materials, gauges and methods of construction, including relation to adjoining and related work when cutting or close fitting is required.
  3. Show all reinforcements, wall plates and backing, anchorage, other work required for a complete installation of fixtures.
  4. Drawings to show item number and quantity required for each detail.
  5. Show adjacent walls, columns, and identify countertop equipment showing item numbers and description.
  6. Show all components that are included in fabricated equipment.
  7. For equipment with load centers (panels), indicate total electrical calculations including circuits.
    - a. Provide electrical diagram for onsite electrician.
  8. Provide color, pattern or finishes for laminated, fiberglass, paint, or stain for approval by the Architect/Owner.
  9. Omissions and discrepancies on approved drawings shall not relieve the LEC of providing items as specified and shown on contract drawings

### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. All equipment herein specified shall be delivered to the job site, uncrated, assembled and set in proper area; ready for final connections, where required, as specified in Sections 23 00 00 and 26 00 00 of Contract Documents.
- B. Protect metal finishes from damage during shipping storage, handling, installation and construction of other work in the same spaces.
  1. Wrap and crate each item of equipment as needed for protection from damage.

### **1.6 SEQUENCE/SCHEDULING**

- A. Schedules And Reports:
  1. Establish earliest and latest job site delivery dates of Owner furnished and Contractor installed items.

### **1.7 WARRANTY**

- A. Workmanship And Guarantees:
  1. All material as specified shall be new, of the best quality, perfect, and without flaw. Equipment shall be delivered in an undamaged condition upon completion. All workmanship and labor shall be of the best in their respective field and skilled mechanics of the trades involved.
  2. All equipment as specified herein this Section shall be guaranteed for a period of one year from the time of Substantial Completion.

- a. If at any time within this warranty period of one year any items of equipment that is found to be faulty due to poor workmanship, or inferior, and/or defective materials, replace said pieces or correct each defective part at no cost to Owner.

## 1.8 SUBSTITUTIONS

- A. Substitution of materials and equipment:
  1. Whenever a material, article, or piece of equipment is identified on the Drawings or in the Specifications by reference to manufacturers' or vendors' names, trade names, catalog numbers, or the like, it is so identified for the purpose of establishing a standard. and any material, article, or piece of equipment of other manufacturers or vendors which will perform adequately the applications required by the general design will be considered equally acceptable, provided, in the opinion of the Architects, it is of comparable substance, appearance and function.
  2. The substituted equipment shall not be purchased or installed without the proper written approval.
    - a. All substitutes shall be submitted for approval at least 10 days before Bid Date.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Refer to the Laundry Equipment Plan for the location of equipment:

**ITEM # ELL-1                      LAUNDRY SINK W/FAUCET**  
**Quantity:                        One (1)**  
**Manufacturer:                  Mustee**  
**Model:                             19CF**

- a. Model 19CF Furnish and install as shown on plans, UTILATUB® Laundry/Utility Tub model 19CF, as manufactured by E.L. Mustee & Sons, Inc. Tub shall be one-piece molded construction using structural thermoplastics with matched metal molds under extreme heat and pressure. Tub to include integrally molded drain assembly for connection to standard 1-1/2" P or S-trap, stopper and wall mounting hardware or heavy gauge steel legs with built-in levelers. 18-gallon capacity tub, 13" deep. Shall meet ANSI Specification Z 124-2011. Color: White.
- b. PROVIDE WITH FAUCET - MODEL NO. 93.600

**ITEM # ELL-2                      EYE WASH, PEDESTAL MOUNTED**  
**Quantity:                        One (1)**  
**Manufacturer:                  GUARDIAN**  
**Model:                             G1825BC**

- a. Model G1825BC Free standing, pedestal mounted eyewash. The unit has stainless steel cover to protect bowl from dust, dirt and other contaminants. Two GS-Plus spray-type spray heads deliver a flood of water for rinsing eyes. Two GS-Plus spray heads. Each head has an internal flow control and filter to remove impurities from the water flow.

**ITEM # ELL-3                      75 LB TUMBER DRYER**  
**Quantity:                        One (1)**  
**Manufacturer:                  Unimac**  
**Model:                             UT075G**

- a. Model UT075G 75 LB DRYER  
UNIMAC Model No. UT075G  
NATURAL GAS - 165,000 BTU  
208V - 3PH  
FAN MOTOR - 0.5 HP  
CYLINDER MOTOR - 0.5 HP  
AIR OUTLET - 8" DIAMETER

**ITEM # ELL-4                      DUCT MOUNT LINT FILTER**  
**Quantity:                      One (1)**  
**Manufacturer:                  Energenics**  
**Model:                              AF-1**

- a. Model AF-1 Air Free Duct Mounted Filter - Self Cleaning.  
No energy or utility required.

**ITEM # ELL-5                      65 LB. WASHER EXTRACTOR**  
**Quantity:                      One (1)**  
**Manufacturer:                  Unimac**  
**Model:                              UWT065D4**

- a. Model UWT065D4 65 LB. WASHER  
UNIMAC Model No. UWT065D4  
HARDMOUNT  
208V - 3PH  
5 HP  
65 LB. DRY WEIGHT CAPACITY

**ITEM # ELL-6                      WASHER DRAIN TROUGH**  
**Quantity:                      One (1)**  
**Manufacturer:                  Provided by GC**

- a. PROVIDED BY GENERAL CONTRACTOR
- b. VERIFY LOCATION WITH STRUCTURAL

**ITEM # ELL-7                      HAND SINK**  
**Quantity:                      One (1)**  
**Manufacturer:                  Advance Tabco**  
**Model:                              7-PS-60**

- a. Model 7-PS-60 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20-gauge 304 stainless steel, with splash mounted heavy duty gooseneck faucet, basket drain, wall bracket, NSF, cCSAus.

**ITEM # ELL-8                      SPARE NO.**

**ITEM # ELL-9                      DUCT MOUNT LINT FILTER**  
**Quantity:                      One (1)**  
**Manufacturer:                  Energenics**  
**Model:                              AF-1**

- a. Model AF-1 Air Free Duct Mounted Filter - Self Cleaning.  
No energy or utility required.

**ITEM # ELL-10                    75 LB. TUMBLE DRYER**  
**Quantity:                      One (1)**

**Manufacturer:** Unimac  
**Model:** UT075G

- a. Model UT075G 75 LB DRYER  
 UNIMAC Model No. UT075G  
 NATURAL GAS - 165,000 BTU  
 208V - 3PH  
 FAN MOTOR - 0.5 HP  
 CYLINDER MOTOR - 0.5 HP  
 AIR OUTLET - 8" DIAMETER

**ITEM # ELL-11**            **WASHER DRAIN TROUGH**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Provided by GC**  
**Model:**                **CUSTOM**

- a. Model CUSTOM PROVIDED BY GC

**ITEM # ELL-12**            **65 LB. WASHER EXTRACTOR**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Unimac**  
**Model:**                **UWT065D4**

- a. Model UWT065D4 65 LB. WASHER  
 UNIMAC Model No. UWT065D4  
 HARDMOUNT  
 208V - 3PH  
 5 HP  
 65 LB. DRY WEIGHT CAPACITY

**ITEM # ELL-13**            **EYE WASH, PEDESTAL MOUNTED**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **GUARDIAN**  
**Model:**                **G1825BC**

- a. Model G1825BC Free standing, pedestal mounted eyewash. Unit has stainless steel cover to protect bowl from dust, dirt and other contaminants. Two GS-Plus spray-type spray heads deliver a flood of water for rinsing eyes. Two GS-Plus spray heads. Each head has an internal flow control and filter to remove impurities from the water flow.

**ITEM # ELL-14**            **LAUNDRY SINK W/FAUCET**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Mustee**  
**Model:**                **19CF**

- a. Model 19CF Furnish and install as shown on plans, UTILATUB® Laundry/Utility Tub model 19CF, as manufactured by E.L. Mustee & Sons, Inc. Tub shall be one-piece molded construction using structural thermoplastics with matched metal molds under extreme heat and pressure. Tub to include integrally molded drain assembly for connection to standard 1-1/2" P or S-trap, stopper and wall mounting hardware or heavy gauge steel legs with built-in levelers. 18-gallon capacity tub, 13" deep. Shall meet ANSI Specification Z 124-2011. Color: White.
- b. PROVIDE WITH FAUCET - MODEL NO. 93.600

**ITEM # ELL-15**                    **HAND SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Advance Tabco**  
**Model:**                        **7-PS-60**

- a. Model 7-PS-60 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20-gauge 304 stainless steel, with splash mounted heavy duty gooseneck faucet, basket drain, wall bracket, NSF, cCSAus

**ITEM # ELL-16**                    **CLEAN LAUNDRY CART**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**                **Dandux**  
**Model:**                        **51-2301**

- a. Model 51-2301 CLEAN LAUNDRY CART  
Poly shelf truck, polyethylene body, powder coated reinforced tubular steel base, (4) 6" castes (bolted to welded caster plates), blue, Shelves swing down in front to make a bulk truck, drain holes.

**ITEM # ELL-17**                    **SOILED LAUNDRY CART**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**                **Dandux**  
**Model:**                        **40070016**

- a. Model 40070016 SOILED LAUNDRY CART  
High tensile sprint steel, water and ear resistant band, riveted stress points, reinforced wear points, rust resistant welded steel bottom support, quality casters rubber or composition, hardwood runners, ID pocket, handle and electro welded construction.

### **PART 3 - EXECUTION**

#### **3.1 DEMONSTRATION AND INSTRUCTION BOOKLETS:**

- A. At such time as designated by the Architect or Owner(s), demonstrate to proper personnel the use, care, and maintenance of equipment.
- B. Submit to Owner at time of demonstrations complete booklets, in hard binders, containing instructions, warranties, and parts list of all bought out items furnished under this section.
  1. Include in the binders a list of names, addresses and telephone numbers of local servicing agencies authorized to make necessary repairs and/or adjustments of the equipment furnished under this Section of Contract Documents.

#### **3.2 INSTALLATION**

- A. Laundry Equipment shall be delivered to job site, freight prepaid.
- B. Uncrate, assemble and install, or erect where required, all items of Laundry Equipment. Shall connect such items, as necessary for use, to building utility systems.
- C. The final hook-up and equipment connections shall be made by the project's Plumbers, HVAC personnel and Electrician.
- D. Provide on-site testing of equipment.
  1. LEC shall make modifications or corrections as necessary for the intended operation and use of specified equipment.

- E. On completion of installation and testing, remove all packaging and debris from site, clean all items of equipment as recommended by manufacturer and leave equipment ready for use by Owners.
- F. The Laundry Equipment Contractor shall have a competent Laundry Equipment Foreman on the premises to assist in furnishing information to tradespersons and supervising installation of equipment under this section.

END OF SECTION

**SECTION 11 31 00 - RESIDENTIAL APPLIANCES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Cooking appliances.
    - a. Microwave countertop ovens.
    - b. Microwave ovens.
    - c. Microwave drawers.
  - 2. Refrigeration appliances.
    - a. Refrigerators.
    - b. Undercounter refrigerators
    - c. Freezers.
    - d. Undercounter freezers.
  - 3. Cleaning appliances
    - a. Dishwashers.
- B. Related Requirements:
  - 1. Division 12 for Countertops.
  - 2. Division 22 for Plumbing Fixtures.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Product Data Submittals: For each type of product indicated.
  - 1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- C. Product Schedule: For appliances. Use same designations indicated on Drawings.
  - 1. Indicate appliances status using one of the following descriptions:
    - a. Contractor Furnished-and-Installed (CFCI).
    - b. Owner-Furnished, Contractor-Installed (OFCI).
    - c. Owner-Furnished-and-Installed (NIC) (not in contract).

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For each type of appliance.
- C. Field quality-control reports.
- D. Sample Warranties: For manufacturers' special warranties.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

**1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Maintains, within 200 of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

**1.7 WARRANTY**

- A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period except as qualified below:
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Microwave Oven: Limited warranty, including parts and labor for first year and parts thereafter, for on-site service on the magnetron tube.
  - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Refrigerator/Freezer, Freezer, and Sealed System: Full warranty, including parts and labor, for on-site service on the product.
  - 1. Warranty Period: Three years from date of original installation.
  - 2. Warranty Period for Sealed Refrigeration System: Six years from date of original installation unless noted otherwise.
- D. Dishwasher: Limited warranty, including parts and labor for first year and parts thereafter, for on-site service on the product.
  - 1. Warranty Period for Deterioration of Tub and Metal Door Liner: Five years from date of Substantial Completion.
  - 2. Warranty Period for Other Components: Two years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Obtain residential appliances from single source.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and ADA Standards for Accessible Design and [ICC A117.1.

**2.3 COOKING APPLIANCES**

- ~~A. Microwave Oven:~~
  - ~~1. Mounting: Undercabinet.~~
  - ~~2. Type: Convection.~~
  - ~~3. Dimensions:~~
    - ~~a. Width: As indicated on Drawings.~~
    - ~~b. Depth: As indicated on Drawings.~~
    - ~~c. Height: As indicated on Drawings.~~
  - ~~4. Capacity: 2.0 cu. ft.~~
  - ~~5. Oven Door: Door with observation window and pull handle.~~
  - ~~6. Exhaust Fan: Variable speed fan, nonvented, recirculating type with charcoal filter and with manufacturer's standard capacity.~~
  - ~~7. Microwave Power Rating: Manufacturer's standard.~~



- ~~a. Convection Element Power Rating: Manufacturer's standard.~~
  - ~~8. Electric Power Supply: 120 V, 60 Hz, 1 phase, 15 A.~~
  - ~~9. Controls: Digital panel controls and timer display.~~
  - ~~10. Other Features: Turntable.~~
  - ~~11. Material: Stainless steel.~~
- B. Microwave Drawer:
1. Basis of Design: ZLINE 24", 1.2 Cu Ft, Stainless Steel Microwave Drawer, Model #MWD-TK-30.
  2. Mounting: Drawer style mounted in base cabinet.
  3. Type: Top loading.
  4. Dimensions:
    - a. Width: 29-3/4".
    - b. Depth: 23-3/8".
    - c. Height: 15-3/4".
  5. Capacity: 1.2 cu. ft..
  6. Oven Door: With observation window.
  7. Intuitive Control Panel: 45 degree angle design.
  8. Microwave Power Rating: 1000W.
    - a. Convection Element Power Rating: Manufacturer's standard.
  9. Electric Power Supply: 120 V, 60 Hz, 1 phase, 15 A.
  10. Controls: Touch screen.
  11. Other Features: Auto-touch Open and Close door.
  12. Material: Stainless steel, brushed.

## 2.4 REFRIGERATION APPLIANCES

- A. Manufacturers: Subject to compliance with requirements, provide Perlick or comparable products by the following:
1. Kenmore
  2. Summit
  3. LG
  4. True
  5. Samsung
- B. Refrigerator (Glass Front): Built-in undercounter refrigerator, ADA compliant.
1. Basis of Design Product: Perlick; Model HA24RB-4-3R/L.
  2. Type: Built-in
  3. Dimensions:
    - a. Width: 23.87 inches.
    - b. Depth: 24.00 inches.
    - c. Height: 32.00 inches.
  4. Storage Capacity: 4.8 cu. ft.
  5. Refrigerator Features:
    - a. Adjustable shelving.
    - b. Glass door.
    - c. Digital temperature control.
  6. Front Panel(s): Stainless steel trim glass door.
  7. Appliance Color/Finish: Black.
- ~~C. Refrigerator (Millwork Front): Built-in undercounter refrigerator, ADA compliant.~~
- ~~1. Basis of Design Product: Perlick; Model HA24RB-3R.~~
  - ~~2. Type: Built-in~~
  - ~~3. Dimensions:~~
    - ~~a. Width: 23.87 inches.~~
    - ~~b. Depth: 24.00 inches.~~
    - ~~c. Height: 32.00 inches.~~

- ~~4. Storage Capacity: 4.8 cu. ft.~~
  - ~~5. Refrigerator Features:~~
    - ~~a. Adjustable shelving.~~
    - ~~b. Wood overlay door.~~
    - ~~c. Digital temperature control.~~
  - ~~6. Front Panel(s): Wood overlay to be selected by Architect.~~
  - ~~7. Appliance Color/Finish: Black.~~
- D. Ice Storage (Two Drawer): Built-in undercounter freezer drawer, ADA compliant.
1. Basis of Design Product: Perlick; Model HA24FB-5.
  2. Type: Built-in
  3. Dimensions:
    - a. Width: 23.87 inches.
    - b. Depth: 24.00 inches.
    - c. Height: 32.00 inches.
  4. Storage Capacity: 4.8 cu. ft.
  5. Freezer Features:
    - a. Smooth glide self closing drawers.
    - b. Digital temperature control.
  6. Front Panel(s): Wood overlay to be selected by Architect.
  7. Appliance Color/Finish: Black.
- E. Refrigerator: Counter depth French door refrigerator, ADA compliant.
1. Basis of Design Product: Samsung; Model RF18A5101SR.
  2. Type: Free standing counter depth
  3. Dimensions:
    - a. Width: 32.125 inches.
    - b. Depth: 28.125 inches.
    - c. Height: 70 inches.
  4. Storage Capacity (Combined): 17.5 cu. ft.
  5. Refrigerator Features:
    - a. Adjustable glass shelving.
    - b. Door storage.
    - c. Humidity controlled crispers.
    - d. Interior LED light.
  6. Freezer Features:
    - a. Automatic icemaker.
    - b. Interior LED light.
  7. Front Panel(s): Stainless steel.
  8. Appliance Color/Finish: Stainless Steel.
- F. Refrigerator: Standard style, top freezer, ADA compliant.
1. Basis of Design Product: GE; ModelGIE18GCN/GSN/GTN.
  2. Type: Free standing counter depth
  3. Dimensions:
    - a. Width: 28 inches.
    - b. Depth: 26.75 inches.
    - c. Height: 67.50 inches.
  4. Storage Capacity (Combined): 17.5 cu. ft.
  5. Refrigerator Features:
    - a. Adjustable glass shelving.
    - b. Door storage.
    - c. Humidity controlled crispers.
    - d. Interior LED light.
  6. Freezer Features:
    - a. Automatic icemaker.
    - b. Interior LED light.

7. Front Panel(s): Stainless steel.
8. Appliance Color/Finish: Stainless Steel.

## 2.5 CLEANING APPLIANCES

- A. Dishwasher: Complying with AHAM DW-1.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide GE ADA Compliant Dishwasher; GDT225SGL/SSL or comparable product by acceptable to Architect.
  2. Type: Built-in undercounter.
  3. Dimensions:
    - a. Width: 23-3/4 inches.
    - b. Depth: 23-1/2 inches.
    - c. Height: 34 inches.
  4. Sound Level: Maximum 51dB.
  5. Tub and Door Liner: Manufacturer's standard stainless steel with sealed detergent and automatic rinsing-aid dispensers.
  6. Rack System: PVC-coated sliding dish racks, with removable cutlery basket.
  7. Energy Star: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.
  8. Front Panel: Manufacturer's standard.
    - a. Panel Color: Stainless steel.
  9. Appliance Color/Finish: Stainless steel.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install appliances according to manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

### **3.3 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
  - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After installation, start units to confirm proper operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.4 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION

**SECTION 11 40 00 - FOOD SERVICE EQUIPMENT****PART 1 - GENERAL****1.1 DEFINITIONS**

- A. The following definitions are intended to clarify the relationships involved in this document and are used as a definition throughout this food service specification.
- B. Food Service Equipment Contractor (FEC) - The FEC is the party responsible for supplying, delivering (including freight, staging, and local warehousing as required), assembling, setting in place, installing, cleaning, sanitizing, and polishing any foodservice item(s) included in this contract, but not limited to all required materials and labor, pursuant to the guidelines and timelines scheduled and rescheduled by the Owner, Architect and Camacho, Incorporated.
- C. Sub-Contractors - The FEC may contract Sub-Contractors to perform any portion of the contract, but the final responsibility for the proper performance of the contract rests solely with the FEC.
- D. General Contractor (G.C) - The G.C. / Construction Manager (C.M.) has the responsibility for overall installation, scheduling, deliveries, coordination of various trades, rough-in and connection of utilities, including but not limited to all labor and materials for said rough-ins and connections for all equipment in this contract unless otherwise specified, by item, within the equipment data specification sections of this contract. The FEC must coordinate its activities and needs with the G.C. / C.M. in a timely manner so as not to delay the project.
- E. Food Service Designer / Consultant – Camacho Foodservice Design and Consulting (Camacho) is the food service designer/consultant for this project.
- F. The FEC is the party responsible for all taxes, tariffs, duties, and/or customs fees and permits where applicable, as may be required. The FEC is contracted by the Owner.
- G. N.I.F.C. - Whenever the abbreviation N.I.F.C. is used in this contract, it shall mean the item or items are not part of the Food Service Equipment Contract.
- H. The assignments and responsibilities as outlined in this section are subject to change at the Owner/Architect's discretion.

**1.2 RELATED DOCUMENTS**

- A. All drawings, general, special, and/or supplementary conditions, Division 01000, specifications, and related documents apply to this specification. The Foodservice Consultant for this project is Camacho. The consultant is responsible to the Project Architect and the Owner to ascertain that the FEC complies with all the requirements of this section.
- B. All work included under this section is subject to Architect's provisions covering Invitation to Bid, Proposal Form, Instructions to Bidders, General Conditions, and all other Supplementary General Conditions as may be added.

**1.3 INTERPRETATIONS****A. PLANS AND SPECIFICATIONS**

- B. The extent of the Food Service Equipment is on the drawings, Equipment Schedule, and Specifications of this Section of Performance Criteria. Each model number includes the code \*C013 and \*C014 as a suffix. This code is known as the Specifier Identification System. It is not

to be removed by the bidders. Its purpose is to identify the specifier to the vendors providing the equipment when it is necessary to communicate questions, clarifications, and comments from before the bid award through the final purchase. It is to be used on all correspondence, including fax and e-mail, when communicating with manufacturer representatives and factories.

- C. The plans indicate the location of the equipment. Slight changes due to the varying dimensions of equipment and wall construction shall be permitted with approval by the Architect.
- D. Conflict in Plans and Specifications where changes, alterations, additions, or deductions are necessary, or where exceptions are concerning sizes, locations, and other details shown on plans, shall be reported in writing for a decision by the Architect.
- E. The Contractor shall be responsible for seeing that the equipment can be entered through openings before the doors and walls are finished.
- F. Should it appear that the work intended to be described or any of the matters relative thereto are not sufficiently detailed or explained on the drawings or in the specifications, the Contractors shall apply to Camacho / Architect for such drawings or explanations as may be necessary and shall conform to them as far as they shall be consistent with original drawings.
- G. If any question arises regarding the true meaning of the drawings, specifications, and/or typographical errors, reference shall be made to Camacho / Architect, whose decision shall be conclusive.
- H. In no instance shall a bid be submitted, or any work started with any uncertainty.
- I. Before doing any work or ordering any materials, the Contractors shall verify all measurements of any work and shall be responsible for their correctness. Any differences which may be found shall be submitted to Camacho / Architect for consideration before proceeding with the work.
- J. Extra compensation will not be allowed because of differences between actual dimensions and measurements indicated on the working drawings.
- K. Where a conflict occurs between or within standards, specifications, codes, ordinances, and working drawings, the more stringent or higher quality requirements shall apply.

#### **1.4 APPLICABLE DOCUMENTS**

- A. Bidding Documents, Contract Forms, and related materials issued by Camacho, the Project Architect, G.C. / C.M., and the Owner before awarding a contract apply to this section.
- B. Architectural, Mechanical, Electrical, and Structural Plans and other Specifications, including all supplements issued thereto and other pertinent documents issued by Camacho, the Project Architect, C.M., and/or the Owner, are a part of these Specifications and the accompanying food service equipment plans and shall be complete within every respect. All the above included herewith will be issued separately by C.M. or is on file at Camacho / Project Architect's office and shall not relieve the Contractors of responsibility or be used as a basis for additional compensation due to omission(s) of Architectural, Structural, Mechanical, Plumbing or Electrical details from food service equipment documents.

#### **1.5 BASE BIDS AND SUBSTITUTIONS**

- A. Substitution of Materials and Equipment:
  - 1. Where equipment is specified by the name of the manufacturer and model number, it is intended that the designated name and number represent a standard of quality and is not intended to restrict competition in any way. The Architect reserves the right to accept or reject each proposed substitution, and such decision shall be final and binding upon all parties. All proposed equipment substitutions shall be submitted at least ten (10) days

- prior to the date of the bid to the Architect, and all substitutions must acquire pre-bid approval. It is, furthermore, the intention of these specifications to produce a set of Foodservice Equipment to meet the needs of the Owner. Among the primary requirements are sanitation, ready accessibility for cleaning, low-cost maintenance and operation, strength, and ruggedness. Any construction detail or evasion of any of the specification requirements shall be cause for rejection. Plans and specifications are based on the products or systems of the first-named manufacturer. Any modifications and substitutions other than the first name that require changes in plumbing, mechanical, or electrical shall be coordinated and paid for by the FEC, as noted in this section.
2. Acceptance of proposed substitution is entirely at the discretion of the Owner or their Representative and subject to the following qualifications:
    - a. Equal in quality of material used in structural strength and details of construction.
    - b. Equal in performance, mechanically, and productivity.
    - c. Equal in the finish or in characteristics permitting specified finish to be applied.
    - d. Availability of replacement parts and maintenance service.
  3. The bid price for each proposed substitute shall include all money required to incorporate the substitute into the project. Later requests for additional monies for substitutes will not be considered.
- B. Bidders recommending substitutions are cautioned to examine the plumbing, mechanical, and electrical plans, and conditions at the building site to determine if such substitution will require changes in plumbing, mechanical and electrical connections already planned or installed. If the proposed substitutions require such changes, the bidder shall include the cost of the same in their bid and call it to the attention of the Architect by including a descriptive notation in the request for approval.
- C. Engage a firm experienced in manufacturing food service equipment similar to that indicated for this project and with a record of successful in-service performance. It is required that all "Fabricated Special" items of equipment such as food service units, tables, sinks, countertops, etc., described in the following specifications other than by name and catalog numbers, be manufactured by a Foodservice Equipment Fabricator who has the manufacturing plant, personnel, and engineering facility to properly design, detail and manufacture high-quality foodservice equipment, NSF and UL approved. The manufacturer shall be subject to the approval of the Architect and Owner. All work in the above category shall be manufactured by one manufacturer and shall be of standard unit assembly and of uniform design and finish.
- D. The manufacturer of this equipment must be able to show that they have, for the past seven years, been engaged in the manufacture of and distribution of equipment as required by the Contractor as their principal product.
- E. All submittals for proposed substitutions must be submitted with an equipment data sheet for each item. The data sheet shall consist of the project name, the Project Architect, the Foodservice Consultant, the firm submitting, the item number, the manufacturer, the manufacturer's model number, a complete written description of what is to be provided, and accessories and options list of what is to be provided, finishes, dimensions, utility requirements as provided (i.e., GAS: NAT or LP, electrical: voltage/phase and amps, plumbing/mechanical: water/sewer, etc.) as well as the type of connection.
- F. The data sheet shall have a blank space (3-1/2"w x 5"h) in the lower right corner of the sheet for stamping, etc. This information must be submitted not less than ten (10) days from the bid due date to be considered as an alternate.
- G. Where substitutions are made by the FEC with the written approval of Camacho / Project Architect, the FEC shall be responsible for and pay all costs of any consequential modifications which may result from the substitution.

- H. If the FEC decides to submit an alternate manufacturer and receives a written response from Camacho / Project Architect accepting this change, then all resulting expenses incurred in the changes or additions to the food service equipment work as well as other contractor's work, shall be the sole responsibility of the FEC and shall be considered as part of the base bid with no additional compensation permitted.
- I. Accepted substitutions will be noted in an addendum issued by the PA/E. No other substitutions and deviations from the primary manufacturer will be permitted subsequent to the date of the Bid Opening except by specific change order and only with sufficient cause. The approval of substitution does not approve, relieve or change the Contractors' responsibilities as outlined herein.
- J. Task/Responsibility
1. Project Coordination: GC/CM\*
  2. Permits (Health Department): ARCH/OWNER
  3. Construction Schedule: GC/CM/ARCH
  4. Coordination of Inspections (Foodservice): FEC
  5. Demolition of Kitchen Equipment (If required): FEC
  6. Wall Repairs (If required): GC/CM
  7. Rough-In Drawings: FEC
  8. Rough-Ins (Required Service to Utility Connections noted on FEC Rough-In Drawings): PC/EC/MC
  9. Tile Work: GC/CM
  10. Stainless Steel Wall Panels: FEC
  11. FRP (Wall Panels): GC/CM
  12. Furnish of Specified Equipment: FEC
  13. Liquor Dispensing System (If Required): FEC
  14. Beverage Raceway and Conduits (If Required): FEC
  15. Beer Systems (If Required): FEC
  16. Bulk CO2 System (If Required): FEC
  17. Indirect Wastes Extend from Equipment to Drains: PC
  18. Installation of Foodservice Equipment: FEC
  19. Final Utility Connection: PC/EC/MC
  20. Utility Interconnections: PC/EC/MC
  21. Trim and Seal Foodservice Equipment: FEC
  22. Clean-Up of Foodservice Areas: FEC
  23. Walk-In Refrigeration Floor Insulation: FEC
  24. Walk-In Refrigeration Sub-Floor and Finished Floor: GC/CM
  25. Walk-In Refrigeration Lighting: FEC Furnished, EC Installed
  26. Ceilings: GC/CM
  27. Floor Troughs: FEC Furnished, PC Installed
  28. Floor Sinks, Floor Drains, Funnel Floor Drains: PC
  29. Mop Sinks, Hand Sinks: PC (Unless otherwise specified)
  30. Bar Scupper Trough (Located by FEC): MWC
  31. Foodservice Sneeze Guards FEC (Unless otherwise Specified)
  32. Insulation of Piping: PC

\*Or as specified in general specifications as prepared by the Architect.

## 1.6 INTENT

- A. It is the intent of the Contract Documents for each/every item and component to be complete with all required devices and standard features necessary for that item and component to function properly.



- B. It is the intent of the Contract Documents for each/every item and component to function and perform in a manner equal to the Primary Manufacturer's intent. FEC is required to notify Camacho / Project Architect in writing of any or all discrepancies or omissions of any components prior to submitting the bid.
- C. Failure of the FEC to report any discrepancies and/or omissions prior to submitting his bid shall not relieve the FEC of his responsibilities for providing complete, functioning, workable systems in full accordance with the intent of the Contract Documents.

## 1.7 RESPONSIBILITY MATRIX

- A. The following represents the basic contractor responsibilities for this project. The assignments and responsibilities as outlined in this section are subject to change at the Owner/Architect's discretion.
  - 1. Abbreviations:
    - a. CM - Construction Manager
    - b. GC - General Contractor
    - c. FEC - Food Service Equipment Contractor
    - d. PC- Plumbing Contractor
    - e. EC - Electrical Contractor
    - f. MC - Mechanical Contractor
    - g. MWC - Millwork Contractor

## PART 2 - SCOPE OF WORK

### 2.1 WORK INCLUDED

- A. Work required under this section consists of providing all necessary services, tools, equipment, material, and labor required to provide the continuous installation (the term installation shall mean the complete installation including, but not limited to, the delivery of all food service equipment items and necessary components complete with transportation charges and taxes prepaid by the FEC to the job site's location) as designated on the food service equipment plan, uncrated, erected, set in place, leveled and made ready for final connection, by G.C., to plumbing, gas, electrical and steam utilities, as specified in Divisions 22000 and 26000 of Performance Criteria and properly anchored and trimmed as may be required.
- B. FEC is to deliver all parts and components, which are to be built into cast-in-place concrete and masonry, in ample time for inclusion in the concrete and masonry work. Furnish necessary setting plans and instructions, oversee the installation of all parts in the masonry and concrete, and be responsible for the correctness and accuracy of the location and installation.
- C. FEC to provide holes, ferrules, and stainless-steel chases on equipment for pipes, drains, electrical outlets, conduits, and similar items as may be required to coordinate and accommodate the installation of the food service equipment in connection with the work of other contractors.
- D. FEC to provide the necessary materials, labor, services, and incidentals necessary for the completion of these sections of work, including but not limited to adhesive, caulking, sealing, trim strips, chases, corner guards, corner trims, and closure panels.
- E. FEC to provide items and components hereinafter specified and shown on plans, completely assembled, or erected in locations indicated, ready for final connections to service by the respective trades. The labor and material(s) required for final connections are the responsibility of G.C. / C.M.

- F. FEC will provide and install where required fasteners, flashing, trim strips, filler panels, can't strips, and caulking and sealant required to complete the installation.
- G. All roof, wall, and floor assemblies, including finishes (as specified herein), penetrations, openings, curbs, platforms, and dunnage pursuant to the requirements of the food service ventilation and refrigeration items are to be provided and installed by the G.C. unless specified otherwise.
- H. All roof, wall, and floor assemblies, including finishes (as specified herein), penetrations, openings, curbs, platforms, and dunnage pursuant to the requirements of the food service ventilation and refrigeration items are to be provided and installed by the G.C. unless specified otherwise.
- I. Keep premises clean and remove from the site all crates, cartons, and other debris resulting from the work. Leave all areas "broom cleaned" and all equipment items and furnishings "construction clean." Final cleaning, sanitizing, and polishing of all equipment items and furnishings shall be done by the FEC. Further, it is the FEC's responsibility to provide protective coverings for all equipment items delivered to the job site during construction.

## 2.2 RELATED WORK OF OTHER CONTRACTORS

- A. Division 01 0000 - General Construction
  - 1. All floor assemblies, including finishes, openings, depressions, sleeves, curbs, and bases.
  - 2. All wall and partition assemblies, including finishes, openings, recesses, sleeves, furring, and backing.
  - 3. All ceiling assemblies include finishes, openings, soffits, access panels, fire separation, and sleeves.
  - 4. All roof assemblies, including finishes, openings, curbs, platforms, and dunnage.
  - 5. All structural supports or grounds for hanging or fastening food service equipment and assemblies as may be described in this section.
  - 6. G.C. to provide on-site storage trailer(s) and security for the Owner's existing and FEC-provided food service equipment to be used on this project, if applicable.
- B. Division 22 0000 - Mechanical
  - 1. Water, gas, and steam supply systems, as required.
  - 2. Sanitary and grease-laden drainage systems.
  - 3. Final plumbing connections include mounting drains, faucets, pre-rinses, hoses, and piping from the point of connection on equipment to building plumbing systems and interconnections between equipment components. Install all hoses from utility raceways to connection points on equipment.
  - 4. Grease traps.
  - 5. Indirect drain line runs from equipment items to the nearest floor drain or floor sink as required.
  - 6. Gas, water, steam pressure-reducing valves, and all other fittings as required. .
  - 7. Gas shut-off valve(s) as required for ventilator fire suppression system and gas regulators on individual pieces of gas-fired equipment in accordance with the manufacturer's recommendations are to be provided by the FEC and installed by the G.C.
  - 8. FEC to furnish faucets with nipples, elbows, supply lines, valve stops, drains, splash-mounted vacuum breakers, etc., for each equipment item as specified herein. Items to be installed by the G.C.
  - 9. All exposed plumbing related to or in connection with food service items is to be chrome plated.

10. Indirect wastes shall be chrome plated and are to drip over and into floor drains and floor sinks. Where drains and supply lines run under equipment, provide the proper support from the underside of the equipment to eliminate interference with cleaning and maintenance.
  11. When the Exhaust Hood Systems are to be furnished and installed by Division 22000 and are not to be included as part of the FEC work, Division 22000 shall provide and install the gas valve in the main supply line serving the cooking equipment to shut off gas service to the cooking equipment in the event of fire system actuation. This work must be coordinated with the FEC and in accordance with NFPA 17A and NEC. This work shall be further provided in accordance with this specification.
- C. Division 23 0000 - H.V.A.C. .
1. G.C. to provide and install all necessary components as may be required for the exhaust/make-up air system(s) and condensate exhaust air system, including but not limited to the fans (unless provided by the FEC), ducting, gas shut-off valve(s), curbs, penetrations, dampers, controls, and switches unless otherwise specified herein.
  2. G.C. to provide and install as required rated chase(s) as well as other separations as may be required.
  3. G.C. to provide and install all heating, ventilating, and air conditioning systems except as otherwise specified in this section.
- D. Division 26 0000 - Electrical
1. All electrical distribution, lighting, and power systems except otherwise specified in this section.
  2. Final electrical connections and interconnections, including labor and materials from point of connection on equipment to building electrical systems and required interconnections between equipment components.
  3. All electrical materials, including wire, conduit, over-current protection, main switches, safety cut-outs, shunt-trip breakers, disconnect switches, lighting control devices, surge protectors, uninterruptible power units, and controllers.
  4. Shunt-trip breakers and contactors and all conduits for shut down of electrically operated cooking equipment and ventilation equipment as required for the ventilator fire suppression system.
  5. Empty conduit systems for refrigeration system, as specified and shown on food service drawings.
  6. Empty conduit system for point-of-sale system, as specified and shown on food service drawings.
  7. Empty conduit system for fire suppression system, as specified and shown on food service drawings.
  8. FEC shall furnish all electrically operated portable and movable equipment items with factory-installed 3-wire or 4-wire heavy-duty insulated cords with a grounded plug with one leg of the cord grounded to a conductible portion of the item's frame.
  9. Furnish and install switches and disconnects within the equipment, contractors, and combination starters with fused disconnects, controls, and similar items necessary for the safe and proper operation of the equipment and for compliance with all N.E.C. and local AHJ requirements.
  10. All switches, disconnects, and control devices shall be safely accessible without reaching across or over any hot and hazardous equipment items.
  11. FEC to secure cords, to the underside of the equipment, on portable and movable equipment to allow ease of maintenance or as required by the owner.
  12. Install all electrical cord sets as provided by the FEC as part of the food service equipment and install all cord sets from utility raceways to connection points on equipment.

13. When the Exhaust Hood Systems are to be furnished and installed by Division 220000 and are not to be included as part of the FEC work, Division 260000 shall furnish and install automatic power disconnect devices (shunt trip breakers or definite purpose contactors) with interlock to fire system micro switch, to shut off all power below the hood (including control voltage) in the event of fire system actuation. This work must be coordinated with the FEC and in accordance with NFPA 17A and NEC.
- E. All Plumbing, Steam, Electrical, and Ventilation Work required in connection with this section shall be done by the other Contractor unless specifically called for in the itemized Equipment Specifications. Work of others shall include but not be limited to exhaust fans and ductwork associated with the ventilation of the hood, roughing-in to points indicated on the mechanical, plumbing, and electrical plans, and final connections from rough-in locations to various pieces of equipment requiring such connections and the supplying of all necessary materials and labor for this work except as specified or scheduled.
- F. Tile adhered to bases below the specified equipment is by others.
- G. Refrigeration Work to be performed under this Section, except for electrical and plumbing connection to compressors, blower coils controls, etc., provided by others, is as listed in the itemized specifications.
- H. All line and disconnect switches, safety cutouts, control panels, fuse boxes, or other electrical controls, fittings, and connections shall be furnished and installed by others. Starting switches shall be provided by Food Service Equipment Supplier as specified under General Specifications. Those starting switches furnished loose as standardized by Food Service Equipment Supplier manufacturers (other than fabricated items) shall be installed and connected by others.
- I. Any sleeves or conduit required for refrigeration and tubing lines shall be furnished and installed by others. Refrigeration alarm system connection by others.
- J. Plumbing and Steam Fitting Trades shall confirm that all lines are flushed free of foreign matter before connecting equipment.
- K. The electrical sub-contractor shall make all final connections to the equipment shown on Drawings or specified. It shall be the responsibility of the electrical subcontractor to check all equipment to determine where starters, contractors, switches, and other items are required.
- L. The plumbing-sub-contractor shall make all final connections to the equipment shown on Drawings or specified, and it shall be the responsibility of the plumbing sub-contractor to provide traps, tailpieces, fittings, water piping, floor drains, shut-off valves, and all other necessary fittings. The Food Equipment Supplier shall provide faucets and all lever waste drains, and hose reels with mixing valves to the plumbing subcontractor for connection and installation.
- M. The mechanical sub-contractor shall make final connections to the equipment shown on Drawings or specified, and it shall be the responsibility of the mechanical sub-contractor to provide and install necessary ventilation facilities of sufficient capacity to operate the equipment. Mechanical work to be done by the Food Service Equipment Supplier is listed in the itemized equipment specifications.
- N. The General Contractor shall provide openings and passageways of sufficient to sustain the weight of the Food Service Equipment Supplier, and he shall provide openings and passageways of sufficient size to permit the delivery and erection of the equipment to their respective locations without dismantling. Coordination of these openings is critical for the equipment installation. The General Contractor shall provide a depressed floor for drains grates and a walk-in cooler/freezer when noted.

### 2.3 RELATED WORK BY OWNERS

- A. Install Owner furnished equipment in accordance with the installation section of this document unless otherwise specified herein.

## 2.4 REFERENCES

- A. The Drawings indicate the desired basic arrangement and dimensions of the equipment. Minor deviations may be substituted for approval provided basic requirements are met and no significant rearrangement of service to the equipment is required to affect the proposed alteration. These deviations shall be made without expense to the Owner.
- B. Operational and functional tests of the installed equipment are required. Defects or deficiencies shall be corrected to the satisfaction of the Architect or Owners at the expense of the Contractor. Consult the Mechanical and Electrical Connections Drawings and their accompanying Specifications to determine additional requirements of the work and shall cooperate with all trades to ensure a satisfactory installation.
- C. The electrical wiring of motors, motor starters, switches, and thermostats of the equipment shall be an integral part of the unit, which shall contain a junction box for the connection of electrical service. All motor-driven equipment shall have thermal overload and underload protection.
- D. Furnish each motor-driven appliance or electrically heated unit; a suitably mounted control switch or starter of proper type per UL or ETL Codes. All controls mounted on vertical surfaces of fixtures shall be set into recessed die-stamped stainless-steel cups or otherwise indented to prevent damage to the control switch.

## PART 3 - QUALITY ASSURANCE

### 3.1 FOOD SERVICE CONSULTANT

- A. The Owner has employed Camacho, Incorporated as the Food Service Consultant. The "chain of command" shall be the Food Service Equipment Contractor, to the General Contractor / Construction Manager, to the Project Architect (PA / E), to the Food Service Consultant, and vice versa in all matters concerning the food service equipment.

### 3.2 EQUIPMENT

- A. Equipment, except for "buy-out" or standard catalog items, shall be fabricated in a plant bearing the name of a recognized food service equipment fabricator. This fabricating firm shall have been in business for at least five years, with a suitable organization to design, engineer, manufacture, deliver and install the equipment. Said installation shall be in accordance with local union conditions when applicable. Such firms shall be able to refer to other successful installations of similar operating conditions. Further, the fabricator shall be able to UL classify and list the items that they fabricated.
  - 1. Under no circumstances shall the FEC sublet any portion of the fabricated equipment to any subcontractor without Camacho's written approval. All fabricated food service equipment with inter-wiring and pre-wired equipment and refrigeration shall be manufactured by a fabricator that can UL list (or other applicable AHJ listing) and classifies their own work.

### 3.3 LABOR

- A. All labor shall be performed by experienced mechanics in this type of work. All work on the premises shall be done at such time as to promote the proper conduct of the project. Provide a

competent on-site superintendent to supervise the work and to provide other trades with the information necessary to maintain proper conduct and timely completion of the work.

### 3.4 FOOD SERVICE EQUIPMENT CONTRACTORS

- A. Pre-approved Food Service Equipment Contractors include:
1. Thompson and Little Foodservice Equipment & Supplies: 910-484-1128
  2. Trimark Foodservice Equipment Supplies & Design 708-496-1700
  3. Edward Don & Company: 1-800-777-4366
  4. Manning Brothers Food Equipment Co.: 1-800-554-3004
  5. Boelter Foodservice Design, Equipment & Supply: 800-263-5837
  6. Birmingham Restaurant Supply, Inc. (Bresco) 205.252.0076 / 800.344.2455
  7. Mobile Fixture 251.342.0455 / 800.345.6458
  8. H & R Restaurant Supply 205.409.0097 / 888.364.4080

## PART 4 - CODES, LAWS, AND STANDARDS

### 4.1 GENERAL REQUIREMENTS

- A. The equipment furnished under this section is to be supplied by one Food Service Equipment Contractor.
- B. Permits and Certificates:
1. All laws, codes, ordinances, and regulations bearing on the conduct of the work as drawn up and specified shall be complied with and given all notices required. For any work upon which an inspection certificate by local authorities or any governing body is required, such Inspection Certificate or Certificates shall be obtained and paid.
- C. Certificates of acceptance or completion as required and issued by the State, Municipal, or other authorities shall be procured and delivered to the Owners. The Owners may withhold payments that are due, or that may become due until the necessary Certificates are obtained and delivered to the Owners.
- D. All safety devices and all accessories required to comply with regulations and governing codes shall be provided, regardless of whether specified or called for in the following technical divisions of the equipment list portion of this Section of Specifications.
- E. Applicable Manufacturing Standards:
1. Special fabrication items shall be manufactured in compliance with Standard No. 2 of the National Sanitation Foundation Testing Laboratory and shall bear the NSF Seal of Approval.
- F. Equipment pieces shall be manufactured in compliance with Standards No. 3, 4, 5, 6, 7, 8, 12, 13, 18, 20, 21, 25, 29, 35, 37, 51, 59, and 61, where applicable, of NSF Testing Laboratories and bear the Seal of Approval. This shall include any pending standards, which shall become applicable at the time the equipment is delivered.
- G. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:
1. National Fire Protection Association (NFPA)
  2. NFPA 96-Installation of equipment for removal of smoke and grease-laden vapors from commercial cooking equipment, current edition
  3. NFPA 13 - Installation of Sprinkler Systems, current edition
  4. NFPA 17 - Dry chemical extinguishing systems, current edition.
  5. NFPA 17A - Wet chemical extinguishing systems, current edition

6. NFPA 70 - National Electric Code.
  7. NFPA 96 - Ventilation Control and Fire Protection
  8. National Sanitation Foundation (NSF)
  9. Underwriter's Laboratories, Inc. (UL), including but not limited to UL-300
  10. National Electric Manufacturers Association (NEMA)
  11. American Gas Association (AGA)
  12. American Society for Mechanical Engineers for Steam Equipment
  13. National Fuel Gas Code (NFGC)
  14. State Board of Health Regulations (10-D-13)
- H. All electrically operated and heated equipment, fabricated or otherwise, shall conform to the latest standards of the National Electric Manufacturer's Association (NEMA) and the Underwriter's Laboratories, Inc. (UL or ETL), where applicable standards have been set up by that agency, or otherwise, such as to be acceptable to authorities having jurisdiction. This shall include any pending standards, which shall become applicable at the time the equipment is delivered.
- I. Electrically heated and motor-driven fixtures shall be for the current shown in the Mechanical and Electrical plans. These items of equipment shall have mounted motor starters, switches, and controls. All shall be required for each fixture or complete section of a fixture or as specified.
- J. Gas burning equipment to be designed for operation with the type of gas furnished and approved by the American Gas Association. The label or listing of the American Gas Association shall be accepted as conforming to this requirement. Installation of equipment shall conform to the standards as set forth by the American Gas Association and the National Plumbing Code. Where required, all gas equipment shall be furnished with a safety pilot, one hundred percent safety cut-off, and automatic pilot ignition.
- K. NFPA Codes 13, 17, 17A, and 96 standards shall be complied with for the exhaust system. Provide all safety devices on all accessories required to comply with regulations and governing codes.
- L. Miscellaneous Requirements:
1. Plumbing:
    - a. Provide chrome-plated faucets specified and certified to NSF standard 61, Section 9. All backsplash-mounted faucets shall be provided with double male nipples having locknuts for rigidly securing the faucet to the backsplash. Nipple-locknut assembly shall be provided under this Section as part of the faucet.
    - b. Provide all wastes incorporated in the custom-built fabricated Food Service Equipment. Provide all waste with a chrome-plated tailpiece.
  2. Electrical:
    - a. Interwiring of Food Service Equipment between heating elements, switches, starters, thermostats, outlets, motors, and solenoids shall be complete to the junction box, terminal box, or disconnect switch (should Specifications call for disconnect switch to be provided in this section).
    - b. Provide grounded receptacles specified under Item No. of detail Specifications or as shown on the Contract Drawings. All receptacles are to be as specified and furnished with stainless steel faceplates.
    - c. All electrically operated equipment to be per the codes, regulations, and laws of the State in which the project is located.
- M. Safety:

1. All Food Service Equipment provided under this Contract shall be manufactured and installed in conformance with the Williams-Steiger Occupational Safety Health Act of 1970.
- N. Coordination:
1. Coordinate with the project's plumbers and electricians to assist in cutting or knocking out holes in the stainless-steel tables, counters, and cabinet bases to allow for efficient utility connections to equipment.
- O. The Contractor shall be held responsible and liable for all changes or variances in Performance Criteria without written authorization from the Architect for said changes or variations.

## **PART 5 - SUBMITTALS**

### **5.1 GENERAL REQUIREMENTS**

- A. FEC shall verify all field measurements on the job site to ensure proper fitting of all equipment. Within four (4) weeks after the G.C. / C.M. has been awarded a contract by the Owner, the FEC is to electronically submit PDF format to the Architect for tentative approval, all dimensioned rough-in drawings, equipment submittal brochures, fabrication, and manufacturer's shop drawings in one package. Partial submittals will not be accepted and will be stamped Revise / Resubmit. The reproduction of original contract documents is not acceptable for use as a submittal.
- B. After the initial review of submittal data, revise and resubmit only the datasheet, coversheets, or rough-in and shop drawings that have been modified or changed. The entire submittal is not required for a resubmission. After two resubmissions, the FEC may be charged a fee for Camacho's continuous re-evaluation. This will be billed as an additional service.
- C. Field measurements required to size and place Food Service Equipment are to be verified with on-site field dimensions. Do not rely on or measure drawings for actual on-site dimensions. Dimensions shall be taken from the actual structure, giving due consideration to any architectural, structural, or mechanical discrepancies that may occur during the construction of the building. Field dimensions shall be taken at the earliest opportunity so as not to delay deliveries. Notify the Foodservice Consultant of the earliest date and time. FEC shall be responsible for the proper fit of all equipment furnished under this Section of the Contract. Gaps over ¼" wide are not acceptable.

### **5.2 SAMPLES**

- A. Provide all samples of materials requested by Camacho / Architect for test purposes or comparisons.
- B. Samples used for testing shall not be used on the work without the written approval of Camacho / Architect.
- C. Samples may be retained by Camacho, the Project Architect, or the Owner as a matter of record without any additional compensation to the Contractors.
- D. Owner to provide all samples as required to FEC to ensure proper sizing of dispensing equipment hereinafter specified (cups, glasses, dishware, etc.).

### **5.3 BROCHURES**

- A. Prepare and submit equipment cut sheets showing all manufacturer's data sheets describing equipment as specified. Include items listed as "Future, Existing-Relocate, or Owner



Furnished." The item numbers shown on the submittal shall be the same as those shown on the contract documents. The equipment cut sheets are to be provided using Auto Quotes format or similar, including coversheets for each item. Where a piece of equipment is used and specified with multiple item numbers assigned, the first item is to be provided with a cover sheet and datasheet. For additional identical items, provide cover sheets only.

- B. Provide the following information on the coversheets:
  - 1. Project name.
  - 2. FEC name.
  - 3. Foodservice Consultant name.
  - 4. Item Number.
  - 5. Equipment description.
  - 6. Quantity.
  - 7. Written specification/description of equipment provided.
  - 8. Accessories.
  - 9. Utilities.
- C. Record copy brochures, which shall be delivered at the demonstration and start-up, are to be bound in booklet form in three-ring binders.

#### 5.4 ROUGH-IN AND MECHANICAL CONNECTION DRAWINGS

- A. FEC is to prepare and submit rough-in drawings showing all utility rough-ins for kitchen equipment items, including items listed as "Future, Existing-Relocate, or Owner Furnished" (min. scale of  $\frac{1}{4}'' = 1'-0''$ ). Drawings to indicate the size and location of all utilities, floor depressions, raised bases, and wall openings for equipment. The item numbers shown on the rough-in drawings shall be the same as those shown on contract documents. Drawings shall be dimensioned to the stub up or stub out, not to the connection on the equipment. The FEC shall be responsible for conforming to these conditions with equipment and connections thereto. In the event rough-in has been completed before the award of the Contract, the FEC shall thoroughly investigate, and field verify the provided rough-in locations and provide equipment to suit building conditions. FEC to provide an equipment floor plan with itemized equipment, to include all utility loads.
- B. Electrical rough-in plans are to be dimensioned to indicate the above-finished floor (AFF) height. 90o plug heads where available. Verify all NEMA plug types, lengths of cords, and equipment connection lengths. Lengths are to be of adequate distance for outlets available and to allow equipment to be placed as shown on contract documents. Show convivence receptacle location.
- C. Plumbing rough-in plans are to be dimensioned to indicate the above-finished floor (AFF) height.
- D. Ventilation rough-in plans are to be dimensioned and indicate the above-finished floor (AFF) height.
- E. Special conditions plan indicating dimensions and locations of:
  - 1. Raised pads.
  - 2. Wall openings for pass-through equipment.
  - 3. Floor drains.
  - 4. Wall backing.
  - 5. Recessed or wall-mounted control panels.
- F. Provide a refrigeration system schematic piping plan indicating line size, elevation, trap locations, and all specified components required for the refrigeration system installation. The plan is to include equipment and parts provided by the Refrigeration Equipment Manufacturer. Verify that refrigeration sizing is proper for line lengths determined by actual field conditions.

## 5.5 SHOP DRAWINGS

- A. Custom stainless-steel equipment, walk-in cooler/freezer and refrigeration, exhaust hoods, dishwashers, scullery equipment, and other shop drawings shall be provided on similar size drawing sheets as contract documents. All shop drawings shall be detailed and fully dimensioned to a minimum scale of  $3/4" = 1' - 0"$ . Elevations and sections are to be detailed to a minimum scale of  $1-1/2" = 1' - 0"$ ). Show all materials, gauges, and methods of construction, including relation to adjoining and related work when cutting or close-fitting is required. Show all reinforcements, wall plates, backing, anchorage, needed other work needed for a complete installation of fixtures. Drawings to show the item number and quantity required for each detail. Omissions and discrepancies on approved drawings shall not relieve the FEC of providing items as specified and shown on contract drawings.
1. Show adjacent walls and columns and identify countertop equipment showing item numbers and descriptions.
  2. Show all components that are included in fabricated equipment.
  3. For equipment with load centers (panels), indicate total electrical calculations, including circuits. Provide an electrical diagram for on-site electricians.
  4. Provide color, pattern, or finishes for laminated, fiberglass, paint, or stain for approval by the Architect/Owner.
- B. Shop drawings showing the plan and elevations shall be  $3/4" = 1' - 0"$  scale, and sections shall be  $1-1/2" = 1' - 0"$  scale covering all fabricated items. Drawings are to show the location of equipment to be coordinated with each item, such as boosters mounted to the underside of the dish table and garbage disposers under sink compartments. The verbiage 'By Others' is not acceptable and should be defined by trade.
- C. Fabrication details must identify all metal gauges, hardware, trim, electrical parts, special fitting, and other components by manufacturer's name and model number.
- D. Foodservice Submittal Documents are to be signed by the FEC to indicate they have been reviewed and coordinated with submittals by electrical, plumbing, mechanical, millwork, or other trades, and meet all contract requirements. Foodservice Submittal Documents, which are not stamped and approved by the FEC, will be returned as "NOT REVIEWED." The FEC will be required to resubmit after review, as stated above.
- E. Verify size and weight information of the service ware (glasses, plates, trays, cups, etc.) for self-level dispensing, ware washing, and mobile equipment with the Owner. Verify that carts, racks, and dollies can fit into fixed equipment (roll-in refrigeration, combi ovens, walk-ins, counters, etc.).

## 5.6 CHECKING

- A. Checking of rough-in drawings, shop drawings, details, and equipment by Camacho is for design concept only and does not relieve the FEC or G.C. / C.M. of responsibility for compliance with design drawings, details, and specifications, verification of utilities with equipment requirements for conformity and location and verification of all dimensions of the equipment, building conditions or reasonable adjustments due to deviations. Drawings shall be prepared on the Food Service Equipment Contractor's sheets and by his employees. Drawings of any part thereof created by photograph, paste-up, or other methods using Camacho and Architect drawing(s) and details are a violation of federal copyright laws and will be returned for re-submittal. FEC will assume responsibility for the proper locations and sizing of sleeves, conduits, and depressions for the various equipment requirements.
- B. FEC is responsible for making multiple field inspections to verify the rough-in locations prior to the pouring of concrete, the closing of walls, etc. FEC shall compensate other trades for any relocation of rough-ins.

**5.7 HANDLING AND STORAGE**

- A. Protect metal and millwork product finishes from damage during shipping, storage, handling, installation, and construction of other work in the same spaces. Wrap and crate each item of equipment as needed for protection from damage.
- B. Cover exposed stainless-steel surfaces and millwork surfaces with a self-adhesive protective paper of a type recommended by the metal and millwork manufacturer, and do not remove until work is installed and ready for cleaning and start-up

**5.8 SCHEDULING**

- A. Schedules and Reports:
  - 1. Establish the earliest and latest job site delivery dates for FEC-provided equipment.
- B. Delivery of Owner furnished equipment for installation shall take place at a time to be determined by Owners, but not necessarily during regular working hours.
- C. Workmanship and Guarantees:
  - 1. Equipment shall be delivered in an undamaged condition upon completion. All workmanship and labor shall be of the best in their respective fields and skilled mechanics of the trades involved.
- D. All equipment, as specified in this section, shall be guaranteed for one year from the time of substantial completion. If, at any time within this warranty period of one year, any equipment is found to be faulty due to poor workmanship, or inferior or defective materials, replace said pieces or correct each defective part at no cost to the Owner.
  - 1. Refrigerated items shall have an additional four-year warranty on the compressor unit. On an extended compressor warranty, only labor charges after the first year shall be paid.
- E. At the end of the first year, assign extended warranties to Owners on equipment having more than one year warranty from the manufacturer.

**5.9 WORKMANSHIP AND GUARENTEES**

- A. Equipment shall be delivered in an undamaged condition upon completion. All workmanship and labor shall be of the best in their respective fields and skilled mechanics of the trades involved.
- B. All equipment specified in this section shall be guaranteed for one year from substantial completion. If, at any time within this warranty period of one year, any equipment is found to be faulty due to poor workmanship or inferior or defective materials, replace said pieces or correct each defective part at no cost to the Owner.
- C. Refrigerated items shall have an additional four-year warranty on the compressor unit. Only labor charges after the first year shall be paid on an extended compressor warranty.
- D. At the end of the first year, assign extended warranties to owners on equipment that have more than one year's warranty from the manufacturer.

**PART 6 - PRODUCTS****6.1 PREFABRICATED EQUIPMENT**

- A. Where reference is made to a manufacturer's model number and manufacturer specifications, it is intended that the specification of that primary manufacturer is utilized as a basis of design and specification standards and has become a part of these Specifications and Documents.
- B. Items and component parts of any item referred to by manufacturer's name and model number shall be furnished complete with all standard equipment of the manufacturer used as a basis of design and specification standards plus all extras and modifications hereinafter specified and required.
- C. Similar type items and similar type components shall be product by the same manufacturer to facilitate maintenance and convenience and reduce the Owner's spare parts inventory.
- D. Modifications to the standard equipment specified shall be made by the original manufacturer when required.

## 6.2 PRODUCT OR MANUFACTURER APPROVAL

- A. The product of the primary manufacturer named, where more than one manufacturer is listed, was used for the basis of design and specification standards and sets the standard of quality, appearance, performance, aspect, capacities, and function for that item.
- B. Only products of listed primary manufacturers will be accepted unless requests for substitutions and submittals of alternate manufacturers are submitted to Camacho in accordance with stated conditions. Alternate manufacturers are approved as a manufacturer; however, each item for an alternate manufacturer must be submitted to Camacho for approval/rejection. Refer to Section 1.5, BASE BIDS AND SUBSTITUTIONS.
- C. Other manufacturers must modify their products if necessary to comply with the quality, physical and functional characteristics of the primary manufacturer and must be approved by Camacho.
- D. All manufacturers listed may not be able to supply an equipment item, pursuant to the specifications, as standardized by the primary manufacturer whose name and model number were utilized herein as the basis of the design standard for this project, in which case, the listed alternate manufacturers may elect to modify an item to meet the specifications.

## 6.3 CONSTRUCTION

- A. GENERAL
  - 1. The materials, components, and techniques describe the construction of items of the Food Service Equipment.
- B. Deviation and extra refinements peculiar to any one item will be described and indicated.
  - 1. It is required that all custom/fabricated items in these plans and specifications, other than by manufacturer name and model number, shall meet the requirements of the American Iron and Steel Institute Designations and be constructed of Type 304 stainless steel, and be manufactured by a fabricator that can UL list and/or classify their own products. Type 430 Stainless steel (straight chrome - no nickel) shall not be acceptable for custom-built fabricated equipment.
  - 2. All sheets shall have a natural mill finish of not less than commercial No. 4 on the exposed side and not less than No. 2 on the unexposed side. All stainless steel shall be stretcher leveled, with a thickness of:
    - a. 14 Gauge - Not less than 0.075 Inch.
    - b. 16 Gauge - Not less than 0.063 Inch.
    - c. 18 Gauge - Not less than 0.050 Inch.
    - d. 20 Gauge - Not less than 0.038 Inch.

- C. Welding shall be of electric arc or oxy-acetylene gas. Welding shall be done with a rod of the same material and full penetration the entire length of the joint. Welds to be flat without buckles, voids, or imperfections. All welds shall be ground flush with adjacent surfaces, conditioned to eliminate slippery surfaces. All shear cuts or bends that tend to open the surface of the metal shall be rewelded, ground, and polished. All edges are to be ground and filed to eliminate sharp or rough edges.
- D. When stainless steel sheets have the grain running in different directions, the sheets shall be so jointed, and welds run and finished in such a manner as to make the sheets appear as one continuous product.
- E. Gauges:
  - 1. All Gauges of metals, where specified, shall be manufactured to the standards set forth by the US. Standard for Sheet Metal.
  - 2. Unless specified, no material shall be finished lighter than 20 gauge for custom-built fabricated equipment.
- F. All exposed surfaces of equipment shall be free of bolts, screws, and rivets. Wherever these fasteners are used they shall be an approved type constructed of stainless steel.
- G. All tops, sink bowls, drain boards, and troughs are to be sound-deadened. Sound-deadening to be no less than 1/8 inch thick and allowed to dry thoroughly before being finished with two coats of paint. Component Hardware, Model Q75-1366 NSF approved gray latex sound deadener for brush or spray application, Model Tacky Tape for worktop application between top and hat channel reinforcing.

#### 6.4 TABLE AND COUNTERTOPS

- A. All tops are to be fabricated with 14-gauge, Type 304 stainless steel one-piece construction with all seams, butt joints, and corners welded, ground, and polished smooth, resulting in a one-piece top without joints and crevices. All intersections of three (3) or planes shall be covered. Tops to be free of all deflection, reinforced with 1" x 5" x 1" inverted 14-gauge stainless steel channels with 1" flanges, stud welded to the underside of tops in a vermin-proof manner. Two (2) channels running lengthwise under tops up to 30" wide (tops over 30" wide, channels spaced maximum of 30" on center). One (1) channel running from front to rear at legs and/or not more than 6'-0" on center. All intersections of channel reinforcing shall be fully welded and sealed.
- B. Tops with open edges shall have 1-3/4" on the bull-nose edge, or 2-inch rolled down the edge with all exposed corners rounded on a 2-1/2-inch radius or bull-nose corner. Where the table borders on or is adjacent to the wall, there is to be a 4" high backsplash with a 1-inch turn back to the wall with welded enclosed ends, unless otherwise specified. See Drawings for typical.
  - 1. Sleeves: Where legs, standards, pipes, or pipe chases come through a work area or tabletop, they shall pass through 3" high stainless-steel sleeves, with the periphery fully welded and polished to match adjacent surfaces.
- C. Where the tops are adjacent to walls, columns, equipment, enclosures, etc., they shall have a splash. The standard splash shall be in accordance with specifications.
- D. Where holes are punched through the top to accommodate equipment, said holes shall be ferruled and provided with a rubber grommet.
- E. Ends adjacent to similar equipment shall have a common end post.
- F. Bases shall be open-type construction, 1-5/8" O.D. stainless steel tubular legs spaced 60" on center, fitted with stainless steel bullet type, adjustable feet, and enclosed conical gussets unless otherwise specified. Cross bracing shall be 1-5/8" O.D. stainless steel tubular members fully welded to legs as required. Where undershelves are provided, they shall be constructed of

16-gauge stainless steel, fully welded to tubular legs, ground smooth, 10" above the finished floor. The braces shall be constructed to form rectangular, or "H" frames, and there shall be at least one brace welded to each leg.

1. Gussets shall be stainless steel NSF-approved, cylindrical type with a setscrew. Leg gussets are to be welded to the underside of tables, reinforcing channels, and underside of sinks. Gussets shall be Model No. A20-0206 manufactured by Component Hardware Group Inc. or comparable stainless-steel gussets manufactured by Standard- Keil Hardware Manufacturing Company, United Showcase, Component Hardware, and Kason Food Service.
2. Feet shall be stainless steel adjustable bullet shape, fully enclosed, tightly fitting the leg. Provide 1-inch up and down adjustment from the central position, at no time exposing any threads. Adjustments are to be easily made by hand without the use of tools. For counters and cabinet bases, the feet shall be the same as for above. Feet having comparable quality to Component Hardware Group, Inc. and Kason Food Service are approved. Legs for the cabinet base shall be 8 inches high, including feet. Freestanding sinks shall be supported on legs and feet as specified, with bracing from front to rear only.
3. When legs are furnished with stainless steel flanged feet, they shall be sealed and secured to the finished floor with stainless steel threaded anchor bolts. Anchor bolts are to be set 3" into the finished slab and extended to a minimum height above the finished floor as required for securing equipment. Equipment to be fastened down with stainless steel lock washers and nuts. Flange feet are to be set in a bed of FDA-approved clear silicone sealant prior to securing to the finished floor. Providing a bead of sealant after securing feet is not acceptable.

G. Casters:

1. Plate Type: Provide stainless steel swivel plate casters. Provide 5-inch Ply-Loc gray wheels with 1-1/4" tread, Zerk grease fittings, and seals and a 250-pound capacity. Front casters to have brakes manufactured by Component Hardware Model No. CMPI- 5RPB or equal manufactured by Jarvis Casters or Colson Caster.
2. Stem Type: Plate Type: Provide stainless steel swivel plate casters. Provide 5-inch Ply-Loc gray wheels with 1-1/4" "tread, Zerk grease fittings, and seals and a 250-pound capacity. Front casters to have brakes manufactured by Component Hardware Model No. CM54-5RPB or equal manufactured by Jarvis Casters or Colson Caster.

- H. When cross bracing is furnished with stainless steel flanged feet, they shall be sealed and secured to the finished wall and/or stainless-steel cabinet bases with stainless steel lock washers and nuts. Flange feet are to be set in a bed of FDA-approved clear silicone sealant prior to securing to the finished wall and/or equipment. Providing a bead of sealant after securing feet is not acceptable.
- I. All ends and edges that are rough or sharp shall be filed and ground to a safe, smooth finish before delivery to the job site.

## 6.5 TABLE WITH BAKER TOP

- A. The top is to be constructed of 3" thick maple hardwood with a 4" x 1" stainless steel channel subframe connected to the base.
- B. Table base, cross bracings, undershelves, splashes. etc. shall be provided as hereinbefore noted under Section 6.3.2 Table and Counter Tops, and hereinafter specified.

## 6.6 TABLE WITH POLY TOP

- A. The top is to be constructed of a 1-1/2" thick white anti-bacterial cutting surface with a 1" X 5" x 1" stainless steel channel subframe connected to the base. Top to be removable for cleaning.
- B. Table base, cross bracings, undershelves, splashes. etc. shall be provided as hereinbefore noted under Section 6.3.2 Table and Counter Tops, and hereinafter specified.

## 6.7 ENCLOSED BASES

- A. Closed base fixtures shall have rigid welded frames enclosed on all sides except where shelves and/or doors are required. The cabinet body shall be constructed of 16-gauge stainless steel.
- B. Tops shall be cross-braced with 1-1/2" X 1-1/2" X 1/8" galvanized angles spaced at 2'-0" O.C. maximum, reinforced with 14-gauge stainless steel 1" X 5" X 1" channels wherever necessary for rigidity.
- C. Leg channels shall be 1" X 5" X 1" 14-gauge stainless steel channels spaced 4'-0" O.C. maximum, on the bottom, to receive legs.
- D. Closed base fixtures shall be mounted on casters, or stainless-steel adjustable counter legs, as indicated on plans and/or item specifications.
- E. Shelf supports shall be continuous 1-1/2" X 1-1/2" X 1/8" galvanized angles welded to the frame. There shall be no exposed galvanized steel channels or supports.
- F. Utility chases shall be 18-gauge stainless steel with removable access or service panels.
- G. Partitions shall be 18-gauge stainless steel.
- H. Exterior panels shall be FRP plastic laminate as a part of millwork, or stainless steel with vertical grain as specified in item specifications.
- I. Non-exposed panels adjacent to walls or closed base fixtures shall be 18-gauge stainless steel.
- J. Interior shelf units shall be 16-gauge stainless steel, edges turned up 2" at sides and rear, down 1-1/2" at the front, and where shelves butt together, corners to be welded. The shelf is to be fixed and constructed in accordance with details (removable 2'-0" max. sections to be provided when specified for ease of removal and cleaning).
- K. Compressor compartments shall have removable louvered panels with 2" X 3/4" X 18-gauge stainless steel double channel perimeter frames, 1/2" X No. 16 Niles flat stainless steel expanded metal guards, 14-gauge galvanized steel compressor mounting channels, and enclosure panels.
- L. Recessed areas shall be lined with 18-gauge stainless steel.
- M. Plastic laminated panels shall have a 3/4" thick exterior plywood base veneered on all exposed sides and edges with Wilsonart, Formica, or Westinghouse Micarta plastic applied or laminated in strict accordance with the manufacturer's recommendations. Plastic laminated panels shall be without joints, and grain and pattern material, color, pattern, and/or texture shall be as approved by Project Architect.
- N. The trim shall be 18-gauge stainless steel with vertical grain.
- O. Stainless steel and brass trim shall have flush welded joints.
- P. Control panel recesses, valve handle recesses, and individual control knob recesses shall be 18-gauge stainless steel. Depth must be sufficient to prevent the control from protruding past the face of the body panel.
- Q. Legs shall be provided as specified. Weld to framing members of the counter. Provide 3-1/2" square 12-gauge galvanized steel top plate welded on legs that are bolted onto equipment. Secure with four (4) 1/4-20 stainless steel bolts.

- R. Cashier's stations shall have 18-gauge stainless steel liners, cash drawer liners, and 14-gauge stainless steel 30 degrees sloping footrests with 10" wide level tops.

#### 6.8 COLD PANS

- A. The interior shall be 16-gauge stainless steel one (1) piece construction with all corners coved on a 3/4" radius pitched to a 1" stainless steel drain fitting welded to the shell. Pipe drain line to the bottom of the cabinet.
- B. Exposed exteriors shall be 18-gauge stainless steel, and concealed exteriors shall be 18-gauge stainless steel.
- C. The entire pan shall be insulated with 2" thick urethane foam. Provide a non-toxic high-impact plastic breaker strip around the entire opening to prevent condensation.
- D. Refrigerated cold pan coils shall be 1/2" O.D., type K copper tube with wrought copper fittings and silver soldered joints. Space runs of the coil at 1-1/2" O.C. parallel to the long axis of the cold pan bottom and sides and solder in place. Runs equally spaced at 4" O.C. securing the coils to the pan. After the coils are secured to the pan, cover the entire bottom and sides with thermal mastic and apply a waterproof covering.

#### 6.9 UNDER COUNTER REFRIGERATORS / FREEZERS

- A. Refrigerators/freezers shall be all metal construction with no wood. The outer shell is to be constructed with 18-gauge stainless steel and be fully welded to form a vapor-proof seal. The inner shell is to be no less than 20-gauge stainless steel with coved corners pitched to a 1" stainless steel drain fitting welded to the shell. The drain should be located as close as possible to the blower coil.
- B. The entire compartment shall be insulated with 2" thick approved urethane insulation on all sides, top and bottom. Provide a non-toxic, high-impact plastic breaker strip around the entire cabinet opening perimeter. Provide the same heaters in freezer doors. A vinyl magnetic gasket shall be installed around the full perimeter of the cabinet opening for a positive seal. Flush mount a 2-1/2" diameter dial thermometer in the face of the cabinet.
- C. Interior shelving to be stainless steel wire shelves mounted on adjustable clips providing four-point support. Shelves shall be removable for cleaning. Provide one (1) bottom shelf and one (1) intermediate shelf unless otherwise specified.
- D. Doors shall be fabricated 1-1/2" thick with approved foam urethane insulation. Doors shall be 18-gauge stainless steel double pan type construction with flat sides for edge-mounted hardware secured to internal tapping strips in the door body. Provide each door with self-closing cam lift hinges. Door(s) to actuate an incandescent shatter-proof light. Light to be mounted so as not to interfere with storage space.
- E. Drawers, if specified, shall be mounted on stainless steel self-closing roller-bearing tracks with positive stops. A vinyl magnetic gasket is to be provided around the entire perimeter of the drawer front for a positive seal. Drawer fronts to be 18-gauge stainless steel double pan construction with urethane insulation. Provide condensate-proof heating wires in the cabinet mullion and the entire perimeter of the drawer opening.
- F. The refrigeration system shall be properly sized to maintain refrigerated food products at 38 degrees to 40 degrees Fahrenheit and frozen food at 0 degrees Fahrenheit.
- G. Where under-counter refrigerators are specified, and the top is to have an opening to receive stainless steel pans, the openings shall be die stamped. The top shall be provided with an 18-gauge stainless steel double pan removable cover with urethane insulation. Cover to be



furnished with gasket, stainless steel lift handle, and lid cover bracket assembly, as manufactured by Component Hardware, Keil, Grant, or Knape.

#### **6.10 UNDER COUNTER REFRIGERATION SYSTEMS**

- A. Evaporator coils for fabricated under-counter refrigerators/freezers shall be blower-type coils and installed for accessibility and replacement.
- B. All temperature controls, expansion valves, sight glass, and solenoid valves are to be installed at the time of manufacturing and mounted for easy adjustment and service.
- C. Refrigeration circuits shall have automatic expansion valves, dual high-low pressure switches, high-pressure line sight glass, and line vibration eliminators.
- D. Evaporator coils shall have the condensate drain line routed to and furnished with a condensate evaporator, as manufactured by Component Hardware, Keil, Grant, or Knape. Provide wall mounting brackets if required.
- E. Each condensing unit shall have a separate control switch with a pilot light and an engraved phenolic plastic identification sign.
- F. Refrigeration lines are to be Type ACR copper with cast fittings assembled by silver soldering joints. Silver soldering or silver brazing shall be done in the presence of nitrogen (oil pumped) in tubing to prevent oxidation and scale formation. The refrigeration system shall be evacuated three (3) times to a pressure of 500 microns maximum and flushed between each evacuation with refrigerant. Refrigeration lines shall be insulated with Armstrong Armaflex insulation.
- G. Refrigeration systems shall operate on Freon R-22 in high and medium temperatures and Type 448A in low-temperature applications.
- H. On remote refrigeration systems, all refrigeration piping is to be pre-piped at the time of manufacturing and routed to one (1) central location ready for a one (1) point hook-up by the Refrigeration Contractor.

#### **6.11 REFRIGERATION**

- A. All refrigeration systems (piping, hangers, compressors, evaporators, installation, etc.) shall comply with Division 22000 and be factory installed by a properly licensed heating and air conditioning contractor. The Contractor must have three (3) years of experience with projects of this size. Upon completion of testing, the manufacturer shall provide the Architect with a written certificate of acceptance, showing that all quality standards have been met and the complete system is operating properly.
- B. Provide start-up and one-year service and maintenance contracts in addition to a regular one-year guarantee for self-contained refrigeration systems.
- C. The refrigeration system shall be pre-packaged, pre-engineered, factory assembled, air-cooled, remote refrigeration system. Verify the location of the system. Provide weather-proof housing.
- D. System to be complete with all refrigeration equipment and accessories required to make a complete refrigeration system that will maintain temperatures indicated. The system is to be provided with low ambient controls consisting of all required condenser fan controls, thermostat time clocks, and crankcase heaters. Refrigerator and freezer condensing units and coils shall be as called for in the itemized specifications and as shown on the plan.
- E. Refrigeration units shall be provided with single-stage compressors with air-cooled condensers operating at such speed within the recommended range of suction and discharge pressures for walk-in coolers and freezers and with required BTU specifications. Each compressor unit shall

be equipped with a compressor, large pump down the capacity receiver with two shut-off valves, liquid line drier, sight glass, suction and discharge vibration eliminator, high-low pressure control, crankcase heater, and flood back head pressure control for low ambient - all factory assembled. Provide all new units of the same manufacturer, factory assembled, to operate with Refrigerant R-448 for the cooler and R-448 for the freezer, 100 degrees F., ambient air, capacities selected on 16 hours running time basis.

- F. Hook-up: Room thermostat and liquid line solenoid valves (for pump down cycle operation) and refrigerant lines (insulated as required) to be provided by FEC All electrical interconnection and control wiring between blowers and compressors is to be provided by the Electrical Contractor. FEC to provide manufacturer's literature and data to electrical contractors in coordinating this work.
- G. System to be pressure tested (both high and low side) with dry nitrogen at 300 psi. After evacuating the system and charging it with refrigerant, test piping with a halide torch and prove tight under actual operating conditions.
- H. Refrigerant Piping and Accessories: FEC to extend refrigerant lines from condensing units to evaporators until completely hooked up and made ready for operation. The system shall be complete and sized to conform to current ACRMA standards. Refrigerant, drain, and condensate water piping shall be Type "L" hard-drawn copper ACR refrigerant tubing with long radius wrought copper solder joint fittings.
  - 1. Provide wall sleeves, hangers, and escutcheons as specified for typical piping. Make-up joints with high-temperature silver-solder (SIL-FOR or equal) suitable for 300 psi working pressure. Pass dry nitrogen gas through the pipe while joints are soldered.
  - 2. All refrigerant suction lines shall be insulated with UL fire, and smoke-rated nominal 3/4" thick flexible foamed plastic, closed-cell pipe insulation equal to Rubatex R-180-FS. Insulation shall have a "k" factor of not more than 0.26 at 70 degrees F mean temperature and a water vapor transmission rate of 0.1 per-inch or less. Slip onto the pipe prior to erection and seal butt joints with #373 adhesive. Insulate sweat fittings with miter-cut pieces of insulation the same size as on adjacent piping. Insulate screwed fittings with sleeved fitting covers fabricated from miter-cut pieces of insulation according to the manufacturer's sleeving size recommendations, overlap, and seal to the adjacent pipe insulation.
  - 3. Paint all insulation with two coats of Rubatex 374 white finish. Condensate drain lines are the same as refrigerant suction lines except for 3/4" thickness.
- I. Sleeves: FEC to provide drawings showing locations and sizes of all necessary sleeves for refrigeration lines, drain lines, etc. Actual penetration through building walls and floors is to be provided by the General Contractor.
- J. Freezer drain lines are to be wrapped in electric heater cable to prevent freezing of condensate in drain lines. All drain lines to exit compartments, as shown on the plan. Secure approval of drain line routing from the Architect prior to installation. The freezer is equipped with an electric defrost unit complete with a timer and built-in thermostat to return systems to the freezing cycle and delay the start of the circulating fan until the heat in the coil has been removed. Timer to stop the defrost cycle in case of thermostat failure. Extend drains from coils in copper tubing through walls to drip over and into a floor drain.
- K. Control Panel: The package shall have factory mounted and pre-wired control panel complete with interlocked main fused disconnect, compressor circuit breakers, contractors, and time clocks wired for single-point electrical connection. The electrical Contractor shall provide and install main power lines to the panel and use wire harness wiring for control and defrost heater between the defrost clock and the refrigeration fixtures, all in accordance with the wiring diagram and local codes. The temperature for each unit shall be controlled by means of a thermostat wired to actuate a solenoid valve in the liquid line, with the compressor operation

controlled by the low-pressure cutout switch. The thermostat and low-pressure controls shall be adjusted to maintain the room temperatures as specified.

- L. Service Contract to Cover Guarantees: Emergency refrigeration service shall be placed with a reliable local refrigeration company maintaining 24-hour service for the life of guarantees and warranties.
- M. Pipe Rack: Compressors shall be furnished with the manufacturer's standard factory-assembled rack unless otherwise specified. Rigidly mount compressor unit motors on the unit or cast base to effect quiet operation.
- N. Provide an electrical phase protector.

#### **6.12 DISH TABLES AND SINK SECTION TOPS**

- A. Tops, troughs, sinks, and back and end splashes shall be 14-gauge stainless steel, integral all welded construction. Tops shall be reinforced with 1"x5"x1" inverted 14-gauge stainless steel channels. Edges shall be constructed per details, 3" high. Back and end splashes at walls, per details, 8" high, 3" return on 45 degrees, 1" turn down at the wall. Top shall slope to dish machine, sinks, troughs, cones, and drainers a minimum of 1/4" per foot with backsplashes and table edges remaining level. When the tabletop attaches to the dish machine, turn it down into the machine and anchor securely, using only stainless-steel fasteners. The front edge and rear splash at the dish machine are to be watertight and welded closed. All sinks, disposer cones, sumps, troughs, or chutes shall be integrally welded with a top to give a one-piece appearance.
- B. Bases shall be open-type construction, 1-5/8" O.D. stainless steel tubular legs, fitted with stainless steel bullet type, adjustable feet, and enclosed conical gussets. Cross-bracing shall be 1-5/8" O.D. stainless steel tubular members welded to legs as required.
- C. When legs are furnished with stainless steel flanged feet, they shall be sealed and secured to the finished floor with stainless steel threaded anchor bolts. Anchor bolts are to be set 3" into the finished slab and extended to a minimum height above the finished floor as required for securing equipment. Equipment to be fastened down with stainless steel lock washers and nuts. Flange feet are to be set in a bed of FDA-approved clear silicone sealant prior to securing to the finished floor. Providing a bead of sealant after securing feet is not acceptable.
- D. When cross bracing is furnished with stainless steel flanged feet, they shall be sealed and secured to the finished wall and/or stainless-steel cabinet bases with stainless steel lock washers and nuts. Flange feet are to be set in a bed of FDA-approved clear silicone sealant prior to securing to the finished wall and/or equipment. Providing a bead of sealant after securing feet is not acceptable.

#### **6.13 DOORS AND REMOVABLE PANELS**

- A. Metal doors shall have 18-gauge stainless steel exteriors and interiors. Form 1-1/2" X 90-degree edges on all sides and welded corners. Rear panels must slip inside front panels and form a double pan assembly with tight joints. Doors and panels are to be easily removable without tools and constructed per details. All doors are to be provided with locking hardware with stainless steel face No. P20-0490 Component Hardware, Keil, Grant, or Knape.
- B. The insulation between panels shall be 1-1/2" rigid fiberglass. Secure to both panels where hardware and other screw fastenings are required.
- C. Metal doors shall have 12-gauge steel tap-in plates welded to the inside of panels where hardware or other screw fastenings are required.
- D. Sliding door tracks shall be No. 1357 Series Keil, Component Hardware, Grant, or Knape. Secure with 1/4"-stainless steel bolts. Sliding door roller assemblies shall be No. 1358-1212-

1000 Keil, Component Hardware, Grant or Knappe, and Vogt. Sliding and hinged door pulls to be full grip, stainless steel No. P46-1012 Component Hardware, Keil, Grant, or Knappe.

- E. Hinged doors to be hung on two (2) stainless steel lift-off type hinges No. R74-800RH and R74-8000LH Component Hardware. Doors are to be fitted with fabricated integral full-grip horizontal stainless steel pulls. Doors to be furnished with flush mounted, concealed type, magnetic catch No. M35-1000 or M35-2000 Component Hardware. For doors measuring more than 24" wide, furnish additional catch at the bottom of doors. For all hardware, Keil, Grant, or Knappe are acceptable.
- F. Louvered doors shall be constructed the same as the door except the center section shall be provided with 18-gauge stainless steel fabricated louvers tack welded flush with the door surface.
- G. Removable panels shall be constructed the same as the door and in accordance with details.

#### **6.14 SINKS**

- A. Construct sinks of 14-gauge stainless steel forming corners with a 3/4" radius, both horizontal and vertical. Sink sizes established on the drawings by Camacho shall be inside measurements.
- B. Provide double-wall partitions between sink compartments with 3/4" radius corners, 3/4" radius top edge, integrally welded in place, ground smooth and polished. Fronts, bottoms, and backs of multiple sinks shall be one piece with no overlapping joints and/or open crevices. The bottom of each sink shall be creased to the center and fitted with a lever-operated rotary waste drain with a strainer plate, chrome-plated tailpiece, and overflow pipe.
- C. The rotary waste drains shall be set into a 1/2" deep recess assuring complete draining. Overflows shall be fitted in the back of the sink to maintain a constant water level 1" below the sink's top edge.
- D. Where sinks occur in tables, sinks are to be integrally welded and polished as above.
- E. Provide all required holes for faucets, vacuum breakers, chemical supply lines, etc.

#### **6.15 SINKS (DROP-IN TYPE)**

- A. Construct sinks of 14-gauge stainless steel forming corners with a 3/4" radius, both horizontal and vertical, and a 1-1/2" wide perimeter flange. Sink sizes established on the drawings by Camacho shall be inside measurements. The bottom of each sink shall be creased to the center and fitted with a lever-operated rotary waste drain with a strainer plate, chrome-plated tailpiece, and overflow pipe. The rotary waste drains shall be set into a 1/2" deep recess assuring complete draining. Overflows shall be fitted in the back of the sink to maintain a constant water level 1" below the sink's top edge.

#### **6.16 DRAWERS**

- A. Drawer shall be constructed per detail. Drawer liners shall be 18-gauge stainless steel; 20"x20"x5" deep removable insert pan No. S81-2020 for tool drawers; 20"x20"x10" deep No. S83-2020 for bread drawers, as manufactured by Component Hardware. Pans to be easily removable without removing the frame or un-tracking the drawer.
- B. Supporting drawer frame shall be 14-gauge stainless steel welded channel. Drawer faces are to be 18-gauge stainless steel double wall construction fully welded with insulation between. Face to be welded to drawer supporting frame. Drawers furnished to be fitted with fabricated integral horizontal full grip, stainless steel pulls per details.

- C. All drawers shall be provided with adjustable replaceable rubber stops.
- D. Drawers are to be enclosed in 16-gauge stainless steel housing under open base tables to make them vermin-proof.
- E. Drawer slides shall be Component Hardware No. S52 Series, 14-gauge stainless steel slides mounted on 14-gauge stainless steel supporting channel frame fitted with stainless steel ball-bearing wheels. Slides to be of a self-closing type of sufficient length to allow drawer liner to be removed without removing slides. The drawer shall support a minimum of 150 pounds capacity in a fully opened position.
- F. The drawer shall have keyed, locking hardware, stainless steel faced No. P30-4700 Series as manufactured by Component Hardware.
- G. Anti-Bacteria, NSF approved cutting board to be Chef's Edge with Microban 18"x24" with 4"x1" handle slot as manufactured by C&K Manufacturing or approved equal. Cutting board to be mounted on 14-gauge stainless steel channels.

#### 6.17 DRAINER PANS

- A. Drainer pans shall be constructed of 14-gauge stainless steel welded integral with tops. Drainer pans shall be a recessed integral part of the top with cove corner bodies that slope to drains per details.
  - 1. Drainer with the disposer.
  - 2. Drainer with removable strainer for pot and pan sinks without disposer.
  - 3. Drainer with removable strainer for countertops.
  - 4. Drop-in drainer with removable strainer for countertops.
  - 5. Drainer with removable strainer secured with tamper-proof fasteners.
- B. Drainer pans recess fitted with strainers located below each glass filler, urn faucet, beverage dispenser, ice dispenser, or draft beer spigot.
- C. Drip pan strainers shall be No. 1580 Series Keil heavy-duty stainless steel drip plates with three (3) 3/4" wide louvers X 90% total strainer length, two (2) No. 1586-1010-1318 Keil finishing rings in each section, 1" X 90-degree angle edges, and welded corners. Component Hardware is an approved equal.
- D. Drip pan strainer shall be constructed in equal length, removable sections.

#### 6.18 ELECTRICAL

- A. Electrical conductors shall be run in rigid conduit to a junction box on the exterior the of fixture and have a minimum 12" pigtail.
- B. Flexible conduit shall not be used except for motor connections.
- C. Motors shall have a flexible conduit vibration section, at least 12" long and not over 24" long, with a ground wire running through the conduit.
- D. Wiring in prefabricated and/or manufactured equipment shall be U.L. approved construction by the equipment manufacturer.
- E. Wiring in custom-built equipment, areas, locations, or compartments where the temperature may exceed 150 degrees F. shall be of Type A1 moisture-proof range and appliance lead wire with nickel conductors, with an approved insulation and braided cover.
- F. Wiring in custom-built equipment, areas, locations, or compartments that will be exposed to moisture or high humidity shall be Type THW-75C machine wool wire with copper conductors

and thermoplastic insulation. All internal wiring in custom-built equipment shall be terminated in one (1) junction box that is accessible for connection and service.

- G. All wiring shall be permanently marked by color coding. A permanent wiring diagram shall be attached to each piece of equipment. Conductors connected to terminals shall have T & B Sta-Kon rings.
- H. Conductors connected together shall have Buchanan Crimp connectors including splash caps and insulators.
- I. Conductors of multi-wire branch circuits shall have two (2) wire circuits with one (1) black and one (1) white: three (3) wire circuits with one (1) black, one (1) white, and one (1) blue.
- J. Neutral conductors shall be white.
- K. Grounding conductors shall be green.
- L. Electrically operated portable equipment shall have a cord and plug.
- M. Service cords shall be Type SJO with grounding conductor securely fastened to the body or frame of equipment.
- N. Plugs shall be grounding type with service cord grounding conductor connected to grounding blade.
- O. Receptacle grounding contacts must be clearly labeled with instructions for the electrician to connect this terminal or contact the branch circuit grounding conductor.
- P. Electric motors shall have control switches for starters.
- Q. Electric motors and electrically heated equipment directly connected to the building electric system shall have a positive disconnect that will open all conductors and meet NEMA standard KS-1-1957 for Type H.D. switches.
- R. Combination starters and disconnects installed in a single NEMA enclosure shall have the same type of components as individual starter switches, fused switches, and breakers.
- S. Starters, transformers, and disconnects shall have NEMA enclosures in dry areas and watertight NEMA 4 or 5 cast enclosures in wet areas.
- T. Each light fixture or group of light fixtures in the same system shall have No. 1251-1 Hubbell or equivalent Arrow-Hart or Pass and Seymour double pole press switch.
- U. All equipment specified or detailed where light fixtures are specified shall LED. All LED lighting fixtures furnished as part of the food service equipment contract shall have a CRI value greater than 90 each, dimmable when specified. LED fixtures are to be provided and installed by the FEC.
- V. Recessed receptacles and switches with pilot lights shall be stainless steel finish, Model R73-1210 and R-73-1212 by Component Hardware, or approved equal, specified with stainless steel faceplates.
- W. Two (2) or more receptacles of the same voltage in the same equipment shall be pre-wired to a common junction box for one (1) final connection, providing the total load does not exceed 30 amps. All pre-wiring shall be done in rigid conduit with all wires color-coded and tagged.
- X. When counters are specified to be pre-wired to circuit breaker panel(s),
  - 1. FEC shall provide 'Square D' breaker panel(s), or approved equal, sized as required to meet the equipment loads as well as local and state codes. Each panel shall be mounted within the counter cabinet body behind the hinged stainless-steel door as located and shown on the plan.

2. Panel(s) to have individual breakers as required and main breaker; all utilities to be on separate breakers. All wires shall be tagged, numbered, color-coded, run through an approved conduit, and located in cabinet utility chase. All breakers shall be labeled, and the unit shall be supplied with wiring schematics.
3. For counters requiring delivery in sections for re-assembly in the field, each section the of counter shall be pre-wired and wire ends supplied with snap-lock type connectors ready for reconnection in the field.
4. Providing rolls of wiring with a counter is unacceptable. The counter shall be complete, and ready for one (1) final connection to each circuit breaker panel by Division 16.

#### **6.19 HANGER ASSEMBLIES**

- A. Framing members for hoods, hoists, or other equipment with a live load of 500 pounds or weighing over 500 pounds shall be 2" X 2" X 1/4" steel angles spaced at 36" O.C. maximum.
- B. Hangers for piping, refrigerant lines, and beverage dispenser conduit shall be Power-Strut metal framing with Series PS-300 channels, Series PS-10 spring clamping nuts, 1/2" diameter hanger rods, brackets, beam clamps, conduit clamps for each pipe or line and fasteners.
- C. The horizontal runs of two or more pipes or lines shall have Power-Strut trapeze hanger and/or surface mounting assemblies spaced at 60" O.C. for lines smaller than 3/4" O.D., 72" O.C. for lines 3/4" to 1-1/2" O.D. for lines 1-5/8" O.D. or larger.
- D. Horizontal and vertical runs adjacent to building walls shall have surface-mounted assemblies with the same spacing and trapeze assembly.

#### **6.20 ELEVATED SHELVES**

- A. Shelves shall be constructed of 14-gauge stainless steel, as applicable.
- B. Shelves shall be level and plumb, underbraced same as top hereinbefore specified when exceeding 48" in length.

#### **6.21 OVERSHELVES**

- A. Over shelves shall be fabricated of 16-gauge stainless steel with edges rolled down or up and supported as specified.
- B. Over shelves mounted on tabletops shall be supported by 16-gauge stainless steel tubular legs. Legs are to be securely fastened to the tabletop with fasteners similar to Model No. 1655000272, manufactured by Kason Food Service or an approved Manufacturer.

#### **6.22 WALL SHELVES**

- A. Wall Shelves shall be fabricated of 16-gauge stainless steel and the same construction as "Over shelves." Secure brackets to the wall with stainless steel screws with expansion shields. Brackets shall be spaced on a maximum of 4 feet on center.
- B. Wall shelves shall be supported on the table's extended rear legs with cantilevered supports of 14-gauge stainless steel flag brackets.

#### **6.23 TROUGH / DISPOSER INSTALLATION**

- A. Fit end(s) of the trough with one (1) chrome-plated water inlet, Component Hardware No. K36-6000, with gate valve control. Minimum connection to unit 1/2". Additional water inlets shall be provided as shown in the drawings and as specified in the itemized specifications.

- B. Each sump, cone, or sink with a disposer mounted in the bottom shall be fitted with a water inlet as specified above, located to direct waste into the disposer with a minimum splash.
- C. All connections shall be made in accordance with the manufacturer's recommendations (FEC shall show schematics on rough-in drawings).
- D. Entire trough/sump combination shall be integral with top to give a one-piece appearance; designed to transfer waste into disposer without accumulation or restriction. Trough/sump to be provided with integral stainless-steel silver saver adjacent to disposer entrance. Silver-saver to be furnished with drain, per Detail DET-37.02
- E. Furnish 14-gauge stainless steel, flush, removable disposer cover with perimeter edge turned down 1/2" at sump/cone.

#### **6.24 STAINLESS STEEL CHANNEL BASE FRAMES.**

- A. Constructed of 12-gauge stainless steel channels.
- B. Stainless steel channel base to be constructed of u-shaped 2" x6"x2" 12-gauge Type 304 stainless steel fully welded, to be secured to equipment cabinet base and finished floor with 3/8" stud bolt at each corner and 4'-0"o.c. with expansion anchor in the concrete slab. Provide cross bracing and notch to suit floor drains and mobile equipment as required. Channel base to be sized to meet equipment requirements to ensure proper clearances, toe kicks, and utility access relative to equipment specified and provided, disassembled, and reassembled in the field, set in place prior to setting equipment in place. Channel base to be epoxy coated and/or finished as specified by the project architect or interior designer or as required by the authority having jurisdiction, secured, and sealed to the floor.
- C. Channel base to be filled with concrete by General Contractor with a sealed top (as required) and cove base. PSI rating of concrete is to be verified by General Contractor with the project architect and/or structural engineer.
- D. Upon installation of equipment, FEC to secure and silicone equipment base to channel frame.

#### **6.25 PASS-THRU TRIM**

- A. Where pass-thru refrigerators, freezers, and/or hot food cabinets are installed through the wall, FEC shall trim both sides of the opening, full perimeter, with trim matching the finish of the units installed. Trim to have a continuous appearance, secured with concealed type fasteners. When units are furnished with 6" high stainless-steel legs, FEC shall provide a removable kick plate (toe base) to match the finish of units, unless otherwise specified. The trim shall be fully sealed to the wall. Exposed fasteners are not acceptable.

#### **6.26 BOOSTER HEATERS**

- A. Booster heaters to be furnished complete with water pressure/temperature relief valve, water pressure regulating valve, low water protection, shock absorber, water treatment system, adjustable thermostat set to provide required supply of 185-degree hot water at dish machine spray nozzles, and two (2) temperature/pressure indicating thermometers (one located on the incoming water line to the booster and one on the outgoing line to the dish machine).
  - 1. FEC shall verify all the above items have been installed and are in a location to provide ease of access to all controls, valves, stops, etc., without moving the heater and/or other equipment.

#### **6.27 DISPOSERS**



- A. The disposer is to be furnished complete with line strainers, chrome plated vacuum breaker, and flow control valves (15GPM of water flow into the base of disposer; 10 GPM water flow into the end of the trough). Provide 14-gauge stainless steel cover plates for trough at cone or sink, and 14-gauge stainless steel control panel mounting bracket. Unit shall be located so that the body and/or legs are positioned a minimum of 2" back from the front edge of the table.

#### **6.28 FIRE PROTECTION SYSTEMS**

- A. Provide as shown and described on contract documents.

#### **6.29 SODA/JUICE SYSTEM**

- A. Soda/ice juice dispensers are to be furnished by Owner's vendor or as described in contract documents.

#### **6.30 BEER DISPENSING TOWER SYSTEM**

- A. Draft Beer System sized as per manufacturer's requirements to include all necessary components, accessories and fittings required for a complete and operating system.

#### **6.31 LIQUOR SYSTEM**

- A. Liquor System sized as per manufacturer's requirements to include all necessary components for a complete system.

#### **6.32 BEVERAGE CONDUIT AND RACEWAY**

- A. Acceptable manufacturer: Conduit – Kelly Bevway, HP Products, or equal.
- B. Raceway – Evolution Stainless Products, or equal.
- C. All beverage raceways are to be sized to accept multiple beverage runs for soda, beer and liquor.
- D. Raceway to be constructed of #14 and #16 gauge stainless steel with removable cover.
- E. Size and routing as per design drawings. FEC is to verify all routing and coordinate with all trades as the routing of the raceway and/or conduit.
- F. All conduits are to be minimum of 6" O.D. tubing. See drawing for size and material.
- G. FEC is to provide shop drawings indicating all starting and ending points with access and pull points indicated on the drawings and a note as to the content of the raceway or conduit shown unless specified otherwise.

#### **6.33 MISCELLANEOUS ACCESSORIES**

- A. Water Filters:
  - 1. Provide water filters for all ice-making, hot and cold beverage equipment, and all steam boilers. All filter units are to be provided with shut-off valves and quick-change filters.
  - 2. FEC to ensure water supply is comprehensively tested, and that the water filter specified effectively treats water within the manufacturer's water standards.
- B. Stainless Steel Enclosures:
  - 1. Provide 20-gauge stainless steel trim to fill in wall openings at Pass-Thru Cabinets. Trim will overlap the wall by approximately 2 inches and be within 1/2 inch of cabinets on the side. Provide for a 3-inch opening between the top of the cabinet and wall.

- C. Stainless Steel Ceiling Panels:
  - 1. Provide 20-gauge stainless steel ceiling panels around the perimeter of the Exhaust Hood. Panels shall extend a minimum of 18 inches away from Exhaust Hood. Verify actual panel sizes from Architect's reflective ceiling plan.

#### **6.34 OWNER VENDOR SUPPLIED ITEMS**

- A. FEC to fully coordinate all Owner furnished items, verify utility requirements, and indicate on shop drawings and utility rough ins, as required.

### **PART 7 - PROCEDURES**

#### **7.1 WORKMANSHIP**

- A. Entire procedure, including materials, workmanship, details, fabrication, and fastening methods shall comply with applicable standards.
- B. Workmanship and finishes shall be in accordance with the best practices of the trade. Only skilled workers shall be employed in the fabrication and erection of the work of this section.
- C. Work shall be provided complete in every detail and the finished work shall be strong, rigid, neat in appearance, and free from defects as may be determined by the Owner / Project Architect and/or Camacho.

#### **7.2 WELDING**

- A. Joints in stainless steel shall be electrically welded using stainless steel electrodes. All welds shall be free of pits and flaws. Acetylene welding or silver soldering will not be acceptable.
- B. Joints in galvanized material shall be electrically welded using electrodes designed to weld galvanized metal. All welds shall be free of pits and flaws.
- C. Acetylene welding will not be acceptable. Materials spot welded together shall have welds equally spaced in straight parallel or perpendicular lines. Spot welding procedure or technique is to be in strict accordance with the recommendations of the material and/or welding machine manufacturer.

#### **7.3 FINISHING**

- A. Joints in stainless steel that have been welded shall be ground smooth and polished to a No. 4 finish. The grain shall be blended into the grain of surrounding surfaces.
- B. Joints in galvanized material that have been welded shall be thoroughly cleaned and finished with one coat of zinc-rich paint (70% minimum). Galvanized steel shall be washed with mineral spirits, primed with Pratt and Lambert Effecto Primer or approved substitute, then spray painted with two (2) coats of Pratt and Lambert Effecto Enamel, or approved substitute of color selected by Camacho / Project Architect. Allow eight hours minimum drying time between the coat of paint and primer.
- C. Powder-coated items shall have a fifteen-year warranty against chipping, cracking, fading, scratching and/or damage due to temperature. Colors to be selected by Project Architect. Finish and materials to be approved for food service use by all governing agencies.

#### **7.4 LUBRICATION – OIL AND GREASE**

- A. Each moving part in the entire food facilities installation shall be provided with suitable bearings with provision for greasing, or with grease gun connections suited to a high-pressure gun for distributing heavy oil or light grease. Points of lubrication shall be readily accessible.

## **PART 8 - MATERIALS**

### **8.1 HARDWARE**

- A. Hardware used in the construction of custom-built equipment shall be standard products of an approved hardware manufacturer and/or as approved by Camacho / Project Architect. Hardware shall be heavy-duty chrome plated brass (walk-in door hardware shall be Kason or approved equal) or stainless steel where specified, by Component Hardware, Keil, Grant, or Knape. All locks specified on equipment shall be of the same manufacturer, keyed alike unless otherwise requested by the Owner.

### **8.2 STAINLESS STEEL COMPONENTS**

- A. Flat sheets shall be type 304 with no.3 finish, in accordance with ASTM-A-167-70 standard. Materials shall be new, of prime quality, and of full gauge thickness. Stainless steel shall be type 304, 18-8 series, with a content of from 17% to 19% chrome, 7% to 10% nickel and a maximum carbon content of 0.09. The exposed surface shall be interpreted to include all inside surfaces exposed to view when the item is open.
- B. Structural shapes shall be type 304 with no.3 finish on all exposed surfaces.
- C. Hardware and fittings shall be the standard product of the manufacturer named as a standard.
- D. Tubes shall be type 304, ornamental grade, with no. 4 finish, 16 gauge minimum, seamless drawn.

### **8.3 GALVANIZED STEEL COMPONENTS**

- A. Flat sheets shall be type 1, class D, in accordance with FF-QQ-S-775D standard.
- B. Structural shapes shall be galvanized by the hot dip process in accordance with ASTM- A-123-69 standards.
- C. Tubes shall be welded steel, structural grade, with a hot dipped galvanized finish applied after fabrication.
- D. Pipes shall be type S, grade B, schedule 40, in accordance with ASTM-A-53-69 standard.

### **8.4 BRASS COMPONENTS**

- A. Flat sheets shall be 70% copper and 30% zinc alloy in accordance with ASTM B19, B36, alloy 260 half-hard finish.
- B. Brass tops are to be B & S gauge as specified.
- C. Structural sheets are to be B & S 18 gauge and seamless.
- D. Brass flat surfaces and structural shapes are to have a mirror finish.
- E. Welds are to be restored to a mirror finish and shall blend into the surface of the surrounding surfaces.

### **8.5 COPPER COMPONENTS**

- A. Flat sheets shall be hard copper ASTM B152, type ETP. 48 ounces per square foot.

#### **8.6 STRUCTURAL STEEL SHAPES**

- A. Angles, channels, rods, and bars used as framing members shall be extruded shapes that are uniform in cross-section, ductile in quality, and free from hard spots, runs, checks, or other defects.
- B. Structural shapes shall conform to ASTM-A-36-70 standards.
- C. Bent or formed sheet metal will not be accepted as a substitute for structural materials unless prior approval in writing is obtained from Camacho / Project Architect.
- D. Where brakes are specified, they shall be adjustable, cam acting, side lever with positive brake shoe on the wheel tread.

#### **8.7 INSULATION**

- A. Fiberglass batts shall be Johns-Manville, Owens-Corning, or W.R. Grace Zonolite blanket insulation.
- B. Plastic foam board insulation shall be Dupont urethane or an approved substitute.
- C. Insulation thickness indicated shall be foamed in place or constructed from multiple layers of board insulation of batts with staggered joints and perpendicular seams.

#### **8.8 WOOD**

- A. Lumber shall be free from knots, pitchy seams, or other imperfections, thoroughly air-seasoned and Kiln dried. Cover all exposed surfaces with two coats of odorless waterproof coating.
- B. Plywood shall be marine grade or exterior APA grade with closed grain and thickness specified.
- C. Exposed wood surfaces to be Birch, interiors to be Cypress, Spuce, or Northern White Pine. Frame casing and jambs to be clear Douglas Fir.

#### **8.9 FIBERGLASS (FRP)**

- A. Fiberglass Reinforced Polyester (FRP) shall be molded with permanent color, minimum thickness, 1/8", glass content 33% minimum, Barcol hardness at least 55, a flexural strength of 30,000 PSI minimum, tensile strength 25,000 PSI. All FRP parts shall be by manufacturer and color as selected by the Project Architect and/or Owner.
- B. Where finished FRP parts are used in conjunction with casters or other metallic parts which impart concentrated stress at specific points, these points shall be reinforced with stainless steel battens, bars, or other required shapes.
- C. Fire ratings shall be as specified by the Project Architect.

#### **8.10 PLASTIC LAMINATING**

- A. Plastic laminated panels shall be constructed of 3/4" thick marine grade plywood veneered on all exposed surfaces with a plastic laminate of pattern and color as selected by Architect / Interior Designer, Seal all unexposed sides with 1/8" Masonite.
- B. Plastic and Masonite shall be pressure laminated to plywood with mastic recommended by the plastic manufacturer.

- C. No joints shall be permitted when standard sheet size will permit panels to be constructed without joints.
- D. Grain on upright surfaces shall run vertically. All inside corners are to be sealed with an approved sealer as per above.

### 8.11 CASTERS

- A. Casters on prefabricated equipment shall be the equipment manufacturer's standard product as specified under the itemized equipment list.
- B. Casters on custom-built equipment shall be Jarvis N.S.F. non-marking polyurethane or approved substitute or as specified under itemized specifications.
- C. Casters shall have wheel sizes indicated.
- D. Standard duty (S.D.) casters shall be No. 5-25-111 swivel plate casters or No. 5-30-113.
- E. Heavy duty (H.D.) casters shall be No. 5-30-113 plate casters.
- F. Secure plate casters with four (4) 1/4-20 stainless steel bolts, stainless steel lock washers, and stainless-steel nuts.

### 8.12 FAUCETS, SPRAY UNITS, AND ACCESSORIES

- A. All faucets, spray units, and accessories shall be chrome-plated, heavy-duty brass, equipped with removable seats and aerators, manufactured by T&S Brass. Approved manufacturer Fisher. Each faucet shall be furnished with 4" wrist action handles unless otherwise noted in the itemized specifications. One (1) faucet shall be provided for each sink bowl unless otherwise shown on drawings and noted in the itemized specifications.
  1. Backsplash mounted faucet No. B-0231-CR with 12" swing faucet and 1/2" inlet.
  2. Backsplash mounted faucet No. B-0290 with 12" swing spout and 3/4" inlet.
  3. Backsplash mounted pre-rinse/faucet assembly No. B-0133-12A-CBJST with 12" swing spout and 1/2" inlet (vegetable prep and pot wash sinks).
  4. Backsplash mounted pre-rinse/faucet No. B-0287 with 12" swing spout and 3/4" inlet
  5. Backsplash mounted pre-rinse assembly No. B-0133-CR with 1/2" inlet (ware wash sink).
  6. Top or deck-mounted faucet No. B-0300-CR with 12" swing spout and 1/2" inlet.
  7. Top or deck-mounted faucet No. B-0325-CR with 1/2" inlet (hand sinks only).
  8. Top or deck-mounted faucet No. B-1142-04-CR with 1/2" inlet (servery sinks only).
  9. Top or deck-mounted electronic faucet No. EC-3100-HG with 1/2" inlet (servery sinks only).
  10. Service sink faucet No. B-0665-BSTP-CR
- B. All units to be complete with check valves.
  1. Vertical No. B-CW1-2 with 1/2" inlet.
  2. Horizontal No. B-CVH1-2 with 1/2" inlet.
  3. Vertical No. B-CW3-4 with 3/4" inlet.
  4. Horizontal No. B-CVH3-4 with 3/4" inlet.
- C. Pot fill faucet assembly (wall mounted) No. B-2312 as manufactured by T&S Brass.
- D. Fill faucet assembly (serving counter) No. B-101-A modified with No. 013E-84 flexible stainless-steel hose, No. B-KF built-in flange and No. B-0512 mixing valve complete with check valves.
- E. Cart washer spray unit (wall mounted) No. MV-0771-12R complete with check valves.

- F. Hose reel assembly, closed, No. B-7132-U01-WS8T-C with 50'-0" hose (unless otherwise specified), stainless steel surface mount control box.
- G. Hose reel assembly, open, No. B-7142-02 with 50'-0" hose (unless otherwise specified).
- H. Small undermount hose reel assembly No. B-7161-C with No. B-0512 mixing valve.
- I. Vacuum breakers shall be mounted neatly above the tabletop or backsplash as required. Provide No B-0455-04 (for a flat surface) and B-0455-M3991 (for a 45-degree surface) with 1/2".

### 8.13 SINK DRAINS

- A. Sink drains shall be a minimum of 2" IPS, or as specified, complete with a rear-connected overflow for each sink bowl and 4" long chrome plated tailpiece. Interconnect multiple same-size drains with chrome-plated continuous waste assembly, where two (2) or more drains are mounted immediately adjacent to each other.
- B. All sinks drain units shall be quick opening type No. B-3950 and No. B-3950-01 stainless steel rotary drain with stainless steel twist handle assembly (unless otherwise specified) and overflow assembly. Furnish overflow assembly in accordance with sink depth as required.
- C. Where specified furnish Component Hardware No. D34-Y011 stainless steel box pattern waste with stainless steel basket and cover for floor troughs.
- D. Sink Bowls containing 180-190 degrees hot water shall be provided with an 8"x10" red plastic warning sign on the wall above the sink compartment. The sign shall have white incised letters and shall read as follows:
  - 1. "WARNING: THIS SINK BOWL (and or faucet) CONTAINS VERY HOT 190 DEGREE WATER – USE EXTREME CARE".

### 8.14 QUICK DISCONNECT ASSEMBLIES

- A. Each of the following gas hose kits shall consist of a stainless-steel braided hose with extruded coating, quick disconnect fitting, two (2) full-flow swivel link connectors, one (1) 90-degree street elbow (when required), one (1) AGA certified gas ball valve, one (1) Sure link restraining cable and all necessary hardware as manufactured by T&S Brass or Dormont.
  - 1. No. HG-4C-\*SK with 1/2" gas inlet.
  - 2. No. HG-4D-\*SK with 3/4" gas inlet.
  - 3. No. HG-4E-\*SK with 1" gas inlet.
  - 4. No. HG-4F-\*SK with 1-1/4" gas inlet.
- B. Each of the following water hose kits shall consist of a stainless-steel braided hose with extruded coating, quick disconnect fitting, two (2) full-flow swivel link connectors, one (1) 90-degree street elbow (when required), one (1) Sure link restraining cable and all necessary hardware as manufactured by T&S Brass or Dormont.
  - 1. No. HW-4B-\*SK with 3/8" water inlet.
  - 2. No. HW-4C-\*SK with 1/2" water inlet.
  - 3. No. HW-4D-\*SK with 3/4" water inlet.
- C. Each of the following flexible coiled water hose kits are for use with coffee and tea makers and similar applications requiring smaller diameter hoses for cold water connections only not to exceed 70 degrees, as manufactured by T&S Brass or Dormont.
  - 1. No. CW-2A-60 or CW-4A-60 with No. AW-5A-SS stainless steel quick disconnect; 1/4" inlet.

2. No. CW-2B-60 or CW-4B-60 with No. AW-5B-SS stainless steel quick disconnect; 3/8" outlet.
- D. FEC to field verify the hose length required for each application to ensure the hose does not rest on the floor and equipment can be moved for cleaning.

## **PART 9 - INSTALLATION**

### **9.1 UTILITIES, DELIVERY, STORAGE, AND SPECIAL HANDLING**

- A. GC/CM shall provide and pay for the temporary power and light, openings, and storage space to permit the scheduled delivery of equipment. See section 015000 for further clarification.
- B. The FEC shall verify door openings, passages, and conditions at the building. All special handling equipment charges shall be paid by the FEC.
- C. Foodservice equipment to be delivered in factory-fabricated containers designed to protect equipment and finish until final installation.
- D. Make arrangements to receive equipment at the project site, or to hold equipment in a secure warehouse until delivery can be made to the job site. Coordinate all site deliveries with GC/CM.
- E. Store food service equipment in original containers, and in a location to provide adequate protection to equipment while not interfering with other construction operations.
- F. Handle food service equipment carefully to avoid damage to component enclosures and finish. Do not install damaged food service equipment; return damaged components to the equipment manufacturer and replace them as required.
- G. Make arrangements for receiving equipment and make delivery into the building. Do not consign any equipment to the Owners or any other Contractor unless written acceptance from them and satisfactory arrangements have been made for the payment of freight and all handling charges.

### **9.2 CONDITIONS AND PREPARATION**

- A. Verify all pertinent field dimensions of the building and examine conditions affecting the proper execution of this section, giving due consideration to any Architectural, Mechanical, or Structural discrepancies which may occur during the construction of the building. No extra compensation shall be allowed for any difference between the actual dimensions secured at the job site and the measurements indicated on the Contract Drawings. Any differences that may be found during field measurements shall be submitted to the Architect for consideration before proceeding with the fabrication or supplying of any equipment.
- B. Evaluate access to various areas for moving in of equipment and coordinate with GC/CM.
- C. Verify water pressure requirements and coordinate the required reducing valve with Plumbing Contractor.
- D. Inspect flooring and raised concrete bases, and wall finishes; verify the existence of required mechanical and electrical rough-ins; check painting, ceiling installation, and all kitchen equipment.
- E. Coordinate with the project superintendent for the proper sequence for installation of equipment and wall finish.
- F. Sweep and clean all floor areas and tops of raised concrete bases before setting equipment in place; remove any spillage or foreign matter.
- G. Dispose of all packaging and debris per Construction Waste Management Plan.

**9.3 PLACEMENT**

- A. Do all fitting and fastening necessary to install fixed items or sub-items in a permanent position as shown on plans.
- B. Place all portable items or sub-items which do not require plumbing or electrical services as shown on plans or as directed by Camacho / Project Architect.

**9.4 ERECTION**

- A. Work shall be erected plumb, square, and unwrapped by experienced personnel.
- B. Protect all metal surfaces in contact with masonry, concrete and/or dissimilar metals with an acceptable nonabsorbent tape and/or gasket material.
- C. Work shall be erected in correct horizontal and vertical alignment at the locations shown on the drawings.
- D. Frames shall be anchored in place with sufficient anchorage to withstand live load with no apparent movement or tendency to fail.
- E. Installation screws and fasteners shall be installed carefully to avoid scratching and/or damaging adjacent surfaces and/or fastener heads and shall be stainless steel.
- F. At the completion of erection work, finished surfaces shall be free of hammer and tool marks, scratches, blemishes, rust, and stains.
- G. Equipment shall be suitably protected by FEC during installation to prevent damage by other trades.
- H. Provide general &/or seismic restraining devices in areas requiring such, as per local codes.

**9.5 CLEARANCE**

- A. Edges of splashes on open base fixtures that are adjacent to walls shall have a 3" cleaning clearance or be sealed, seal bead not to exceed 3/8", against a wall.
- B. Edges of splashes on closed base fixtures that are adjacent to a wall or other solid fixtures higher than the splash shall form tight hairline joints. Seal joints with transparent Geoprene, General Electric, or Dow silicone sealant. All excess sealant is to be cleaned out to a smooth radius fillet.

**9.6 FIELD JOINTS**

- A. Field joints in stainless steel and/or brass tops shall be welded, ground, polished and finished as specified herein.
- B. Body joints shall be drawn type with hairline joints. Provide angle bracing on each side of the body joint, 3/8" stainless steel diameter draw bolts, a lock washer and lock nuts.

**9.7 UTILITY SERVICE CONNECTIONS**

- A. Plumbing, electrical and mechanical furnished by the FEC shall be limited to that which is built-in or is an integral part of the equipment itself.
- B. Final utility installation and connections shall be by related trades and is to be included in the G.C. / C.M. contracts.
- C. Provide restraining devices with mobile cooking equipment as required.



**9.8 CONTRACTOR COOPERATION**

- A. Cooperate with and render all necessary assistance to other Contractors concerned with roughing-in and final connection of utility services for this contract.
- B. After final utility connections are made, thoroughly clean, sanitize, polish, and inspect the proper function of all items.
- C. Report malfunctioning, incomplete, or missing items, Owner furnished equipment or components to CAMACHO / Project Architect.

**9.9 COORDINATION**

- A. It shall be the responsibility of FEC to keep up to date with progress made in the field and installation of all necessary utility rough-ins required to accommodate all equipment specified, as shown on drawings, and to make as many visits to the job site as is necessary to check and assure all rough-ins are being properly installed to accommodate this equipment.
- B. FEC to cooperate with all trades so that the end results of this work will be a professional, complete, approved, and accepted installation. Written reports of each visit shall be sent promptly to the Project Architect and Camacho.
- C. Progress of construction is of paramount importance in the execution of this project.
- D. FEC is to carry out its work so that no delay in the completion of this project is incurred.
- E. FEC is to procure all specified equipment and coordinate installation as required by the project schedule.

**9.10 NOT USED****9.11 RESERVATIONS AND CONDITIONS**

- A. It is the intent of this specification to complete the installation of all equipment covered herein in all phases ready for operation.
- B. The FEC shall carefully examine the plans and the specifications for building construction contracts and determine therefrom the extent of its operations in all respects. All labor and materials not included in building construction contracts necessary to accomplish the intent are hereby included in this contract.
- C. The FEC shall make all arrangements for receiving equipment and make delivery into the building.
- D. TheFEC shall not consign any equipment to the Owner or any other Contractor unless written acceptance from them and satisfactory arrangements have been made for the payment of freight and all handling charges.
- E. The FEC shall attend the first job meeting and subsequent job meetings, as required, for the purpose of coordinating his work with other trades.
- F. All equipment shall be delivered into the building fully protected, uncrated, assembled, level, and fully protected. It will be the responsibility of the FEC to protect the equipment until completely installed and accepted.
- G. The FEC to set equipment temporarily in its final locations, permitting the mechanical and electrical trades to take the necessary measures for the connection of the service lines; then move the equipment sufficiently to allow the installation of such service lines. After which realign the equipment level and plumb, making the final erection as shown on the Contract Drawings. All equipment shall be installed to eliminate objectionable vibration.

- H. The FEC shall do all things and furnish all material necessary to carry out the full intent and meaning of these specifications.
- I. The FEC is to be proactive in their involvement with the project and shall have a competent Food Service Equipment foreman on the premises to assist in furnishing information and supervising the installation of Food Service Equipment under this Section.
  - 1. This foreman shall verify the correct locations for Rough-Ins, shall monitor work in progress, and coordinate their work as required to meet all scheduled dates.

#### **9.12 ACCEPTANCE**

- A. Camacho will inspect the completed work connected with this section for compliance with the Contract Documents, upon notification by the Owner, Project Architect, or FEC whichever occurs first.
- B. Prior to acceptance of the work of this Section, FEC shall clean, sanitize, polish, and treat all stainless steel, cast iron, enamel porcelain, and other type surfaces in accordance with the manufacturer's recommendations and/or procedures.
- C. Prior to acceptance of this Section, FEC shall clean and retouch all painted surfaces, powder-coated surfaces that have been damaged must be re-finished by an established powder-coating firm.
- D. NOTE: In addition to the stipulated retainage of payment as required, the Owner shall retain an additional (10%) ten percent of the line item applicable to "Food Service Equipment" as listed in the Contractor's Schedule of Values. This additional retainage will be released only after the requirements of this section of these specifications are met and approved in their entirety to the complete satisfaction of the Consultant and Owner's Project Manager.

#### **9.13 TESTING, DEMONSTRATING, AND INSTRUCTING**

- A. FEC shall at the completion of this work remove all debris, crating, packaging materials, and implements associated with this work leaving the area broom clean.
- B. FEC shall provide and maintain protective covering for finished surfaces and other parts of equipment and/or cooler/freezer assemblies subject to damage during and after installation.
- C. Clean, test, adjust, and calibrate by factory-authorized service agency all food service equipment and fixtures to make them ready for operation when the facility is turned over to the Owner.
- D. After the above is complete, FEC shall devote one (1) full working day to monitoring all items furnished under this Contract are operational and thoroughly tested to ensure proper safe operation. The Owner, the Food Service Consultant, the G.C. and/or C.M. shall be notified of this testing and is to be provided with a copy of the service agencies' report.
- E. When the food service equipment has been cleaned and tested and is operating properly, the FEC shall arrange and coordinate to have equipment furnished under this section of the contract demonstrated, pursuant to the availability of the Owner and its representatives, by authorized representatives who are to instruct the Owner's designated personnel in the use, care, and maintenance of the equipment. NOTE: Attendance at the demonstration meeting is required of all manufacturers' designated representatives providing equipment under this Contract and is to occur at one meeting.
- F. Coordinate start-up of equipment with testing and balancing of the HVAC system. Ensure that the HVAC will be operating correctly, even during maximum equipment use.

- G. The FEC shall be responsible for scheduling the demonstration meeting. Each manufacturer's representative shall be present at this meeting:
1. Demonstrate to and instruct the Owner's designated personnel as to the operation, use, care, cleaning, and maintenance of all items of equipment supplied and respond to all questions and concerns by written response. Supply the Architect with an affidavit signed by the Owners or Food Service Manager/Director that this service was rendered and performed.
  2. Provide the Owner's designated representative with the name, address, and telephone number of a designee of each manufacturer and state which designee shall be responsible for quickly responding to warranty work 24 hours a day, 365 days a year. This is to be direct contact.
  3. The Owner may contact such warranty representative's designee directly, and such designee may respond without voiding any responsibility or warranties of the manufacturer, the FEC, the G.C. and/or the C.M. Service charges for this warranty representative, no matter what the resolution of the problem may be, shall be the responsibility of the manufacturer, the FEC, the G.C and/or the C.M.
  4. In any event, the FEC shall be responsible to immediately pay upon invoice, charges by the warranty representative in order to keep the warranty representative responsive. Whether the plumbing, electrical, food service equipment, or other sub-contractors (or even the Owner) should be back charged will be resolved later.
  5. Provide the Owner's representative with two (2) booklets for each item of equipment furnished under this contract. This set shall be neatly bound in a three-ring binder, by FEC with the delivery of this booklet receipted at the time of delivery. The booklets shall contain:
    - a. Operation Maintenance Manuals.
    - b. Instructions.
    - c. Warranties.
    - d. Part lists of all bought-out items provided under this section.
    - e. List of names, addresses, telephone numbers, and emails of local authorized service agencies.
    - f. Where available, provided videos to show and detail the proper care and maintenance of equipment.
  6. Attendance at the one demonstration meeting is required of all manufacturers' representatives providing equipment under this contract. If for any reason an additional meeting must be scheduled the FEC will be responsible for all additional fees and costs incurred.
- H. After all connections to equipment have been completed, conduct the final test or tests of equipment in the presence of the Architect or authorized representative for a period of one.
- I. (1) hour minimum. Adjust and lubricate as required. Each piece of equipment with a heating device shall be tested for temperature control and/or thermostat functions; thermostats shall be re-calibrated as needed.
- J. Provide a training program by a Serve Safe certified culinary chef to consist of one (1) day within ten days of a start-up, showing all equipment and how it works with demonstrations.
1. The trainer shall monitor employees and demonstrate how to properly use equipment with live cooking.
  2. The service provided shall include abbreviated classes in Serve Safe and HACCP and the proper method for receiving and storing product.
  3. Training consists of a total of four (4) hours.

- K. The Contractor shall issue a letter, signed by all sub-contractors involved, and co-signed by the Owner's representative, stating the Owner or the Food Service Manager/Director and/or staff have been satisfactorily instructed in the use, operation, and minor maintenance of the equipment.

## **PART 10 - CORRECTION OF DEFECTS, SERVICES, GUARANTEES, AND RESPONSIBILITIES**

### **10.1 GENERAL**

- A. All equipment shall be delivered in an undamaged condition upon completion. FEC shall replace, at the Owner's, CAMACHO's and/or the Project Architect's discretion, or make satisfactory repairs to any item of equipment that fails to conform to the requirements of the Contract at the time and shall remedy any defects due to faulty materials or workmanship which appear within a period of one (1) year from start-up and demonstration of equipment.
- B. Items shall be tested and adjusted by skilled mechanics and this Contractor shall guarantee the material and workmanship of the equipment furnished by him under these specifications, for a period of one (1) year after acceptance by the Owner.
- C. All equipment, refrigeration systems, and ice makers shall have start-up and a two (2) year extended service warranty for parts and labor and a five (5) year extended warranty on compressors which will start on the date of Owner's acceptance. All additional warranties as noted in the itemized specification shall be factory-purchased warranties for each item; proof of warranties shall be provided. The cost of all warranties shall be included in the bid proposal and contract sum and shall serve as a prepaid service contract.
- D. Contractors who do not normally maintain local refrigeration service personnel shall be required to provide the Owner with a refrigeration service policy in writing from a local refrigeration service company that maintains a twenty-four (24) hour call service and that is acceptable to the Owner for a period of one (1) year at no additional expense to the Owner.
- E. Provide the Owner a listing of factory-authorized service agencies and copies of written service and warranty agreements on all items of equipment provided under this contract, excluding Owner furnished and/or existing items.
- F. Service contracts on refrigeration systems must be contracted by the FEC with authorized local service organizations capable of providing prompt and efficient service. Submit six copies of all service contracts, as specified herein, upon completion of the installation of the equipment to the Owner.

### **10.2 EXAMINATION OF PLANS AND SPECIFICATIONS**

- A. Plans and specifications are furnished for the use of the FEC in preparing an itemized cost estimate and indicating the design intent of Camacho.
- B. It is the responsibility of the FEC to examine all documents, which include the contract drawings and specifications, to ensure there are no typographical errors, discrepancies in quantities, drafting errors, utility information, manufacturer and model numbers, options, etc. which would affect the outcome of a complete and professional bid. Should a model number no longer be available and/or has been replaced, the latest model shall be provided. All discrepancies and verification requests shall be brought to the attention of Camacho / Project Architect (PA) prior to the submittal of the bid and are to be addressed in the form of a written RFI to Camacho with a copy to the PA for interpretation. In the case these discrepancies and verifications are not brought to the attention of Camacho / Project Architect prior to the submittal of the bid, the FEC will be fully responsible to furnish and provide the equipment as represented by Camacho, within reason, at no additional cost to the Owner.

**PART 11 - MISCELLANEOUS REQUIREMENTS****11.1 UNIFORM QUALITY**

- A. Custom-built items must be constructed by the same fabricator to ensure uniform quality and appearance.
- B. Similar type items of manufacture and/or prefabricated equipment must be the product of the same manufacturer.

**11.2 IDENTIFICATION PLATES**

- A. Each piece of equipment must have a suitable nameplate supplied by the manufacturer that is to include the name of the manufacturer and the electrical and/or utility demands.
- B. Each switch and/or control device shall have an approved nameplate indicating its function or purpose such as display shelf lights, frost plate compressor, and plate warmer.
- C. Indicator dials and other standard components of prefabricated equipment will be considered acceptable identification of their physical location clearly indicating the warmers and/or other equipment items that they control.
- D. All nameplates must be non-corrosive metal with engraved letters or have acid etched, phenolic and/or painted letters.

**PART 12 - FOODSERVICE EQUIPMENT NOTES**

- A. In each item of equipment hereinafter specified under the 'Itemized Specifications', these specifications shall identify each respective item by name, model number, accessories, required utilities, brochure data sheets, as well as list various component parts and warranty requirements provided for same.
- B. These items and their component parts shall be of material (mounted where applicable) constructed and furnished in strict accordance with that described in the General Specifications for these items and integrally constructed where applicable. It shall be intended that where buy-out (prefabricated) items are specified, the same shall be furnished with all the accessories as normally furnished by the manufacturer for these items.
  - 1. Also, in strict accordance with the current manufacturer's engineering data sheet for each respective item.
- C. It is the responsibility of the FEC to ensure that any products by manufacturers listed as being acceptable to the original specification meet the design and performance specifications of the prime specification in every way.
- D. The intent of the prime specification is to set forth the level of quality and features/options that are desired by the Owner. All features and options of the prime specification must be included with, and product substituted from the list of approved manufacturers.
- E. All cooking equipment shall have stainless steel exterior (unless otherwise specified).
- F. All gas fired equipment to have rear gas connects where applicable and automatic ignition.
- G. Provide POSI-SET devices at all rear casters of mobile cooking line equipment located below exhaust hoods.
- H. Reference Kitchen Floor Plan for the location of equipment. Obtain equipment of like families through the same manufacturer.

**PART 13 - ITEMIZED SPECIFICATIONS****B1 – EVENT LEVEL BALLROOM 1**

**ITEM # B1-1**                    **UNDER-COUNTER BUFFET WARMER**  
**Quantity:**                    **Ten (10)**  
**Manufacturer:**              **CookTek**  
**Model:**                        **660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # B1-2**                    **COLD SHELF, UNDERMOUNT**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**              **Hatco**  
**Model:**                        **CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA  
b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P, standard

**ITEM # B1-3**                    **BACK BAR COOLER, 4 DOOR**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **BBS108**

- a. Model BBS108 Refrigerated Back Bar Cabinet, four-section, 108"W, self-contained refrigeration, 33.5 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus  
b. 120v/60/1-ph, 4.2 amps, NEMA 5-15P  
c. Stainless steel top - no tapping holes  
d. Condensing unit location: Left  
e. Condensing unit cover finish: Black vinyl coated  
f. End finish: Stainless steel, unfinished, both sides, standard  
g. Door type, first: solid, black vinyl/field laminated  
h. Door hinge location, first: Left  
i. Door handle, first: full length stainless steel handle, 24"  
j. Shelving style, first: (3) flat shelves  
k. Door type, second: solid, black vinyl/field laminated  
l. Door hinge location, second: Left  
m. Door handle, second: full length stainless steel handle, 24"  
n. Shelving style, second: (3) flat shelves  
o. Door type, third: solid, black vinyl/field laminated  
p. Door hinge location, third: Right  
q. Door handle, third: full length stainless steel handle, 24"  
r. Shelving style, third: (3) flat shelves  
s. Door type, fourth: solid, black vinyl/field laminated  
t. Door hinge location, fourth: Right  
u. Door handle, fourth: full length stainless steel handle, 24"

- v. Shelving style, fourth: (3) flat shelves
- w. Crisp White LED
- x. Model 57787 Casters (3-3/4"), set of (6)

**ITEM # B1-4**                      **PORTABLE BAR**  
**Quantity:**                      **Two (2)**  
**Manufacturer:**                **Perlick Corporation**  
**Model:**                         **MOBS-66TE-S**

- a. Model MOBS-66TE-S Signature Series Mobile Bar, with hand sink, 66" total bartending width, 30" ice chest, 12" insulated bottle well, (1) 12" drainboard, 42" curved speed rail, 12" hand sink, LED bartender task lighting, 1.5 gallon water heater, water pump, fresh water tank, grey water tank, ice melt drain tank, 5" stainless steel casters (locking), 120v/60/1-ph, 13.3 amps, NEMA 5-15P, NSF
- b. Exterior color to be selected by arch / interiors.
- c. Bar top material & color to be selected by arch / interiors.

**ITEM # B1-5**                      **POINT OF SALE**  
**Quantity:**                      **Three (3)**  
**Manufacturer:**                **BY OPERATIONS**  
**Model:**                         **POS**

- a. Model POS PROVIDED BY OPERATIONS

**ITEM # B1-6**                      **BACK BAR COOLER, 3 DOOR**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **Perlick Corporation**  
**Model:**                         **BBS84**

- a. Model BBS84 Refrigerated Back Bar Cabinet, three-section, 84"W, self-contained refrigeration, 24.8 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 4.2 amps, NEMA 5-15P
- c. Stainless steel top - no tapping holes
- d. Condensing unit location: Right
- e. Condensing unit cover finish: Black vinyl coated
- f. End finish: Stainless steel, unfinished, both sides, standard
- g. Door type, first: solid, black vinyl/field laminated
- h. Door hinge location, first: Left
- i. Door handle, first: full length stainless steel handle, 24"
- j. Shelving style, first: (3) flat shelves
- k. Door type, second: solid, black vinyl/field laminated
- l. Door hinge location, second: Right
- m. Door handle, second: full length stainless steel handle, 24"
- n. Shelving style, second: (3) flat shelves
- o. Door type, third: solid, black vinyl/field laminated
- p. Door hinge location, third: Right
- q. Door handle, third: full length stainless steel handle, 24"
- r. Shelving style, third: (3) flat shelves
- s. Crisp White LED
- t. Model 57787 Casters (3-3/4"), set of (6)

**ITEM # B1-7**                    **BACK BAR COOLER, 2 DOOR**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **BBS60**

- a. Model BBS60 Refrigerated Back Bar Cabinet, two-section, 60"W, self-contained refrigeration, 16 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/5 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 2.5 amps, NEMA 5-15P
- c. Stainless steel top - no tapping holes
- d. Condensing unit location: Right
- e. Condensing unit cover finish: Black vinyl coated
- f. End finish: Stainless steel, unfinished, both sides, standard
- g. Door type, first: solid, black vinyl/field laminated
- h. Door hinge location, first: Left
- i. Door handle, first: full length stainless steel handle, 24"
- j. Shelving style, first: (3) flat shelves
- k. Door type, second: solid, black vinyl/field laminated
- l. Door hinge location, second: Right
- m. Door handle, second: full length stainless steel handle, 24"
- n. Shelving style, second: (3) flat shelves
- o. Crisp White LED
- p. Model 57786 Casters, 3-3/4", set of (4)

**ITEM # B1-8**                    **CLASSIC TABLE WITH HIDDEN RANGES**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**              **Spring USA**  
**Model:**                        **CLASSIC TABLE**

- a. Model CLASSIC TABLE 84"L x 30"W x 34"H CLASSIC TABLE  
SMARTSTONE TOP WITH WOOD EDGE  
CHOICE IN COLOR AND FINISH OF SMARTSTONE  
WILSONART 7954-12 NATURAL RIFT LAMINATE  
(3) SM-651SS HIDDEN WARMERS - 5.4 AMPS EACH  
20 AMP DEDICATED CIRCUIT REQUIRED  
(1) POWERSTRIP  
HIDDEN CONTROLS  
GROMMET HOLE IN BOTTOM OF TABLE FOR CORDS  
CASTERS

#### **BC – EVENT LEVEL BUNKER CLUB**

**ITEM # BC-1**                    **UNDERBAR HANDSINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12HS**

- a. Model TSF12HS TSF Series Underbar Hand Sink Unit, 12"W x 24"D, 10" wide x 14" front-to-back x 9-1/4" deep 18 gauge stainless steel sink, backsplash, 4" OC splash mount faucet holes, (16) oz. pump soap dispenser integrated into front apron, C-fold paper towel dispenser integrated into front apron, stainless steel hinged door with magnetic catches, 1-1/2" NPS male drain, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with 1" adjustable thermoplastic feet.



- b. 6" Backsplash standard
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # BC-2**                      **UNDERBAR SINK UNITS**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **Perlick Corporation**  
**Model:**                         **TS48M3-DBL**

- a. Model TS48M3-DBL TS Series Underbar Multi-tank Sink Unit, three 18 gauge stainless steel compartment, 48"W x 18-9/16"D, backsplash, 10" wide x 14" front-to-back x 9-1/4" deep compartments, 12" pitched drainboard top on the left, 4" OC (TS) splash or (TSF) deck mount faucet holes, seamless 18 gauge stainless steel front apron, includes 1-1/2" drains & 8-1/2" removable overflow standpipes, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet (replaces TS43R)
- b. 6" backsplash
- c. (2) Model ZZPERL1040635 TS Series, Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- d. Model 934-10LF Front Loading Faucet, wall/splash mount, lead free, 10" swing spout, faucet valves include built-in check valves to prevent back flow or cross flow, (2) 3/8" O.D. x 3/8" O.D. x 18" braided stainless steel supply lines included
- e. (3) Model 54965-1 Drain Screen, for 1-1/2" drain socket

**ITEM # BC-3**                      **POINT OF SALE**  
**Quantity:**                      **Two (2)**  
**Manufacturer:**                **BY OPERATIONS**  
**Model:**                         **POS**

- a. Two (2) Model POS PROVIDED BY OPERATIONS

**ITEM # BC-4**                      **UNDERBAR STORAGE CABINET**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **Perlick Corporation**  
**Model:**                         **TSF24SC**

- a. Model TSF24SC Underbar Storage Cabinet 24"W x 24"D, 4" or 6"H backsplash with 1" return at top, pitched drainboard top with 1-1/2" NPS drain socket with 1/2" OD barb & 1/2" ID anti-microbial tubing, 1-1/2" NPS male drain center back of cabinet bottom, (1) adjustable intermediate shelf, stainless steel construction, Perlick Quick Clamp stainless steel legs & adjustable feet, NSF Listed (replaces SC24)
- b. 6" backsplash
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 1032968-24 TSF Series 24"W Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- e. Model DR24SC Field reversible door and lock set for 24"W storage cabinets
- f. Model SC-ES-L End Splash, left, for storage cabinets
- g. Model SC-ES-R End Splash, right, for storage cabinets

**ITEM # BC-4.1**                    **UNDERBAR STORAGE CABINET**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF18DB**

- a. Model TSF18DB TSF Series Underbar Drainboard, 18"W x 24"D, pitched drainboard top, all stainless steel construction, backsplash, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet (replaces TSF18 TSD18)
- b. 6" backsplash
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 1032573-18 TSF Series 18"W Flat Top Drainboard Insert, no perforations, stainless steel construction.

**ITEM # BC-5**                    **UNDERBAR BLENDER STATION W/SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12BS**

- a. Model TSF12BS TSF Series Underbar Blender Station with 18 gauge stainless steel dump sink, 12"W, backsplash, 9-5/8" wide x 10-5/8" front-to-back x 6" deep sink, 4" OC splash mount faucet holes, recessed blender shelf with access hole & installed junction box, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet (replaces TS12BLW)
- b. 6" Backsplash
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # BC-6**                    **UNDERBAR ICEWELL**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TS36IC**

- a. Model TS36IC TS Series Underbar Ice Bin/Cocktail Unit, modular, 36"W x 18-9/16"D, approximately 85-lb. ice capacity, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF
- b. 6" Backsplash
- c. Model ICC36 Ice Chest Covers, 2-piece sliding assembly, 36"W, front & back, stainless steel.

**ITEM # BC-6.1**                **SPEED RAIL**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **SR-D36A**

- a. Model SR-D36A Speed Rail, double, 36" W, stainless steel construction, factory installed.

**ITEM # BC-7**                    **BACK BAR COOLER, 4 DOOR**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **BBS108**

- b. BBS108 Refrigerated Back Bar Cabinet, four-section, 108"W, self-contained refrigeration, 33.5 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- c. 120v/60/1-ph, 4.2 amps, NEMA 5-15P
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Right
- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Left
- n. Door handle, second: full length stainless steel handle, 24"
- o. Shelving style, second: (3) flat shelves
- p. Door type, third: solid, black vinyl/field laminated
- q. Door hinge location, third: Right
- r. Door handle, third: full length stainless steel handle, 24"
- s. Shelving style, third: (3) flat shelves
- t. Door type, fourth: solid, black vinyl/field laminated
- u. Door hinge location, fourth: Right
- v. Door handle, fourth: full length stainless steel handle, 24"
- w. Shelving style, fourth: (3) flat shelves
- x. Crisp White LED
- y. Model 57787 Casters (3-3/4"), set of (6)

**ITEM # BC-8**                    **EXPRESSO MACHINE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **By Owner**

- a. PROVIDED BY OWNER

**ITEM # BC-9**                    **DROP-IN ICE WELL**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **DI24IC**

- a. Model DI24IC Ice Chest, drop-in, 26"W x 19-1/4"D, 50 lb. ice capacity, includes 2-piece stainless steel sliding cover, 1/2" drain, stainless steel top & interior, galvanized exterior, NSF.

**ITEM # BC-10**                  **UNDER-COUNTER BUFFET WARMER**  
**Quantity:**                    **Five (5)**  
**Manufacturer:**              **CookTek**  
**Model:**                        **660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # BC-11**                    **COLD SHELF**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**              **Hatco**  
**Model:**                        **CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA  
b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P, standard

### **CKA – EVENT LEVEL COMMISSARY KITCHEN - AREA A**

**ITEM # CKA-1**                    **WALK-IN BULK FREEZER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Thermo-Kool**  
**Model:**                        **WIF**

- a. Model WIF THERMO-KOOL Walk-in Cooler/Freezer  
25' 1" x 36' 6" x 9' 6" High  
Insulation: 4" DURATHANE, all-urethane foamed-in-place (Class 1)  
Exterior: Stucco Aluminum  
Interior Walls: Stucco Aluminum  
Interior Ceilings: White Stucco Aluminum  
Interior Floors: Galvanized Steel  
Cooler, Freezer with Floor - recessed by 8" for tile & grout  
(1) 36" x 80" Flush Mounted Entrance Door(s), with hardware, Pilot light & switch assembly, vapor proof light & dial thermometer. NSF LISTED  
(1) 5' 0" x 6' 8"H " Framed Opening  
(2) Kason # 1806 LED light fixture at door(s)  
(1) dial thermometer  
(2) Center light above door  
(2) Thermo-Kool TK4700 walk-in monitor system with TK4 panic switch, motion detector, battery backups, dry contacts and thermostatically controlled heater wires  
(1) Stainless Steel to Interior & Exterior of Door & Frame  
(1) Door(s) with (3) Hinges per door  
(1) 14" x 14" peep window w/ heated frame & glass  
(1) 48"H 1/8" Aluminum Treadplate kickplates and jamb guards int & ext  
(1) Foot treadle(s)  
(1) Curtron Polar Pro model PP-C-080-3680-IP vinyl swing door(s) w/ impact plates  
(2) Pressure relief vent(s)  
(6) Kason 48" LED light fixture(s)  
(1) 8' x 100' Roll(s) of 6 mil polyethylene sheeting  
Angle Walls  
(1) Bluezone 2400  
Ceiling & floor Splice  
Ceiling suspension  
Enclosure panels w/ removable access panel

Trim  
 1/8" Treadplate wainscot on exp. exterior 48" high (shipped loose for field installation)  
 (1) Curtron PP-C-080-6080- vinyl swing door w/ impact plates

**ITEM # CKA-1.1**            **FREEZER EVAPORATOR COIL**  
**Quantity:**                **Two (2)**  
**Manufacturer:**        **Thermo-Kool**  
**Model:**                    **RL6E090DDA**

- a. (2) Model RL6E090DDA RL6E090DDA 208-230/60/1 coil (1.0 fan amps, 9.8 heater amps) with Dual Speed EC motor.  
 Accessories:  
 KE2 Evaporator Defrost Control w/ LLSV.

**ITEM # CKA-1.2**            **FREEZER CONDENSING UNIT**  
**Quantity:**                **Two (2)**  
**Manufacturer:**        **Thermo-Kool**  
**Model:**                    **RW0650L4SEA**

- a. (2) Model RW0650L4SEA 3 1/2 HP, Remote Pre-Assembled Refrig. System Model RWO350L4SEA 208-230/60/3  
 Low Temperature, base, Scroll, Water-cooled, R448A, Std. Defrost Kit (10.9 Compressor RLA) each with 1 RL6E090DDA 208-230/60/1 coil (1.0 fan amps, 9.8 heater amps) with Dual.  
 Accessories:  
 - Heat Exchanger  
 - Suction line components  
 - Sealed Filter  
 - Water-regulating valve

**ITEM # CKA-2**                **WALK-IN BULK COOLER**  
**Quantity:**                **One (1)**  
**Manufacturer:**        **Thermo-Kool**  
**Model:**                    **WIC**

- a. Model WIC SEE ITEM CKA-1

**ITEM # CKA-2.1**            **COOLER EVAPORATOR COIL**  
**Quantity:**                **Two (2)**  
**Manufacturer:**        **Thermo-Kool**  
**Model:**                    **RL6A141ADA**

- a. (2) Model RL6A141ADA RL6A141ADA 115/60/1 coil (2.4 amps) with Dual Speed EC motor.  
 Accessories:  
 (2) KE2 Evaporator Defrost Control w/ LLSV

**ITEM # CKA-2.2**            **COOLER CONDENSING UNIT**  
**Quantity:**                **One (1)**  
**Manufacturer:**        **Thermo-Kool**  
**Model:**                    **RW0400E4SEA**

- a. Model RW0400E4SEA 4 HP, Remote Pre Assembled Refrig. System Model RWO400E4SEA 208-230/60/3

Medium Temperature, base, Scroll, Water-cooled, R448A, Air Defrost Timer (18.4 Compressor RLA).

Accessories:

- Heat Exchanger
- Suction line components
- Sealed Filter
- Water-regulating valve

**ITEM # CKA-2.3            FOOD PRESERVATION UNIT**  
**Quantity:                One (1)**  
**Manufacturer:          Evo America, LLC**  
**Model:                    10-BZ-2400FP**

- a. Model 10-BZ-2400FP Bluezone Food Preservation for Walk-in Coolers, treats up to 15,000 cu. ft. of air per unit, (4) ozone generating UV bulbs, digital display screen, control panel, mounting rails/feet, 250 watts, 120v/60/1-ph, 3 amps, cETLus, ETL-Sanitation

**ITEM # CKA-3            SPARE NO.**

**ITEM # CKA-4            DUNNAGE RACK**  
**Quantity:                Seven (7)**  
**Manufacturer:          Channel Manufacturing**  
**Model:                    ES2048**

- a. Model ES2048 Dunnage Rack, Tubular Dunnage Rack, Stainless Series, 48"W x 20"D x 12"H, Stainless Steel Construction, (4,000) lb. distributed weight capacity per shelf, Made in USA, NSF

**ITEM # CKA-5            COLD STORAGE SHELVING**  
**Quantity:                Sixty (60) – (15 COMPLETE UNITS 4 SHELVES EACH)**  
**Manufacturer:          Metro**  
**Model:                    2160NK3**

- a. Model 2160NK3 Quick Ship - Super Erecta® Shelf, wire, 60"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. (60) Model 74PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 74-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

**ITEM # CKA-5.1        COLD STORAGE SHELVING**  
**Quantity:                Thirty-Two (32) – (8 COMPLETE UNITS 4 SHELVES EACH)**  
**Manufacturer:          Metro**  
**Model:                    2148NK3**

- a. Model 2148NK3 Quick Ship - Super Erecta® Shelf, wire, 48"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. (32) Model 74PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 74-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

**ITEM # CKA-5.2**            **COLD STORAGE SHELVING**  
**Quantity:**            **Four (4) – (1 COMPLETE UNIT 4 SHELVES)**  
**Manufacturer:**       **Metro**  
**Model:**                **2142NK3**

- a. Model 2142NK3 Quick Ship - Super Erecta® Shelf, wire, 42"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. (4) Model 74PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 74-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

**ITEM # CKA-5.3**            **COLD STORAGE SHELVING**  
**Quantity:**            **Four (4) – (1 COMPLETE UNIT 4 SHELVES)**  
**Manufacturer:**       **Metro**  
**Model:**                **2136NK3**

- a. Model 2136NK3 Quick Ship - Super Erecta® Shelf, wire, 36"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. (4) Model 74PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 74-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

**ITEM # CKA-6**            **PALLET STORAGE**  
**Quantity:**            **Two (2)**  
**Manufacturer:**       **By Owner**

- a. PROVIDED BY OWNER

**ITEM # CKA-7**            **CAN RACK**  
**Quantity:**            **Three (3)**  
**Manufacturer:**       **Channel Manufacturing**  
**Model:**                **CSR-156M**

- a. Model CSR-156M Can Rack, First In / First Out - Mobile, Heavy-Duty Series, 25.5"W x 42.25"D x 79"H, Aluminum Construction, (156) #10 Cans, Heavy-Duty 5"x2" Plate Casters (front are swivel : rear are rigid) model # CPS25U, Made in USA, NSF, 185lbs.
- b. Model /022 Accessories, Corner Bumper (Set of 2).
- c. Model /5B Accessories, Caster Brakes, Heavy-Duty (Set of 2).

**ITEM # CKA-8**            **DRY STORAGE SHELVING**  
**Quantity:**            **Fourty (40) – (8 COMPLETE UNITS 5 SHELVES EACH)**  
**Manufacturer:**       **Metro**  
**Model:**                **2160NK3**

- a. Model 2160NK3 Quick Ship - Super Erecta® Shelf, wire, 60"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. (32) Model 86PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 86-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double

grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

**ITEM # CKA-9                    SPARE NO.**

**ITEM # CKA-10                SPARE NO.**

**ITEM # CKA-90                STORAGE SHELVING**  
**Quantity:                    Four (4) – (1 COMPLETE UNIT 4 SHELVES)**  
**Manufacturer:                Metro**  
**Model:                        2148NK3**

- a. Model 2148NK3 Quick Ship - Super Erecta® Shelf, wire, 48"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. Model 74UPK3 Quick Ship - Super Erecta® SiteSelect™ Post, 73-7/8"H, for use with stem casters, Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
- c. (2) Model 5PC Quick Ship - Super Erecta® Stem Caster, swivel, 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper
- d. (2) Model 5PCB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper

**CKB – EVENT LEVEL COMMISSARY KITCHEN – AREA B**

**ITEM # CKB-11                EXHAUST HOOD W/FIRE SYSTEM**  
**Quantity:                    One (1)**  
**Manufacturer:                Accurex**  
**Model:                        XBEW-474.00-S**

- a. Model XBEW-474.00-S
  - A. Type I, exhaust only wall canopy suitable for all types of cooking applications. The hood(s) shall be U.L. 710 Listed without a fire damper (with optional) for medium, heavy, or extra-heavy duty rated cooking appliances. Make-up air shall be independently provided. The hood(s) exterior shall be constructed of a minimum of 18-gauge 300 series stainless steel. The hood(s) shall be constructed using the standing seam method for optimum strength and with a Performance Enhancing Lip (PEL) to improve capture efficiency by turning air back into the hood. Front panels shall be of single wall construction. An integral 3-inch air space is provided to meet NFPA® 96 clearance requirements against limited combustible walls. Integral 3-inch air space may be omitted for non-combustible construction. All seams, joints and penetrations of the hood enclosure shall be welded and/or liquid tight. Lighter material gauges, alternate material types and finishes are not acceptable. All unexposed interior surfaces shall be constructed of a minimum 18-gauge corrosion resistant stainless steel including, but not limited to ducts, plenum, and brackets.
  - B. The hood(s) shall include a filter housing constructed of the same material as the hood. The filters shall be stainless steel baffle type (non-stick coating optional), U.L. 1046 Classified, and in sufficient number and size to ensure optimum performance. The filter housing shall terminate in a pitched, full length grease trough which shall drain into a removable grease container. These filters shall have a grease removal efficiency of 28% at 8 microns (16% from 3-10 microns) and static pressure drop of 0.5-0.6 in WC. Vapor proof, U.L.



- C. LED light fixtures shall be pre-wired to a junction box located at the top of the hood for field connection. The wiring shall conform to the requirements of the NFPA® 70.
- D. The canopy hood(s) shall be built in accordance with the NFPA® 96, IMC, UMC, and bear the NSF Seal of Approval. The hood manufacturer shall provide, on request, the necessary data that confirms compliance with the code authorities listed above.
- E. Continuous Capture - UL listed connection to join multiple sections.
- F. Provide Accurex Controls: XKC-CV-S Controls system shall be a UL listed outlet center which shall standardly consist of a NEMA-1 Stainless Steel Enclosure within a Stainless-Steel Enclosure Panel, Printed Circuit Board (PCB), with Full Color Touchscreen, audible alarm, sensor (s) and motor starters. The constant volume Accurex Controls shall utilize resistive type temperature sensors that are mounted in the capture tank of the hood to monitor exhaust air temperatures, and an optional room temperature sensor, shipped loose, to be installed to detect ambient air temperatures in the kitchen space. Temperature sensors shall be made of stainless steel and shall be installed in a UL approved coupling.
- G. Fire System – Provide factory pre-piped for Ansul R-102 fire protection system located in an integral utility cabinet on the right end of the hood. The system shall provide surface, duct, and plenum protection for items of cooking equipment located beneath the hood in accordance with all applicable codes and provisions of NFPA 17A and 96. All system piping shall be concealed where possible with exposed portions of either chrome fittings or stainless-steel sleeving. The system shall be wired with shunt trip breaker and electric/gas shut-off valve serving items of cooking equipment beneath the hood to provide power and fuel shut-off in the event of system actuation.
- H. Exhaust fan(s) and supply fan(s) to be supplied by Mechanical Contractor
- I. 304 Stainless Steel inside and out. No galvanized metal.
- J. Provide fire cabinet on right end of hood.
- K. Provide stainless steel backsplash for entire length of hood with 18" to extend right and 18" to extend left of the hood where applicable.
- L. Provide stainless steel hood enclosure panel. Top of hood to have a minimum of 3" above the ceiling.

**ITEM # CKB-12                    ISLAND WORK TABLE**  
**Quantity:                        One (1)**  
**Manufacturer:                  Atlanta Custom Fabricators**  
**Model:                             IWT**

- a. Model IWT Island work table, all stainless steel construction, 3'-0" long X 2'-6" wide X 36" high. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges. Table to be fully welded construction with all welds ground and polished to a uniform finish. Table to be provided with stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet.
- b. (1) Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- c. Unit to be further constructed in accordance with shop drawings.  
**APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.**

**ITEM # CKB-13                    FRENCH FRY WARMER**  
**Quantity:                        One (1)**  
**Manufacturer:                  Merco**  
**Model:                             MCG2727NNN**

- a. Model MCG2727NNN CrispyMax™ Crisp & Ready Serving Station, countertop, triple lane, low profile, heated Therma-Lock™ convective airflow, on/off switch, LED indicator, removable food tray & crumb tray, includes (2) dividers, stainless steel construction, cULus, UL EPH Classified, Made in USA

**ITEM # CKB-14                      GAS FRYER, BATTERY**  
**Quantity:                              Two (2)**  
**Manufacturer:                        Henny Penny**  
**Model:                                    OFG322.0**

- a. Model OFG322.0 OFG-322 Open Fryer, gas, 2 wells, 65 pound fat and 15 pound food capacity per well, stainless steel construction and rectangular fry pot, built-in filter system, basket supports, (4) casters (2 locking), cULus, UL EPH, CE, ENERGY STAR®
- b. Natural gas
- c. Station 1 control: C1 C1000 Computron = Computron® 1000 control with melt mode, idle mode, two 4-character LED displays per control
- d. Station 2 control: C1 C1000 Computron = Computron® 1000
- e. Without direct connect shortening disposal system plumbing
- f. Station 1: Full Basket, per well
- g. Station 2: Full Basket, per well
- h. Model 03629 Fryer Pot Cover, 32x full pot
- i. Model 03622 Crumb Catcher, for (2) and (3) well drain pans
- j. T&S Brass Model HG-2D-48SK-PS Safe-T-Link Gas Connector Kit, 3/4" connection, 48" hose, stainless steel braiding with extruded coating, (2) SwiveLink fittings, 360° rotatable hex nut, with 90° elbow & installation kit (includes restraining cable & ball valve), Posi-Set, 215,000 BTU/ hr minium flow capacity

**ITEM # CKB-15                      REFRIGERATED EQUIPMENT STAND**  
**Quantity:                              One (1)**  
**Manufacturer:                        Delfield**  
**Model:                                    F2996CP**

- a. Model F2996CP Refrigerated Low-Profile Equipment Stand, 96-1/4"W x 31-47/50"D x 24"H, three-section, (6) drawers (pans not included), marine edge stainless steel top & drawer fronts, front non-spill edge, ABS interior sides, 4" casters, side-mounted refrigeration system with electric condensate evaporator, R290 Hydrocarbon refrigerant, 1/4 hp, cUL, UL, NSF

**ITEM # CKB-16                      GRIDDLE**  
**Quantity:                              One (1)**  
**Manufacturer:                        Vulcan**  
**Model:                                    VCCG48-AR**

- a. Model VCCG48-AR Heavy Duty Griddle, countertop, gas, 48" W x 24" D cooking surface, 1" thick chrome plate, (4) burners, solid state thermostat every 12", atmospheric type "U" shaped aluminized steel burners, electronic spark ignition & pilot protection, wire knob guards, (1) drawer, includes: palmetto brush, scraper & blade, stainless steel front, sides, front top ledge, front grease trough, 4" back & tapered side splashes, 4" adjustable legs, 120,000 BTU, CSA, ENERGY STAR®, NSF
- b. Natural gas
- c. 120v/50/60/1-ph, 2 amp, NEMA 5-15P
- d. T&S Brass Model HG-2D-48SK Safe-T-Link Gas Connector Kit, 3/4" connection, 48" hose, stainless steel braiding with extruded coating, (2) Swivelink fittings, (1) 90° elbow,

ball valve, necessary hardware, with Surelink restraining cable adjustable for 3' to 5', 215,000 BTU/ hr minium flow capacity

- e. T&S Brass Model POSI-SET Safe-T-Link Posi-Set Appliance Locating Device, for positive placement of mobile kitchen equipment, includes set of (2) units, mounting screws (#10-24) & screw anchors, heat & impact resistant plastic

**ITEM # CKB-17**                    **CHARBROILER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Vulcan**  
**Model:**                        **VACB47**

- a. Model VACB47 Achiever Charbroiler, countertop, 46-7/8", (8) 17,000 BTU cast iron burners, infinite heat control valves, fully welded chassis, (2) drip trays, stainless steel front, sides & top trim, backsplash & grease trough, 4" adjustable legs, 136,000 BTU, CSA, NSF
- b. Natural gas
- c. T&S Brass Model HG-2D-48SK Safe-T-Link Gas Connector Kit, 3/4" connection, 48" hose, stainless steel braiding with extruded coating, (2) Swivelink fittings, (1) 90° elbow, ball valve, necessary hardware, with Surelink restraining cable adjustable for 3' to 5', 215,000 BTU/ hr minium flow capacity
- d. T&S Brass Model POSI-SET Safe-T-Link Posi-Set Appliance Locating Device, for positive placement of mobile kitchen equipment, includes set of (2) units, mounting screws (#10-24) & screw anchors, heat & impact resistant plastic

**ITEM # CKB-18**                    **HD RANGE, 36", 6 OPEN BURNERS**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Vulcan**  
**Model:**                        **V6B36C**

- a. Model V6B36C V Series Heavy Duty Range, gas, 36", (6) 35,000 BTU open burners, cast iron grates, convection oven, stainless steel front, front top ledge, sides, base, burner box & stub back, 6" adjustable legs, 242,000 BTU, CSA, NSF
- b. Natural gas (specify elevation if over 2,000 ft.)
- c. Model PRESREG-NA11/4 1-1/4" NPT pressure regulator (Natural gas)
- d. 1-1/4" rear gas connection, standard
- e. Rear gas connection: cap & cover, both ends
- f. 115v/60/1-ph, 4.0 amp, fan motor voltage, cord & plug, standard
- g. Model V36RR Reinforced Riser, for standard or convection ovens.
- h. Model CASTERS-ADJRR4 Casters, 6", adjustable (set of 4) (2 with locks)
- i. T&S Brass Model HG-2F-48SK Safe-T-Link Gas Connector Kit, 1-1/4" connection, 48" hose, stainless steel braiding with extruded coating, (2) Swivelink fittings, (1) 90° elbow, ball valve, necessary hardware, with Surelink restraining cable adjustable for 3' to 5', 818,000 BTU/ hr minium flow capacity
- j. T&S Brass Model POSI-SET Safe-T-Link Posi-Set Appliance Locating Device, for positive placement of mobile kitchen equipment, includes set of (2) units, mounting screws (#10-24) & screw anchors, heat & impact resistant plastic

**ITEM # CKB-19**                    **SALAMANDER BROILER, GAS**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Vulcan**  
**Model:**                        **36IRB-N**

- a. Model 36IRB-N Salamander Broiler, natural gas, 36" wide, 30,000 BTU heavy duty infrared burner, dual control, (6) grid positions, removable pan, stainless steel front, top & sides, 3/4" gas connection & pressure regulator
- b. Range mount
- c. Model V36RR Reinforced Riser, for standard or convection ovens
- d. Model PLUMBIN-KIT Inter-plumbing gas connection kit (requires rear gas connection on range), for connecting 36RB/36IRB to heavy duty V-Series ranges
- e. Model BOTTOM-SLMNDR Stainless bottom panel (required with wall bracket)
- f. Model BACK-SLMNDR Stainless back panel
- g. T&S Brass Model HG-2D-48SK Safe-T-Link Gas Connector Kit, 3/4" connection, 48" hose, stainless steel braiding with extruded coating, (2) Swivelink fittings, (1) 90° elbow, ball valve, necessary hardware, with Surelink restraining cable adjustable for 3' to 5', 215,000 BTU/ hr minium flow capacity.

**ITEM # CKB-20                      TILTING SKILLET BRAISING PAN, ELECTRIC**  
**Quantity:                            One (1)**  
**Manufacturer:                      Cleveland Range**  
**Model:                                SEL40T1**

- a. Model SEL40T1 PowerPan™ Tilting Skillet, electric, 40-gallon capacity, bead blasted cooking surface, 10° tilt cooking feature, with easy manual hand tilt, spring-assisted cover with vent, gallon & liter markings, stainless steel construction with open leg frame, 208v/60/3-ph, UL, CE, NSF
- b. 480v/60/3-ph, 18kW, 21.7 amp
- c. Standard controls, temperature control dial, LED ON indicator light, main power switch, standard
- d. Model TD2SK 2" tangent draw-off valve, front mounted left side
- e. Model PCS Pan Carrier, for floor models
- f. Model DKFS Double Pantry Skillet Filler, with 60" hose
- g. Model FBST1 Faucet Bracket for T1 series floor model skillets
- h. Model FSSK Food Strainer, 30 & 40 gallon, for braising pans

**ITEM # CKB-21                      FLOOR TROUGH**  
**Quantity:                            One (1)**  
**Manufacturer:                      Atlanta Custom Fabricators**  
**Model:                                FT**

- a. Model FT Stainless steel floor trough, 9'-0" long x 2'-0" wide, 5" deep, constructed of 14 gauge type 304 stainless steel with perimeter stainless steel anchor tabs welded approximately 12" O.C., stainless steel subway grating of 3/16" X 1" bar anti-splash drain pan with built-in pitch toward drain. Grating flat bars to be parallel to pour pattern to minimize splash. Provide with 4" O.D. tailpiece drain connection and removable stainless steel scrap basket.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-22                      MULTI-COOK OVEN**  
**Quantity:                            Two (2)**  
**Manufacturer:                      Alto-Shaam**  
**Model:                                VMC-F3E**

- a. Model VMC-F3E Vector® F Series Multi-Cook Oven, electric, (3) individually controlled cooking chambers, holds (6) half-size sheet pans (3) full sized sheet pans, programmable touch screen controls with Structured Air Technology®, double pane glass door, interior

LED cavity lighting, includes: (1) wire rack & (2) jet plates per cooking chamber, USB port, stainless steel construction, 4" adjustable legs, cULus, UL EPH Classified, Made in USA

- b. 208-240v/60/3-ph, 11.1-14.4 kW, 31-35 amps, No cord & plug
- c. Simple controls, standard
- d. Model 5031521 Stacking Bracket, for F-Series
- e. Stacking with legs, standard

**ITEM # CKB-22.1      MULTI-COOK OVEN**

**Quantity:**            **Two (2)**  
**Manufacturer:**    **Alto-Shaam**  
**Model:**              **VMC-F4E**

- a. Model VMC-F4E Vector® F Series Multi-Cook Oven, electric, (4) individually controlled cooking chambers, holds (8) half-size sheet pans (4) full sized sheet pans, programmable touch screen controls with Structured Air Technology®, double pane glass door, interior LED cavity lighting, includes: (1) wire rack & (2) jet plates per cooking chamber, USB port, stainless steel construction, 4" adjustable legs, cULus, UL EPH Classified
- b. 208-240v/60/3-ph, 14.8-19.2 kW, 41-46 amps, No cord & plug
- c. Simple controls, standard
- d. Model 5031521 Stacking Bracket, for F-Series
- e. Model 5025815 Mobile Base, 6"H (15cm), stainless steel, with casters, for all models

**ITEM # CKB-23      SPARE NO.**

**ITEM # CKB-24      SPARE NO.**

**ITEM # CKB-25      SPARE NO.**

**ITEM # CKB-26      1 COMPARTMENT SINK PREP TABLE**

**Quantity:**            **One (1)**  
**Manufacturer:**    **Atlanta Custom Fabricators**  
**Model:**              **1CSPT**

- a. Model 1CSPT Prep table with 1-Compartment Sink, 8'-0" long X 2'-6" wide X 36" high, all 14 gauge type 304 stainless steel construction. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be provided with 8" high back splash, 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel Z-clips, marine edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flanged feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Sink to be 18" long X 20" wide X 12" deep, provided with T&S Brass #B-3950 Waste Valve, twist handle assembly for 3-1/2" sink opening, 2" drain outlet with 1-1/2" adapter and stainless steel lever waste bracket. Crease bottom of sink bowl to pitch to the drain. Stainless steel sink cover. Provide stainless steel skirt to cover sink bowl.
- c. (1) Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- d. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-26.1      FAUCET**  
**Quantity:            One (1)**  
**Manufacturer:        T&S Brass**  
**Model:                B-0231-CR**

- a. Model B-0231-CR Faucet, 12" swing nozzle, 8" wall mount base, 1/2" NPT female Inlets, quarter-turn Cerama cartridges, low lead, ADA Compliant

**ITEM # CKB-27            ISLAND WORK TABLE**  
**Quantity:            One (1)**  
**Manufacturer:        Atlanta Custom Fabricators**  
**Model:                IWT**

- a. Model IWT Island work table, all stainless steel construction, 6'-0" long X 2'-6" wide X 36" high. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges. Table to be fully welded construction with all welds ground and polished to a uniform finish. Table to be provided with stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet.
- b. (1) Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- c. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-28            REFRIGERATED PREP TABLE**  
**Quantity:            Two (2)**  
**Manufacturer:        Delfield**  
**Model:                18672PDLP**

- a. Model 18672PDLP LiquiTec® Refrigerated Pizza Table, two-section, 72" W, (6) 12" x 20" pan capacity, (2) doors, (2) 1/1 GN shelves, stainless steel removable hinged covers, 17" polyurethane cutting board, flush mount LiquiTec® raised rails, on/off switch, 18 gauge stainless steel top, stainless steel construction, 4" casters, self-contained side-mounted refrigeration system, R290 refrigerant, 1/5 & 1/3 HP, cUL, UL, NSF
- b. 115v/60/1-ph, 12.7 amps, NEMA 5-20P, standard
- c. Model 505B-72 Stainless steel back, for 72" table

**ITEM # CKB-29            REACH-IN FREEZER**  
**Quantity:            One (1)**  
**Manufacturer:        Delfield**  
**Model:                GAF2P-S**

- a. Model GAF2P-S Specification Line® Freezer, Reach-In, two-section, 46.0 cubic feet capacity, top-mounted self-contained refrigeration system, (2) full-height hinged solid doors (locking), (6) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, pilaster with shelf clips, stainless steel exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.68 HP, 115v/60/1-ph, 10.0 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®
- b. Left door hinged on left, right door hinged on right, standard
- c. Model AS000-AXC-003P Stainless steel back (2 section)
- d. Set of (4) 5" locking casters, standard

**ITEM # CKB-30**                    **WORK TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **WT**

- a. Model WT Work table, all stainless steel construction, 4'-0" long X 2'-6" wide X 36" high. Table to be fully welded construction with all welds fully ground and polished to a uniform finish. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges, 4" left end splash with 1" return on 45 degree angle, attach with stainless steel Z clips, stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. (1) Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- c. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-31**                    **1 COMPARTMENT SINK PREP TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **1CSPT**

- a. Model 1CSPT Prep table with 1-Compartment Sink, 7'-0" long X 2'-6" wide X 36" high, all 14 gauge type 304 stainless steel construction. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be provided with 8" high back splash, 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel Z-clips, marine edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flanged feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Sink to be 20" long X 20" wide X 12" deep, provided with T&S Brass #B-3950 Waste Valve, twist handle assembly for 3-1/2" sink opening, 2" drain outlet with 1-1/2" adapter and stainless steel lever waste bracket. Provide stainless steel skirt to cover sink bowl.
- c. (1) Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- d. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-31.1**                **FAUCET**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **T&S Brass**  
**Model:**                        **B-0231-CR**

- a. Model B-0231-CR Faucet, 12" swing nozzle, 8" wall mount base, 1/2" NPT female Inlets, quarter-turn Cerama cartridges, low lead, ADA Compliant

**ITEM # CKB-32**                    **WALL MOUNTED OVER SHELF**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**

**Model: WMO**

- a. Model WMO Wall mounted over shelf, 7'-0" long X 12"deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-32.1 WALL MOUNTED OVER SHELF**

**Quantity: One (1)**  
**Manufacturer: Atlanta Custom Fabricators**  
**Model: WMO**

- a. Model WMO Wall mounted over shelf, 7'-0" long X 14"deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-33 REFRIGERATED PREP TABLE**

**Quantity: One (1)**  
**Manufacturer: Delfield**  
**Model: 18672PDLP**

- a. Model 18672PDLP LiquiTec® Refrigerated Pizza Table, two-section, 72" W, (6) 12" x 20" pan capacity, (2) doors, (2) 1/1 GN shelves, stainless steel removable hinged covers, 17" polyurethane cutting board, flush mount LiquiTec® raised rails, on/off switch, 18 gauge stainless steel top, stainless steel construction, 4" casters, self-contained side-mounted refrigeration system, R290 refrigerant, 1/5 & 1/3 HP, cUL, UL, NSF.

**ITEM # CKB-34 WALL MOUNTED OVER SHELF**

**Quantity: One (1)**  
**Manufacturer: Fabricated**  
**Model: WMO**

- a. Model WMO Wall mounted over shelf, 6'-0" long X 14"deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

c.

**ITEM # CKB-35 REACH-IN REFRIGERATOR**

**Quantity: One (1)**  
**Manufacturer: Delfield**  
**Model: GAR2P-S**

- a. Model GAR2P-S Specification Line® Refrigerator, Reach-In, two-section, 46.0 cubic feet capacity, top-mounted self-contained refrigeration system, (2) full-height hinged solid doors (locking), (6) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, stainless steel exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon



refrigerant, 0.35 HP, 115v/60/1-ph, 6.0 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®

- b. Left door hinged on left, right door hinged on right, standard
- c. Set of (4) 5" locking casters, standard

**ITEM # CKB-36**            **HAND SINK**  
**Quantity:**            **Three (3)**  
**Manufacturer:**      **Advance Tabco**  
**Model:**                **7-PS-66**

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus

**ITEM # CKB-37**            **WORK TABLE**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Atlanta Custom Fabricators**  
**Model:**                **WT**

- a. Model WT Work table, all stainless steel construction, 7'-6" long X 2'-6" wide X 36" high. Table to be fully welded construction with all welds fully ground and polished to a uniform finish. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges, 8" back splash and left end splash with 2" return on 45 degree angle and 1" turned down, attach with stainless steel Z clips, stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. (1) Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- c. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-38**            **WALL MOUNTED OVER SHELF**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Atlanta Custom Fabricators**  
**Model:**                **WMO**

- a. Model WMO Wall mounted over shelf, 7'-6" long X 12" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-38.1**        **WALL MOUNTED OVER SHELF**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Atlanta Custom Fabricators**  
**Model:**                **WMO**

- a. Model WMO Wall mounted over shelf, 7'-6" long X 14" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2",

supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.

- b. Unit to be further constructed in accordance with shop drawings.

APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-39**                    **WORK TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **WT**

- a. Model WT Work table, all stainless steel construction, 6'-8" long X 2'-6" wide X 36" high. Table to be fully welded construction with all welds fully ground and polished to a uniform finish. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges, 8" back splash and left end splash with 2" return on 45 degree angle and 1" turned down, attach with stainless steel Z clips, stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. (1) Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- c. Unit to be further constructed in accordance with shop drawings.  
 APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-40**                    **WALL MOUNTED OVER SHELF**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **WMO**

- a. Model WMO Wall mounted over shelf, 6'-8" long X 12" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
 APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-40.1**                **WALL MOUNTED OVER SHELF**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **WMO**

- a. Model WMO Wall mounted over shelf, 6'-8" long X 14" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
 APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-41**                    **SPARE NO.**

**ITEM # CKB-42**                    **SPARE NO.**

**ITEM # CKB-43**                    **WALL MOUNTED OVER SHELF**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **WMO**

- a. Model WMO Wall mounted over shelf, 4'-0" long X 12" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-44**                    **HOSE REEL**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **T&S Brass**  
**Model:**                        **B-7242-10**

- a. Model B-7242-10 Hose Reel System, open, 3/8" x 50' hose with extended spray wand, with ratcheting system & adjustable hose bumper, epoxy coated steel
- b. Model B-1433-LR Hose Reel Supply System, 8" wall mount mixing faucet, adjustable centers, quarter-turn Eterna cartridges with spring checks, lever handles with color coded indexes, EasyInstall 16" and rigid 40" risers, continuous pressure vacuum breaker, 3/8"NPT x 36" flexible water hose connector with stainless steel quick disconnect, (2) 2-3/8" wall brackets, 1/2" NPT

**ITEM # CKB-45**                    **FLOOR TROUGH**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **FT**

- a. Model FT Stainless steel floor trough, 4'-0" long X 1'-6" wide, 2" deep, constructed of 14 gauge type 304 stainless steel with perimeter stainless steel anchor tabs welded approximately 12" O.C., removable washable 1" X 1/4" fiber grate. Grating flat bars to be parallel to pour pattern to minimize splash. Provide with 4" O.D. tailpiece drain connection and removable stainless steel scrap basket.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-46**                    **ICE MACHINE FLAKER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Hoshizaki**  
**Model:**                        **F-1501MWJ**

- a. Model F-1501MWJ Ice Maker, Flake-Style, 30"W, water-cooled, self-contained condenser, production capacity up to 1624 lb/24 hours at 70°/50° (1410 lb AHRI certified at 90°/70°), stainless steel finish, Advanced CleanCycle24™, R-404A refrigerant, 208-230v/60/1-ph, 15.4 amps, NSF, UL
- b. Model B-1500SS ITEM 46.1 - Ice Bin, 60"W, hinged bottom door & top view windows, 1500-lb ice storage capacity, for top-mounted ice maker, stainless steel construction, universal top included, stainless steel legs, protected with H-GUARD Plus Antimicrobial Agent, ETL, ETL-Sanitation
- c. Model HS-2111 Stainless Cover/Separator, 11.3" x 26.2"
- d. Model LP-6 LEG Leg Package, (4) x 6" stainless steel legs
- e. Model HS-5607 Scoop Holder Kit

- f. Model H9320-51 ITEM 46.2 - Water Filtration System, single configuration

**ITEM # CKB-47**                    **HAND SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Advance Tabco**  
**Model:**                        **7-PS-66**

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus

**ITEM # CKB-48**                    **OYSTER SHUCKING WORK TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Atlanta Custom Fabricators**  
**Model:**                        **OSWT**

- a. Model OSWT Oyster shucking work table, all stainless steel construction, 8'-0" long X 2'-6" wide X 36" high. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be provided with 8" high back splash and left end splash 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel Z-clips, marine edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flange feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Table to be provided with insulated oyster shucking iced pan, 3'-2" long X 2'-0" wide X 12" deep, NSF7 approved. Unit to be constructed of 16 gauge type 304 stainless steel interior and exterior with 2" thick insulation, 1" drain fitting and 16 gauge stainless steel removable perforated false bottom (18" long sections max). Unit top to be fully welded to and integral with stainless steel counter top provided with 1-1/2" stainless steel perimeter flange. Interior to be provided with (2) 16 gauge stainless steel removable dividers with hemmed edges to be set in stainless steel fixed channels set in iced pan.
- c. Table to be provided with insulated oyster sink, 20" long X 18" wide X 14" deep, all type 304 stainless steel construction, double pan with 1-1/2" insulation, integrally welded to top. Interior to be 14 gauge stainless steel, exterior to be 16 gauge stainless steel. Tank to be provided with a removable stainless steel scrap basket set in a recessed stainless steel housing with a T&S Brass #B-3950-01 waste valve twist handle and overflow assembly for 3-1/2" sink opening, 2" drain outlet with 1-1/2" adapter and stainless steel lever waste bracket. Crease bottom of sink bowl to pitch to the drain. Provide sink with stainless steel removable perforated false bottom (18" long sections max.).
- d. Table to be provided with cutting board, size per plan X 1" thick anti-bacteria white composite. Cutting board to be non-porous, high density material for food processing applications designed with scratch resistance, to not absorb moisture, bacteria or odors. Material to be NSF, FDA and USDA compliant. Cutting board to be provided with 4"X1" cut-out, 1" from edge and centered.
- e. To store cutting board under counter, provide 2 sets of 16 gauge type 304 stainless steel 1" U-shaped channels welded to legs at location shown on drawings. Channels to be length of cutting board with closed end to act as stop.
- f. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- g. Provide 8" x 8" cut out in undershelf for plumbing drain at oyster sink.
- h. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-48.1**      **PRE-RINSE W/ FAUCET**  
**Quantity:**            **Two (2)**  
**Manufacturer:**      **T&S Brass**  
**Model:**                **B-0133-12ACBJST**

- a. Model B-0133-12ACBJST Pre-Rinse Unit, with add-on faucet, splash/wall mount, 8" OC, 44" flexible stainless steel hose with B-0107-J-SMV spray valve, 18" riser, add-on faucet with 12" swing spout (includes 2.2 gpm VR aerator), lever handles, Cerama cartridges with check valves, 6" wall bracket, accessory fitting tee & pre-rinse swivel, low lead

**ITEM # CKB-49**      **UNIVERSAL ROLL-IN RACK**  
**Quantity:**            **Twenty-Three (23)**  
**Manufacturer:**      **Cres Cor**  
**Model:**                **207UA12AC**

- a. Model 207UA12AC Rack, Roll-In Refrigerator, open frame design, (12) universal slides for 12" x 20" thru 18" x 26" pans on 4-1/2" centers, adjustable at 1-1/2" intervals, welded extruded aluminum frame, NSF  
b. Model 1032 001 Pan Stop, mounted to rear, prevents accidental push through of pans  
c. Model 1056 002 Corner Bumpers, add 2" to OA dimensions, non-marking, gray

**ITEM # CKB-50**      **WALK-IN COOLER (SEAFOOD)**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Thermo-Kool**  
**Model:**                **WIC**

- a. Model WIC 9' 6" x 21' 0" x 9' 6" High  
Insulation: 4" DURATHANE, all-urethane foamed-in-place (Class 1)  
Exterior: Stucco Aluminum  
Interior Walls: Stucco Aluminum  
Interior Ceilings: White Stucco Aluminum  
Interior Floors: Galvanized Steel  
Coolers with Floor - recessed by 8" for tile & grout  
(3) 36" x 80" Flush Mounted Entrance Door(s), with hardware, Pilot light & switch assembly, vapor proof light & dial thermometer. NSF LISTED  
(3) Stainless Steel to Interior & Exterior of Door, Stainless Steel to Interior & Exterior of Frame  
(3) Door(s) with (3) Hinges per door  
(3) Kason # 1806 LED light fixture at door(s)  
(3) Thermo-Kool TK4700 walk-in monitor system with TK4 panic switch, motion detector, battery backups, dry contacts and thermostatically controlled heater wires  
(3) 14" x 14" peep window w/ heated frame & glass  
(3) 48"H 1/8" Aluminum Treadplate kickplates and jamb guards int & ext  
(3) Foot treadle(s)  
(3) Curtron Polar Pro model PP-C-080-3680-IP vinyl swing door(s) w/ impact plates  
(3) Center light above door  
(3) 48" LED light fixture(s) w/ bulbs  
(1) 8' x 100' Roll(s) of 6 mil polyethylene sheeting  
(2) Bluezone 2400  
Enclosure panels w/ removable access panel  
Trim  
1/8" Treadplate wainscot on exp. exterior 48" high (shipped loose for field installation)

**ITEM # CKB-50.1      COOLER EVAPORATOR COIL**  
**Quantity:            One (1)**  
**Manufacturer:        Thermo-Kool**  
**Model:                RL6A094ADA**

- a. Model RL6A094ADA RL6A094ADA 115/60/1 coil (1.6 amps) with Dual Speed EC motor.  
 Accessories:  
 KE2 Evaporator Defrost Control w/ LLSV

**ITEM # CKB-50.2      COOLER CONDENSING UNIT**  
**Quantity:            One (1)**  
**Manufacturer:        Thermo-Kool**  
**Model:                RWO151E4SEA**

- a. Model RWO151E4SEA 1 1/2 HP, Remote Pre-Assembled Refrig. System Model RWO150E4SEA 208-230/60/3  
 Medium Temperature, base, Scroll, Water-cooled, R448A, Air Defrost Timer (9.3 Compressor RLA).  
 Accessories:  
 - Heat Exchanger.  
 - Water-regulating valve  
 - Suction line components  
 - Sealed Filter

**ITEM # CKB-50.3      FOOD PRESERVATION UNIT**  
**Quantity:            One (1)**  
**Manufacturer:        Evo America, LLC**  
**Model:                10-BZ-2400FP**

- a. Model 10-BZ-2400FP Bluezone Food Preservation for Walk-in Coolers, treats up to 15,000 cu. ft. of air per unit, (4) ozone generating UV bulbs, digital display screen, control panel, mounting rails/feet, 250 watts, 120v/60/1-ph, 3 amps, cETLus, ETL-Sanitation

**ITEM # CKB-51        WALK-IN COOLER (DAILY USE)**  
**Quantity:            One (1)**  
**Manufacturer:        Thermo-Kool**  
**Model:                WIC**

- a. Model WIC SEE ITEM 50

**ITEM # CKB-51.1      COOLER EVAPORATOR COIL**  
**Quantity:            One (1)**  
**Manufacturer:        Thermo-Kool**  
**Model:                RL6A094ADA**

- a. Model RL6A094ADA RL6A094ADA 115/60/1 coil (1.6 amps) with Dual Speed EC motor.  
 Accessories:  
 KE2 Evaporator Defrost Control w/ LLSV

**ITEM # CKB-51.2      COOLER CONDENSING UNIT**  
**Quantity:            One (1)**  
**Manufacturer:        Thermo-Kool**  
**Model:                RWO151E4SEA**

- a. Model RWO151E4SEA 1 1/2 HP, Remote Pre Assembled Refrig. System Model RWO150E4SEA 208-230/60/3  
Medium Temperature, base, Scroll, Water-cooled, R448A, Air Defrost Timer (9.3 Compressor RLA).  
Accessories:  
- Heat Exchanger.  
- Water-regulating valve  
- Suction line components  
- Sealed Filter

**ITEM # CKB-51.3      FOOD PRESERVATION UNIT**  
**Quantity:            One (1)**  
**Manufacturer:       Evo America, LLC**  
**Model:                10-BZ-2400FP**

- a. Model 10-BZ-2400FP Bluezone Food Preservation for Walk-in Coolers, treats up to 15,000 cu. ft. of air per unit, (4) ozone generating UV bulbs, digital display screen, control panel, mounting rails/feet, 250 watts, 120v/60/1-ph, 3 amps, cETLus, ETL-Sanitation

**ITEM # CKB-52        COLD STORAGE SHELVING**  
**Quantity:            Sixteen (16) (4 COMPLETE UNITS 4 SHELVES EACH)**  
**Manufacturer:       Metro**  
**Model:                2148NK3**

- a. Model 2148NK3 Quick Ship - Super Erecta® Shelf, wire, 48"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF  
b. (16) Model 74PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 74-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

**ITEM # CKB-52.1     COLD STORAGE SHELVING**  
**Quantity:            Four (4) (1 COMPLETE UNIT 4 SHELVES)**  
**Manufacturer:       Metro**  
**Model:                2136NK3**

- a. Model 2136NK3 Quick Ship - Super Erecta® Shelf, wire, 36"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF  
b. (4) Model 74PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 74-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

**ITEM # CKB-53        ROLL-IN HEATED CABINET**  
**Quantity:            One (1)**  
**Manufacturer:       Delfield**  
**Model:                GAHRI2-S**

- a. Model GAHRI2-S Specification Line® Heated Cabinet, Roll-In, two-section, 76.5 cubic feet capacity, (2) full-height hinged solid doors (locking), 4.3" easyTouch® screen temperature display/control with remote monitoring, incandescent interior lighting, 1" tall

- stainless steel ramp, stainless steel exterior front, sides & interior, 208-240v/60/1-ph, 10.5 amps, NEMA 6-20P, NSF, cULus, ENERGY STAR®
- b. Left door hinged on left, right door hinged on right, standard
  - c. Full height solid doors, standard
  - d. Model AS269-AFJ-0043 Raised Ramp, for roll in/roll thru, standard

**ITEM # CKB-54**                    **WORK TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **WT**

- a. Model WT Work table, all stainless steel construction, 7'-6" long X 2'-6" wide X 36" high. Table to be fully welded construction with all welds fully ground and polished to a uniform finish. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges, 8" back splash with 2" return on 45 degree angle and 1" turned down, attach with stainless steel Z clips, stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- c. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-55**                    **WALL MOUNTED OVER SHELF**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **WMO**

- a. Model WMO Wall mounted over shelf, 7'-6" long X 12" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-55.1**                **WALL MOUNTED OVER SHELF**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **WMO**

- a. Model WMO Wall mounted over shelf, 7'-6" long X 14" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-56**                    **1 COMPARTMENT SINK PREP TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **1CSPT**



- a. Model 1CSPT Prep table with 1-Compartment Sink, 8'-0" long X 2'-6" wide X 36" high, all 14 gauge type 304 stainless steel construction. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be provided with 8" high back splash, 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel Z-clips, marine edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flanged feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Sink to be 20" long X 20" wide X 12" deep, provided with T&S Brass #B-3950 Waste Valve, twist handle assembly for 3-1/2" sink opening, 2" drain outlet with 1-1/2" adapter and stainless steel lever waste bracket. Provide stainless steel skirt to cover sink bowl.
- c. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- d. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-56.1      FAUCET**  
**Quantity:            One (1)**  
**Manufacturer:        T&S Brass**  
**Model:                B-0231-CR**

- a. Model B-0231-CR Faucet, 12" swing nozzle, 8" wall mount base, 1/2" NPT female Inlets, quarter-turn Cerama cartridges, low lead, ADA Compliant

**ITEM # CKB-57      ELECTRIC FOOD CUTTER**  
**Quantity:            One (1)**  
**Manufacturer:        Hobart**  
**Model:                84186-1**

- a. Model 84186-1 Food Cutter with #12 attachment hub, 18" diameter stainless steel bowl 20 RPM, double stainless steel knives 1725 RPM, bowl cover with safety interlock, push/pull on/off switch, one-piece burnished aluminum housing, 3" legs, 115v/60/1-ph, 1 HP, 6' cord with plug

**ITEM # CKB-58      HAND SINK**  
**Quantity:            One (1)**  
**Manufacturer:        Advance Tabco**  
**Model:                7-PS-66**

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus

**ITEM # CKB-59      SPARE NO.**

**ITEM # CKB-60      SPARE NO.**

**ITEM # CKB-61      DISPOSER**  
**Quantity:            One (1)**  
**Manufacturer:        Salvajor**  
**Model:                200-SA-6-WSP**

- a. Model 200-SA-6-WSP Water Saving Package with Operator Sensor, Disposer, Sink Assembly, 6-1/2" sink collar, 2 Hp motor, start/stop push button, drain/flush/time delay, automatic reversing & water saving with safety line disconnect ARSS-LD control, includes fixed nozzle, chrome plated vacuum breaker, solenoid valve, sink stopper & flow control, heat treated aluminum alloy housing, UL, CE
- b. 208v/60/3-ph, 6.6 amps
- c. Model 980105 Mounting bracket for ARSS-2, ARSS, ARSS-LD & WSP
- d. Model DP Stainless steel dejamming prong

**ITEM # CKB-62**                    **SALAD / VEGETABLE DRYER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Delfield**  
**Model:**                        **SALD-1**

- a. Model SALD-1 Shelleymatic® Salad Dryer, capacity (20) gallons, stainless steel exterior & lid, polyurethane interior, unit completely enclosed, watertight motor, 1-1/2" drain, adjustable on/off timer with cycles up to 5 minutes, cord & plug included, 4" locking stem casters, 1/6 HP, 115v/60/1-ph, 2.7 amp, NEMA 5-15P, cUL, UL, NSF

**ITEM # CKB-63**                    **FOOD PROCESSOR, BENCHTOP / COUNTERTOP**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Robot Coupe**  
**Model:**                        **R2N**

- a. Model R2N Commercial Food Processor, 3 liter gray polycarbonate bowl with handle, vegetable prep attachment with external ejection, kidney-shaped opening, includes: (1) "S" blade (27055), (1) 2mm grating disc (27577), (1) 4mm slicing disc (27566), continuous feed, bowl attachment designed for vertical cutting & mixing, on/off & pulse switch, single speed, 1725 RPM, 120v/60/1-ph, 7.0 amps, 1 HP, NEMA 5-15P, cETLus, ETL-Sanitation

**ITEM # CKB-64**                    **2-COMPARTMENT SINK PREP TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **2CSPT**

- a. Model 2CSPT Prep table with 2-Compartment Sink, 10'-0" long X 2'-6" wide X 36" high, all 14 gauge type 304 stainless steel construction. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be provided with 8" high back splash, 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel Z-clips, marine edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flanged feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Sinks to be 20" long X 20" wide X 12" deep, provided with T&S Brass #B-3950 Waste Valve, twist handle assembly for 3-1/2" sink opening, 2" drain outlet with 1-1/2" adapter and stainless steel lever waste bracket. Crease bottom of sink bowl to pitch to the drain. Provide stainless steel skirt to cover sink bowl.
- c. Disposer option:  
Right sink to be 10" deep with modified drain opening to accept disposer and mounting hardware, Item #CKB-61, as shown on plan and hereinafter specified. Lever handle waste and rear connect overflow to be deleted from sink.
- d. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree

angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.

- e. Unit to be further constructed in accordance with shop drawings.

APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-64.1      PRE-RINSE W/ FAUCET**

**Quantity:            One (1)**

**Manufacturer:      T&S Brass**

**Model:                B-0133-12ACBJST**

- a. Model B-0133-12ACBJST Pre-Rinse Unit, with add-on faucet, splash/wall mount, 8" OC, 44" flexible stainless steel hose with B-0107-J-SMV spray valve, 18" riser, add-on faucet with 12" swing spout (includes 2.2 gpm VR aerator), lever handles, Cerama cartridges with check valves, 6" wall bracket, accessory fitting tee & pre-rinse swivel, low lead

**ITEM # CKB-65      WALL MOUNTED OVER SHELF**

**Quantity:            One (1)**

**Manufacturer:      Atlanta Custom Fabricators**

**Model:                WMO**

- a. Model WMO Wall mounted over shelf, 3'-0" long X 12" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.

- b. Unit to be further constructed in accordance with shop drawings.

APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-65.1    WALL MOUNTED OVER SHELF**

**Quantity:            Two (2)**

**Manufacturer:      Atlanta Custom Fabricators**

**Model:                WMO**

- a. Model WMO Wall mounted over shelf, 3'-0" long X 14" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.

- b. Unit to be further constructed in accordance with shop drawings.

APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-66      POT FILLER**

**Quantity:            One (1)**

**Manufacturer:      T&S Brass**

**Model:                B-0605-CR**

- a. Model B-0605-CR Pot & Kettle Filler Faucet, wall mount, single hole, 4-arm handle, ceramic cartridge, vacuum breaker, 68" stainless steel hose, self closing hook, low lead, 1/2" NPT, NSF

**ITEM # CKB-67      VERTICAL CUTTER/MIXER**

**Quantity:            One (1)**

**Manufacturer:      Hobart**

**Model:                HCM450-3**

- a. Model HCM450-3 460/60/3 (requires 20 amp service, 11 amps drawn); Cutter Mixer; includes Cut-Mix attachment, Knead-Mix attachment, Strainer Basket, & Mixing Baffle arm.

**ITEM # CKB-68**                    **FLOOR TROUGH**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **FT**

- a. Model FT Stainless steel floor trough, 3'-0" long x 1'-0" wide, 5" deep, constructed of 14 gauge type 304 stainless steel with perimeter stainless steel anchor tabs welded approximately 12" O.C., stainless steel subway grating of 3/16" X 1" bar anti-splash drain pan with built-in pitch toward drain. Grating flat bars to be parallel to pour pattern to minimize splash. Provide with 4" O.D. tailpiece drain connection and removable stainless steel scrap basket.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-69**                    **SLICER TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Bizerba**  
**Model:**                        **SLICER-TABLE-315**

- a. Model SLICER-TABLE-315 Equipment Stand, mobile, 27.9"W x 32.25"D x 31.75"H, 600 lb. capacity, coved-upward edge on all four sides of table-top, 14-gauge stainless steel top, (4) predrilled mounting holes, combination handle/remote sharpener holder, (6) 18" x 26" pan capacity, 2.375" tray slide spacing, side lift arm for mobility or lock in place, (1) fixed stainless steel bottom shelf with 3" center drain, stainless steel welded construction, (4) high friction pad feet with retractable casters, NSF, Made in USA.

**ITEM # CKB-70**                    **MEAT SLICER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Bizerba**  
**Model:**                        **GSP HD I 150-GCB**

- a. Model GSP HD I 150-GCB Automatic Heavy Duty Illuminated Safety Slicer, 13" Grooved Cheese Blade, product fence, 3-speeds, 3-strokes, servo assist, 8-safety interlocks, seamless anodized aluminum construction, high carriage 25° incline towards operator, 40° gravity feed, thumb guard 5.8" W, remote sharpener with spring-loaded dial, slice thickness 0-0.94", VFD-motor, 120v/60/1-ph, 2.6 amps, 0.24kW, cord with NEMA 5-15P, ETL-Sanitation, UL-157 gaskets & seals, cETLus, DGUV safety tested

**ITEM # CKB-71**                    **2-COMPARTMENT SINK PREP TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **2CSPT**

- a. Model 2CSPT Prep table with 2-Compartment Sink, 10'-0" long X 2'-6" wide X 36" high, all 14 gauge type 304 stainless steel construction. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be provided with 8" high back splash, 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel Z-clips, marine edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flanged feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.

- b. Sinks to be 20" long X 20" wide X 12" deep, provided with T&S Brass #B-3950 Waste Valve, twist handle assembly for 3-1/2" sink opening, 2" drain outlet with 1-1/2" adapter and stainless steel lever waste bracket. Crease bottom of sink bowl to pitch to the drain. Provide stainless steel skirt to cover sink bowl.
- c. (2) Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- d. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-71.1      FAUCET**  
**Quantity:            One (1)**  
**Manufacturer:        T&S Brass**  
**Model:                B-0231-CR**

- a. Model B-0231-CR Faucet, 12" swing nozzle, 8" wall mount base, 1/2" NPT female Inlets, quarter-turn Cerama cartridges, low lead, ADA Compliant

**ITEM # CKB-72        WALL MOUNTED OVER SHELF**  
**Quantity:            One (1)**  
**Manufacturer:        Atlanta Custom Fabricators**  
**Model:                WMO**

- a. Model WMO Wall mounted over shelf, 10'-0" long X 12" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-72.1     WALL MOUNTED OVER SHELF**  
**Quantity:            Two (2)**  
**Manufacturer:        Atlanta Custom Fabricators**  
**Model:                WMO**

- a. Model WMO Wall mounted over shelf, 10'-0" long X 14" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-73        SPARE NO.**

**ITEM # CKB-74        SPARE NO.**

**ITEM # CKB-75        MOBILE WORK TABLE**  
**Quantity:            Four (4)**  
**Manufacturer:        Atlanta Custom Fabricators**  
**Model:                MWT**

- a. Model MWT Mobile work table, all stainless steel construction, 6'-0" long X 2'-6" wide X 36" high. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edge. Stainless steel cross bracing, stainless steel legs and (4) 5" diameter non-marking polyurethane swivel casters, (2) with brakes.
- b. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- c. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-76**            **CAN OPENER**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Edlund**  
**Model:**                **1**

- a. Model 1 Can Opener, manual, #1™ with plated base (for cans up to 11" tall) "Old Reliable"™

**ITEM # CKB-77**            **PORTION SCALE**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Alfa International**  
**Model:**                **APW-10**

- a. Model APW-10 CAS Portion Control Scale, compact, portable, 10 lb. x 0.005 lb., 9.4" x 8.9" stainless steel platter, LCD display, AC adapter 1.5v or (6) "C" battery operated (not included), ABS plastic & metal housing, replaces OEM PWII-10

**ITEM # CKB-78**            **HAND SINK**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Advance Tabco**  
**Model:**                **7-PS-66**

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus

**ITEM # CKB-79**            **60 QT MIXER**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Hobart**  
**Model:**                **HL600C-2STD**

- a. Model HL600C-2STD 380-460/50/60/3 Mixer; with bowl, beater, "D" whip, & spiral dough arm; US Correctional Facility configuration - Legacy Correctional Planetary Mixer, 3.0 HP, 60 quart, (4) fixed speeds plus stir speed, gear-driven transmission, 20-Minute SmartTimer™, power bowl lift, stainless steel bowl, "B" beater, "D" wire whip, "ED" dough hook, stainless steel bowl guard
- b. Model TRUCK-HL1486 Legacy® Mixer Bowl Truck.

**ITEM # CKB-80**            **EQUIPMENT STAND**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Advance Tabco**

**Model: MT-MS-300**

- a. Model MT-MS-300 Mixer Table, mobile, 30"W x 30"D x 28H" 14/304 stainless steel top, stainless steel base, aluminum pan rack with 2" spacing, pan rack accommodates (6) 18" x 26" pans, (4) 5" swivel casters (2 braked), NSF

**ITEM # CKB-81            20 QT MIXER**  
**Quantity:                One (1)**  
**Manufacturer:           Hobart**  
**Model:                    HL200-1STD**

- a. Model HL200-1STD 100-120/50/60/1; Bench type mixer; with bowl, beater, whip & spiral dough arm, US/EXP configuration - Legacy Planetary Mixer, Bench, 20 quart, (3) fixed speeds plus stir speed, gear-driven transmission, 15-minute SmartTimer™, #12 taper hub, manual bowl lift, stainless steel bowl, aluminum "B" beater, stainless steel "D" wire whip, aluminum "ED" spiral dough arm, stainless steel bowl guard, 1/2 hp, cord with plug.

**ITEM # CKB-82            BAKER'S WORK TABLE**  
**Quantity:                One (1)**  
**Manufacturer:           Atlanta Custom Fabricators**  
**Model:                    BWT**

- a. Model BWT Work table, all stainless steel construction, 8'-0" long X 3'-0" deep X 36" high. Top to be 14 gauge type 304 stainless steel with an 8" back and end splashes with 2" return on 45 degree angle, attach with stainless steel Z clips, stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet (stainless steel flange feet as required). Front edge to be provided with 14 gauge type 304 stainless steel reverse 3" deep X 1-1/2" rolled rim flour catch running the full length of table. All exposed back and end splashes to be enclosed, fully welded, ground and polished. Table to be fully welded construction with all welds ground and polished to a uniform finish.
- b. Model TMOS Stainless steel table mounted over shelf, 8'-0" long X 1'-0" wide. Shelf to be 14 gauge type 304 stainless steel, supported by stainless steel tubular uprights fully welded to shelves, to pass through backsplash and secured to table framework using stainless steel fasteners and sealed to backsplash, with flanges fully welded to table top, ground and polished.
- c. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-83            INGREDIENT BIN**  
**Quantity:                Four (4)**  
**Manufacturer:           Cambro**  
**Model:                    IBS20148**

- a. Model IBS20148 Ingredient Bin, mobile, 21 gallon capacity, molded polyethylene with sliding cover, scoop holder included (scoop sold separately), (4) 3" heavy duty casters (2 front swivel, 2 fixed), with bin securely attached to base plate, white with clear cover, NSF
- b. Model SCP12CW135 Camwear® Scoop, 12 oz., polycarbonate, clear, NSF

**ITEM # CKB-84            EXHAUST HOOD W/ FIRE SYSTEM**  
**Quantity:                One (1)**  
**Manufacturer:           Accurex**  
**Model:                    XXEW-174**

- a. Model XXEW-174

A. Grease-X-Tractor™ Filter Canopy Hood, Wall Style, Exhaust Only with Single Wall Front. Kitchen Ventilation hood(s) shall be of the Type I, exhaust only wall canopy suitable for all types of cooking applications. The hood(s) shall be U.L. 710 Listed without a fire damper (with optional) for medium, heavy, or extra-heavy duty rated cooking appliances. Make-up air shall be independently provided.

B. The hood(s) exterior shall be constructed of a minimum of 18 gauge 300 series stainless steel. The hood(s) shall be constructed using the standing seam method for optimum strength and with a Performance Enhancing Lip (PEL) to improve capture efficiency by turning air back into the hood. An integral 3-inch air space is provided to meet NFPA® clearance requirements against limited combustible walls. Integral 3-inch air space may be omitted for non-combustible construction. All seams, joints and penetrations of the hood enclosure shall be welded and/or liquid tight Lighter material gauges, alternate material types and finishes are not acceptable. All unexposed interior surfaces shall be constructed of a minimum 18-gauge corrosion resistant steel including, but not limited to ducts, plenum, and brackets.

C. The hood(s) shall include a filter housing constructed of the same material as the hood. The Grease-X-Tractor high efficiency stainless steel filters shall be U.L. 1046 Classified and NSF Certified as manufactured by Accurex, in sufficient number and size to ensure optimum performance. Grease-X-Tractor filters shall direct the exhaust airflow through individual cyclone chambers, utilizing centrifugal impingement grease extraction technology. The filter housing shall terminate in a pitched, full length grease trough which shall drain into a removable grease container. These filters shall have a grease removal efficiency of 69% at 8 microns (51% from 3-10 microns) and static pressure drop of 0.7-0.8 inWC.

D. LED light fixtures shall be pre-wired to a junction box located at the top of the hood for field connection. The wiring shall conform to the requirements of the NFPA® 70.

E. The canopy hood(s) shall be built in accordance with the NFPA® 96, IMC, UMC, and bear the NSF Seal of Approval. The hood manufacturer shall provide, on request, the necessary data that confirms compliance with the code authorities listed above.

F. Provide Accurex Controls: XKC-CV-S Controls system shall be a UL listed outlet center which shall standardly consist of a NEMA-1 Stainless Steel Enclosure within a Stainless-Steel Enclosure Panel, Printed Circuit Board (PCB), with Full Color Touchscreen, audible alarm, sensor (s) and motor starters. The constant volume Accurex Controls shall utilize resistive type temperature sensors that are mounted in the capture tank of the hood to monitor exhaust air temperatures, and an optional room temperature sensor, shipped loose, to be installed to detect ambient air temperatures in the kitchen space. Temperature sensors shall be made of stainless steel and shall be installed in a UL approved coupling.

G. Fire System – Provide factory pre-piped for Ansul R-102 fire protection system located in an integral utility cabinet on the right end of the hood. The system shall provide surface, duct, and plenum protection for items of cooking equipment located beneath the hood in accordance with all applicable codes and provisions of NFPA 17A and 96. All system piping shall be concealed where possible with exposed portions of either chrome fittings or stainless-steel sleeving. The system shall be wired with shunt trip breaker and electric/gas shut-off valve serving items of cooking equipment beneath the hood to provide power and fuel shut-off in the event of system actuation.

H. Exhaust fan(s) and supply fan(s) to be supplied by Mechanical Contractor

I. 304 Stainless Steel inside and out. No galvanized metal.

J. Provide fire cabinet on left end of hood.

K. Provide stainless steel backsplash for entire length of hood with 18" to extend right and 18" to extend left of the hood where applicable.

L. Provide stainless steel hood enclosure panel. Top of hood to have a minimum of 3" above the ceiling.



**ITEM # CKB-85**                    **SMOKER OVEN**  
**Quantity:**                    **One (1)**  
**Manufacturer:**               **Cookshack**  
**Model:**                        **FEC750SS**

- a. Model FEC750SS Fast Eddy's™ Rotisserie Smoker, wood pellets, 750 lbs. per load capacity, IQ5 digital controller with (8) programs, alarm cycle & USB, auto-start, (2) convection fan, (15) stainless steel rotisserie grills/racks, 80 lbs. hopper, stainless steel construction, includes: (5) grill rack baskets, (4) casters, 160 lbs. pellets, foot pedal & Cookshack Spice Kit, 1800 watts, 15.0 amps, 120v, 108,000 BTU pellet burner, power cord, NSF, cULus. UNIT IS FULLY ELECTRIC.

**ITEM # CKB-86**                    **ROLL-IN COMBI OVEN**  
**Quantity:**                    **One (1)**  
**Manufacturer:**               **RATIONAL**  
**Model:**                        **ICP 20-FULL E 480V 3 PH (LM100GE)**

- a. Model ICP 20-FULL E 480V 3 PH (LM100GE) (CG1ERRA.0000228) iCombi Pro® 20-Full Size Combi Oven, electric, (20) 18" x 26" sheet pan or (40) 12" x 20" steam pan or (20) 2/1 GN pan capacity, mobile oven rack & (10) stainless steel grids included, intelligent cooking system with (4) assistants; iDensityControl, iCookingSuite, iProductionManager, & iCareSystem, (6) operating modes, (5) cooking methods, (3) manual operating modes, 85° to 572°F temperature range, quick clean, care control, eco mode, 6-point core temperature probe, retractable hand shower, Ethernet interface, Wi-Fi enabled, 480v/60Hz/3-ph, 81.7 amps, 67.9 kW, IPX5, UL, cULus, NSF, ENERGY STAR-®
- b. Model CAP Chef Assistance Program, a RATIONAL certified Chef conducts 4 hours/location specialized application training with personnel, no charge
- c. Model 9999.2002 Pre-Installation Site Consultation, provides an installation consultation to ensure the site has proper space and connections for gas, electric, drain & water, one (1) Consultation is needed for every four (4) cooking systems, includes 100 miles (200 miles round trip).
- d. Model 9999.2202 RCI RATIONAL Certified Installation, new certified installation for each electric floor iCombi, 100 miles (200 round-trip) included.
- e. Model 8720.1563US Installation Kit, for electric iCombi/SCC/CMP 62 (208/60Hz/3ph & 240/60Hz/3ph); electric iCombi/SCC/CMP 202 (480/60Hz/3ph)
- f. Model 1900.1158US Water Filtration Double Cartridge System, for full-size Combi-Duos or if used for more than (2) units, includes: (1) double head with pressure gauge, (2) R95-CLX filter & (1) filter installation kit (for each additional unit add (1) additional head & additional cartridge. Maximum (4) cartridges)
- g. Model 9999.2271 RCI RATIONAL Certified Installation, additional installation cost for a RATIONAL Water Filter System is available when purchased with Certified Installation of RATIONAL unit
- h. Model 42.00.162 RATIONAL USB Data Memory Stick, for transferring of cooking programs and HACCP data between units & computers.
- i. Model 60.22.490 (Mobile Oven Rack, type 20-full size Pro/Classic, (20) 24" x 20" pan capacity, 2-1/2" spacing.
- j. Model 60.22.392 Sheet Pan Adapter, top, for 20-full size mobile racks with (20) racks, allows use of full size sheet pans without stainless steel grid  
Model 60.22.393 Sheet Pan Adapter, below, for 20-full size mobile racks with (20) racks, allows use of full size sheet pans without stainless steel grid.

**ITEM # CKB-87**                    **ROLL-IN BLAST CHILLER**  
**Quantity:**                    **One (1)**

**Manufacturer:** Alto-Shaam  
**Model:** QC3-100

- a. Model QC3-100 Quickchiller™ Blast Chiller, roll-in, self-contained with dual refrigeration systems, (40) 12" x 20" pan capacity, touch control with (20) preset menu options, (3) product temperature probes, quick freeze soft-chill hard-chill and holding modes, automatic defrost cycle, HACCP, stainless steel interior and exterior, (4) adjustable legs (NOT installed at factory), includes: One (1) Roll-in pan cart, (20) non-tilt pan support rails, 22-13/16" (678mm) horizontal width & 2-9/16" (65mm) vertical spacing between rails, (10) stainless steel shelves, (1) removable drip tray & (1) cart handle , cULus, NSF
- b. 115/208-230v/60/3-ph, 16.0 amps, 3.68 kW, 5 wire direct connection, no cord or plug
- c. Left-hand door swing
- d. Model 5026385 Roll-In Pan Cart, (20) shelf pan trolley (shelves/pans sold separately), 2-9/16" vertical spacing, fits 20-20E, 20-20G, 20-20MW and QC3-100, stainless steel construction, (4) casters (2 locking)

**ITEM # CKB-88** ICE MACHINE, CUBE  
**Quantity:** Two (2)  
**Manufacturer:** Hoshizaki  
**Model:** KM-1301SWJ

- a. Model KM-1301SWJ Ice Maker, Cube-Style, 48"W, water-cooled, self-contained condenser, production capacity up to 1247 lb/24 hours at 70°/50° (1230 lb AHRI certified at 90°/70°), crescent cube style, stainless steel exterior, R-404A refrigerant, 208-230v/60/1-ph, 8.2 amps, NSF, UL

**ITEM # CKB-88.1** ICE BIN, W/CART  
**Quantity:** Two (2)  
**Manufacturer:** Follett Products, LLC (Middleby)  
**Model:** DEV1475SG-60-75

- a. Model DEV1475SG-60-75 Ice-DevIce™ with SmartCART™ 75, 1490 lb. bin storage capacity, with front chute, poly liner, SmartGATE ice shield, poly door with PowerHinge™ door hinge, full stainless steel exterior and base, ABS/poly top custom cut for ice machine, includes 82 oz plastic ice scoop, paddle and rake set, and (1) polyethylene cart with hinged lid and (3) polyethylene Totes ice carriers, each carrier holds 25 lb/75 lb total per cart, for cube or Chewblet ice only, NSF
- b. Model ABICEPADDL46 Ice Paddle, high density poly, 46-1/2" long, for slope front bin, single door upright bin, and single door Ice DevIce ice storage and dispensing system

**ITEM # CKB-88.2** WATER FILTER  
**Quantity:** Two (2)  
**Manufacturer:** Hoshizaki  
**Model:** H9320-53

- a. Model H9320-53 Water Filtration System, triple configuration

**ITEM # CKB-88.3** ICE CART  
**Quantity:** Two (2)  
**Manufacturer:** Follett Products, LLC  
**Model:** 00112771

- a. Model 00112771 SmartCART™ 75, mobile, polyethylene, includes 3 totes, 75-lb capacity, NSF

**ITEM # CKB-89**                    **FLOOR TROUGH**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Atlanta Custom Fabricators**  
**Model:**                        **FT**

- a. Model FT Stainless steel floor trough, 9'-0" long X 2'-6" wide, 2" deep, constructed of 14 gauge type 304 stainless steel with perimeter stainless steel anchor tabs welded approximately 12" O.C., removable washable 1" X 1/4" fiber grate. Grating flat bars to be parallel to pour pattern to minimize splash. Provide with 4" O.D. tailpiece drain connection and removable stainless steel scrap basket.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-90**                    **STORAGE SHELVING**  
**Quantity:**                    **Eight (8) – (2 COMPLETE UNITS 4 SHELVES EACH)**  
**Manufacturer:**            **Metro**  
**Model:**                        **2148NK3**

- a. Model 2148NK3 Quick Ship - Super Erecta® Shelf, wire, 48"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. Model 74UPK3 Quick Ship - Super Erecta® SiteSelect™ Post, 73-7/8"H, for use with stem casters, Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
- c. (4) Model 5PC Quick Ship - Super Erecta® Stem Caster, swivel, 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper
- d. (4) Model 5PCB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper

**ITEM # CKB-91**                    **MOBILE HEATED CABINET**  
**Quantity:**                    **Fourteen (14)**  
**Manufacturer:**            **FWE**  
**Model:**                        **ETC-UA-12HD**

- a. Model ETC-UA-12HD Heated Transport Cabinet, full height, (12) removable & adjustable universal tray slides 4-1/2" OC, capacity (12) 18" x 26" or (24) 12" x 20" pans, (1) insulated door, stainless steel interior & exterior, recessed hand grip, cULus, UL EPH Classified, IPX4, CE
- b. 120v/60/1-ph, 13 amps, 1565 watts, cord with NEMA 5-15P (USA)
- c. Manual Control, standard
- d. Standard door(s)
- e. Cord Winding Bracket

**ITEM # CKB-92**                    **DOLLY TRUCK**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**            **New Age**  
**Model:**                        **50112**

- a. Model 50112 Bulk Sheet Pan Dolly, 140 pan capacity, 27-3/4"W x 73"H x 28-1/2"D, (4) 8" x 2" plate swivel casters (C526), Made in USA.

**ITEM # CKB-93**            **HOSE REEL**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **T&S Brass**  
**Model:**                **B-7242-10**

- a. Model B-7242-10 Hose Reel System, open, 3/8" x 50' hose with extended spray wand, with ratcheting system & adjustable hose bumper, epoxy coated steel
- b. Model B-1433-LR Hose Reel Supply System, 8" wall mount mixing faucet, adjustable centers, quarter-turn Eterna cartridges with spring checks, lever handles with color coded indexes, EasyInstall 16" and rigid 40" risers, continuous pressure vacuum breaker, 3/8"NPT x 36" flexible water hose connector with stainless steel quick disconnect, (2) 2-3/8" wall brackets, 1/2" NPT.

**ITEM # CKB-94**            **HAND SINK**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Advance Tabco**  
**Model:**                **7-PS-66**

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus

**ITEM # CKB-95**            **SPARE NO.**

**ITEM # CKB-96**            **SPARE NO.**

**ITEM # CKB-97**            **3-COMPARTMENT SINK SCULLERY TABLE**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Fabricated**  
**Model:**                **3CSST**

- a. Model 3CSST Scullery table with 3-Compartment Sink, 9'-0" long X 2'-10" wide X 36" high, all 14 gauge type 304 stainless steel construction, size and shape per plan. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be provided with 8" high back splash, 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel Z-clips, 3" high X 1-3/4" rolled edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flanged feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Each sink to be 28" long X 20" wide X 14" deep, provided with T&S Brass #B-3950-01 Waste Valve, twist handle and overflow assembly for 3-1/2" sink opening, 2" drain outlet and stainless steel lever waste bracket. Provide stainless steel skirt to cover sink bowls. Crease bottom of sink bowl to pitch to the drain.
- c. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-97.1**        **FAUCET**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **T&S Brass**  
**Model:**                **B-0290**

- a. Model B-0290 Sink Mixing Faucet, wall mount, 8" adjustable centers, 12" Big-Flo swing nozzle with plain end outlet, 4-arm kitchen handles with color coded indexes, 00LL street elbows with 3/4" female NPT inlets, ADA Compliant

**ITEM # CKB-97.2      PRE-RINSE W/ FAUCET**  
**Quantity:            One (1)**  
**Manufacturer:        T&S Brass**  
**Model:                B-0287-427-B**

- a. Model B-0287-427-B Big-Flo Pre-Rinse Unit, 8" wall mount mixing faucet, adjustable centers, spring action gooseneck, check valves, 4-arm handles with color coded indexes, 18" riser, 44" flexible stainless steel hose, Big-Flo compression spindles, 1.15 GPM spray valve, 6" adjustable wall bracket, 3/4" NPT, low lead, NSF, cCSAus

**ITEM # CKB-98        POT RACK**  
**Quantity:            One (1)**  
**Manufacturer:        Advance Tabco**  
**Model:                SW-96**

- a. Model SW-96 Pot Rack, wall-mounted, double bar design, 96"W x 12"D, constructed of 1/4" x 2" stainless steel, includes: (18) plated double pot hooks, NSF

**ITEM # CKB-99        HAND SINK**  
**Quantity:            One (1)**  
**Manufacturer:        Advance Tabco**  
**Model:                7-PS-66**

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus

**ITEM # CKB-100      WALL MOUNTED SLANTED RACK SHELF**  
**Quantity:            One (1)**  
**Manufacturer:        Atlanta Custom Fabricators**  
**Model:                WMSRS**

- a. Model WMSRS Wall mounted slanted rack shelf, all stainless steel construction, 7'-8" long X 1'-8" wide. Shelf to be fully welded construction with all welds ground and polished to a uniform finish. Shelf to be constructed of 14 gauge type 304 stainless steel, supported by 14 gauge stainless steel cantilever brackets, mounted using stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-100.1    WALL MOUNTED SLANTED RACK SHELF**  
**Quantity:            One (1)**  
**Manufacturer:        Atlanta Custom Fabricators**  
**Model:                WMSRS**

- a. Model WMSRS Wall mounted slanted rack shelf, all stainless steel construction, 4'-0" long X 1'-8" wide. Shelf to be fully welded construction with all welds ground and polished to a uniform finish. Shelf to be constructed of 14 gauge type 304 stainless steel, supported by 14 gauge stainless steel cantilever brackets, mounted using stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-101                    U-SHAPED SOILED DISH TABLE WITH LEDGE**  
**Quantity:                        One (1)**  
**Manufacturer:                    Atlanta Custom Fabricators**  
**Model:                             USDTL**

- a. Model USDTL U-Shaped Soiled dish table with ledge, all stainless steel construction, 4'-6" x 10'-7" x 15'-2" long X 2'-6" wide X 34" high. Ledge to be 7'-2" long X 12" wide and fully welded continuously with table. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be 14 gauge type 304 stainless steel with 8" high back splash, 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel Z-clips, 3" high X 1-3/4" rolled edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flanged feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Scrapping Sink, 14 gauge type 304 stainless steel construction, 21"long X 21"wide X 6"D, integrally welded to top. Crease bottom of sink bowl to pitch to the drain. Sink to be provided with 14 gauge stainless steel removable rack guide to rest flush with table top.
- c. Disposer:  
Sink to have a modified drain opening to accept disposer and mounting hardware, Item #102, as shown on plan and hereinafter specified.
- d. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-101.1                PRE-RINSE**  
**Quantity:                        One (1)**  
**Manufacturer:                    T&S Brass**  
**Model:                             B-0133**

- a. Model B-0133 EasyInstall Pre-Rinse Unit, wall mount mixing faucet with 8" adjustable centers, quarter-turn Eterna cartridges with spring checks, lever handles with color-coded indexes, 18" EasyInstall riser, 44" flexible stainless steel hose with heat-resistant gray handle & hold down ring, 1.15 GPM spray valve (B-0107), finger hook, polished chrome-plated brass faucet body, 1/2" NPT female inlets, CSA

**ITEM # CKB-102                DISPOSER**  
**Quantity:                        One (1)**  
**Manufacturer:                    Salvajor**  
**Model:                             200-SA-6-WSP**

- a. Model 200-SA-6-WSP Water Saving Package with Operator Sensor, Disposer, Sink Assembly, 6-1/2" sink collar, 2 Hp motor, start/stop push button, drain/flush/time delay, automatic reversing & water saving with safety line disconnect ARSS-LD control, includes fixed nozzle, chrome plated vacuum breaker, solenoid valve, sink stopper & flow control, heat treated aluminum alloy housing, UL, CE
- b. 208v/60/3-ph, 6.6 amps
- c. Model 980105 Mounting bracket for ARSS-2, ARSS, ARSS-LD & WSP
- d. Model DP Stainless steel dejamming prong

**ITEM # CKB-103                CONVEYOR DISH MACHINE**  
**Quantity:                        One (1)**  
**Manufacturer:                    Hobart**  
**Model:                             CL66-BAS ELECTRIC - RL**

- a. Model CL66-BAS ELECTRIC - RL Conveyor Dishwasher, single tank with power scrapper; (202) racks/hour, .45 gallon/rack, Complete Delime with Booster Guard, Touch

Screen Controls with diagnostics, troubleshooting, and SmartConnect App, capless wash arms, NSF Pot & Pan mode, pumped rinse, insulated hinged doors, cULus, NSF, ENERGY STAR®, Factory Startup - Free for installations within 100 miles (accessible by public roadway) of a Hobart Service Office during normal business hours with appropriate notice; Installation beyond 100 miles or those not accessible by public roadway will be quoted by Service.

- b. Maintenance Inspection
- c. Model CL66BAS-HTE15K Electric tank heat 15kW
- d. Model CL66BAS-ELE0CD 480v/60/3-ph Single point connection standard
- e. Model CL66BAS-HGTHS Higher than Standard 24"H x22"W opening, fits large oval trays, tall drink dispensers
- f. Model CL66BAS-ERH18K With 18 kW Booster
- g. Model CL66BAS-DIR0RL Right to left operation
- h. Model DWT-CL Drain water tempering kit for CL models
- i. Installation of DWT kit
- j. Model VNTSTK-EXTND 21" Adjustable vent stack extension, field installed
- k. Model TBLLIM-CL Table limit switch for CL & CLEN series
- l. (3) Model FLGFT-CLE\*3 Flanged Feet, all CLeN Models require quantity of 3 sets (6 feet)

**ITEM # CKB-104            EXHAUST DUCT RISER**  
**Quantity:                One (1)**  
**Manufacturer:          Atlanta Custom Fabricators**  
**Model:                    EDR**

- a. Model EDR Exhaust duct riser, constructed of 16 gauge type 304 stainless steel, fully welded and polished with stainless steel ceiling collar, size and shape per plan to fit dish machine. Unit to be constructed and installed per plan. All labor and materials included but not limited to ducting and access panels by a factory authorized licensed mechanical contractor. Installation shall conform but is not limited to section 15600.
- b. NOTE:
  - 1. GC to provide and install all rated chases with required access panels and all ducting. Installation shall include all ducting, chases, fans, and curbs as provided by the FEC, access panels, roof penetrations and comply with all governing agencies.
  - 2. GC to provided continuous welded stainless steel ducting from pantleg to exhaust fan.
  - 3. GC is also to interconnect fan w/ contact in dish machine controls.
- c. Unit to be further constructed in accordance with shop drawings.  
 APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-104.1        EXHAUST DUCT RISER**  
**Quantity:                One (1)**  
**Manufacturer:          Atlanta Custom Fabricators**  
**Model:                    EDR**

- a. Model EDR Exhaust duct riser, constructed of 16 gauge type 304 stainless steel, fully welded and polished with stainless steel ceiling collar, size and shape per plan to fit dish machine. Unit to be constructed and installed per plan. All labor and materials included but not limited to ducting and access panels by a factory authorized licensed mechanical contractor. Installation shall conform but is not limited to section 15600.
- b. NOTE:
  - 1. GC to provide and install all rated chases with required access panels and all ducting. Installation shall include all ducting, chases, fans, and curbs as provided by the FEC, access panels, roof penetrations and comply with all governing agencies.

2. GC to provided continuous welded stainless steel ducting from pantleg to exhaust fan.
3. GC is also to interconnect fan w/ contact in dish machine controls.
- c. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-105            CLEAN DISH TABLE**  
**Quantity:                One (1)**  
**Manufacturer:            Fabricated**  
**Model:                    CDT**

- a. Model CDT Clean dish table, all stainless steel construction, 10'-0" long X 2'-6" wide X 34" high. Top to be 14 gauge type 304 stainless steel with 8" high back splash, 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel z-clips, 3" high X 1-3/4" rolled edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flanged feet. Provide accommodations for table limit switch. Table to be fully welded construction with all welds ground and polished to a uniform finish. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-106            WALL MOUNTED SLANTED RACK SHELF**  
**Quantity:                One (1)**  
**Manufacturer:            Atlanta Custom Fabricators**  
**Model:                    WMSRS**

- a. WMSRS Wall mounted slanted rack shelf, all stainless steel construction, 7'-0" long X 1'-8" wide. Shelf to be fully welded construction with all welds ground and polished to a uniform finish. Shelf to be constructed of 14 gauge type 304 stainless steel, supported by 14 gauge stainless steel cantilever brackets, mounted using stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-107            POT STORAGE SHELVING**  
**Quantity:                Eight (8) – (2 COMPLETE UNITS 4 SHELVES EACH)**  
**Manufacturer:            Metro**  
**Model:                    2142NK3**

- a. Model 2142NK3 Quick Ship - Super Erecta® Shelf, wire, 42"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. Model 74UPK3 Quick Ship - Super Erecta® SiteSelect™ Post, 73-7/8"H, for use with stem casters, Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
- c. (4) Model 5PC Quick Ship - Super Erecta® Stem Caster, swivel, 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper
- d. (4) Model 5PCB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper

**ITEM # CKB-108            FLOOR TROUGH**  
**Quantity:                One (1)**  
**Manufacturer:            Atlanta Custom Fabricators**  
**Model:                    FT**



- a. Model FT Stainless steel floor trough, 10'-0" long x 1'-0" wide, 5" deep, constructed of 14 gauge type 304 stainless steel with perimeter stainless steel anchor tabs welded approximately 12" O.C., stainless steel subway grating of 3/16" X 1" bar anti-splash drain pan with built-in pitch toward drain. Grating flat bars to be parallel to pour pattern to minimize splash. Provide with 4" O.D. tailpiece drain connection and removable stainless steel scrap basket.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CKB-109            SPARE NO.**

**ITEM # CKB-110            SPARE NO.**

**ITEM # CKB-111            SPARE NO.**

**ITEM # CKB-112            DISH CART / DOLLY**  
**Quantity:                Eight (8)**  
**Manufacturer:            Metro**  
**Model:                    PCD11A**

- a. Model PCD11A Quick Ship - Poker Chip Dish Dolly, 26-5/8"W x 26-5/8"D x 31-15/16"H, adjustable, dish size 4-1/4" to 11-3/4", removable dividers & towers, two-handed access, recessed handles, 5"Dia. swivel casters with neoprene wheels (2 with brakes), chip-resistant polymer shell with Microban® antimicrobial protection, aesthetic blue, vinyl dust/water splash cover, NSF

**ITEM # CKB-113            RACK DOLLY**  
**Quantity:                Eight (8)**  
**Manufacturer:            Metro**  
**Model:                    D2121C**

- a. Model D2121C Dolly, for Cup/Glass Rack, platform design, single stack, designed for 20" x 20" racks, all aluminum construction, without bumpers & handle

**ITEM # CKB-114            MOP SINK CABINET**  
**Quantity:                One (1)**  
**Manufacturer:            Advance Tabco**  
**Model:                    9-OPC-84DL**

- a. Model 9-OPC-84DL Cabinet with Mop Sink, 50-3/8"W x 22-3/4"D x 84"H O.A., double hinged doors, left side mop sink 20"W x 16"D front to back x 12" deep (drain included), storage for mop bucket to roll in on right, (2) mop holders, (4) fixed intermediate shelves (3 on right, 1 on left above sink), slotted side panels for ventilation, 16/304 series stainless steel sink bowl, 18/304 series sink bowl apron, 18/430 series stainless steel cabinet, NSF
- b. Model K-240 Service Sink Faucet, wall mount, heavy duty, 8" OC, 6-1/2" spout, with hose thread & pail hook, vacuum breaker spout, wall braced, chrome-plated brass
- c. Model K-610CF Perforated bottom strainer plate, stainless steel, removable, sits 1" above bottom of sink, fits Advance Tabco Fabricated 16" x 20" sink bowls only

### **CRK – EVENT LEVEL CREW KITCHEN**

**ITEM # CRK-1**                    **1 COMPARTMENT SINK PREP TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Atlanta Custom Fabricators**  
**Model:**                      **1CSPT**

- a. Model 1CSPT Prep table with 1-Compartment Sink, 8'-0" long X 2'-6" wide X 36" high, all 14 gauge type 304 stainless steel construction. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be provided with 8" high back splash, 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel Z-clips, marine edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flanged feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Sink to be 20" long X 20" wide X 12" deep, provided with T&S Brass #B-3950 Waste Valve, twist handle assembly for 3-1/2" sink opening, 2" drain outlet with 1-1/2" adapter and stainless steel lever waste bracket. Crease bottom of sink bowl to pitch to the drain. Provide stainless steel skirt to cover sink bowl.
- c. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- d. Unit to be further constructed in accordance with shop drawings  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CRK-1.1**                **FAUCET**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **T&S Brass**  
**Model:**                      **B-0231-CR**

- a. Model B-0231-CR Faucet, 12" swing nozzle, 8" wall mount base, 1/2" NPT female Inlets, quarter-turn Cerama cartridges, low lead, ADA Compliant

**ITEM # CRK-2**                    **WALL MOUNTED OVER SHELF**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Atlanta Custom Fabricators**  
**Model:**                      **WMO**

- a. Model WMO Wall mounted over shelf, 8'-0" long X 12" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CRK-2.1**                **WALL MOUNTED OVER SHELF**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**            **Atlanta Custom Fabricators**  
**Model:**                      **WMO**

- a. Model WMO Wall mounted over shelf, 8'-0" long X 14" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.

- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CRK-3**                    **HAND SINK**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Advance Tabco**  
**Model:**                        **7-PS-66**

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus

**ITEM # CRK-4**                    **REACH-IN FREEZER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Delfield**  
**Model:**                        **GAF1P-SH**

- a. Model GAF1P-SH Specification Line® Freezer, Reach-In, one-section, 21.0 cubic feet capacity, top-mounted self-contained refrigeration system, (2) half-height hinged solid doors (locking), (3) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, pilaster with shelf clips, stainless steel exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.55 HP, 115v/60/1-ph, 7.2 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®
- b. Door hinged on right standard
- c. Set of (4) 5" locking casters, standard

**ITEM # CRK-5**                    **VENTLESS FRYER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perfect Fry Company**  
**Model:**                        **PFA500**

- a. Model PFA500 Ventless Automatic Deep Fryer, countertop, 2.9 gallon oil capacity, 3lb product load, front loading and dispensing, oil drainage kit, Built in Fire Suppression, interactive touchscreen control, WiFi enabled, USB port for recipe sharing and data transfer, RapidFry technology, cETLus, ETL -Sanitation, NSF
- b. Model MDD-1001 Open Kitchen bundle, includes - 1 x ConnectWare module, 1 x Secure Access Point (SAP), 3 year subscription for Open Kitchen
- c. 208v/60/3ph, 5.0 KW, 14 amps NEMA 15-30P

**ITEM # CRK-6**                    **WORK TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Fabricated**  
**Model:**                        **WT**

- a. WT Work table, all stainless steel construction, 5'-0" long X 2'-6" wide X 36" high. Table to be fully welded construction with all welds fully ground and polished to a uniform finish. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges, 4" back splash with 1" return on 45 degree angle, attach with stainless steel Z clips, stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Unit to be further constructed in accordance with shop drawings  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CRK-7**                    **ELECTRIC GRIDDLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Evo America, LLC**  
**Model:**                        **10-0148-EVT**

- a. Model 10-0148-EVT Evo® EVent® 48E Full Metal Surround Cooking Station, electric, 48"W x 24"D rectangular steel cooktop surrounded with black granite, self-contained ventilation, multi-stage filtration system, integrated fire suppression system, 100° F to 550° F (38° C to 288° C) temperature range, touch panel display, includes: cleaning kit, (2) stainless steel spatulas, (1) stainless steel scraper, UL, UL EPH Classified, Made in USA
- b. 208v/60/1-ph, 32.0 amps, 6.7 kW, 8-foot cord, NEMA 6-50P
- c. Model 10-0150-EVT-FMS Customization for 10-0148-EVT: Metal surround, stainless steel enclosure
- d. Model 10-0150-EVT-36 Caster Kit, for 36" working height, standard

**ITEM # CRK-8**                    **REACH-IN HEATED CABINET**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Delfield**  
**Model:**                        **GAH1-S**

- a. One (1) Model GAH1-S Specification Line® Heated Cabinet, Reach-In, one-section, 21.0 cubic feet capacity, (1) full-height hinged solid door (locking), (3) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, incandescent interior lighting, stainless steel exterior front, sides & interior, (4) 5" locking casters, 208-240v/60/1-ph, 6.0 amps, NEMA 6-20P, NSF, cULus, ENERGY STAR®
- b. Model 0460003CN 3 year parts & labor warranty, standard
- c. Door hinged on left
- d. Full height solid door, standard
- e. Set of (4) 5" locking casters, standard

**ITEM # CRK-9**                    **WORK TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **WT**

- a. Model WT Work table, all stainless steel construction, 7'-0" long X 2'-6" wide X 36" high. Table to be fully welded construction with all welds fully ground and polished to a uniform finish. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges, 8" back splash with 2" return on 45 degree angle and 1" turned down, attach with stainless steel Z clips, stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- c. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CRK-10**                  **DRY STORAGE SHELVING**  
**Quantity:**                    **Twelve (12) (3 COMPLETE UNITS 4 SHELVES EACH)**  
**Manufacturer:**              **Metro**

**Model: 1848NK3**

- a. Model 1848NK3 Quick Ship - Super Erecta® Shelf, wire, 48"W x 18"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. Model 86PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 86-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

**ITEM # CRK-11 REACH-IN REFRIGERATOR**  
**Quantity: One (1)**  
**Manufacturer: Delfield**  
**Model: GAR1P-S**

- a. Model GAR1P-S Specification Line® Refrigerator, Reach-In, one-section, 21.0 cubic feet capacity, top-mounted self-contained refrigeration system, (1) full-height hinged solid door (locking), (3) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, stainless steel exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.22 HP, 115v/60/1-ph, 4.2 amps, NEMA 5-15P, NSF, cULus
- b. Door hinged on right standard
- c. Model AS359-CT7-0035 Stainless steel back
- d. Set of (4) 5" locking casters, standard

**ITEM # CRK-12 MEGA TOP SANDWICH / SALAD PREPARATION REFRIGERATOR**  
**Quantity: One (1)**  
**Manufacturer: Delfield**  
**Model: D4448NP-12M**

- a. Model D4448NP-12M Mega Top Sandwich/Salad Top Refrigerator, two-section, 48" W, 16.0 cubic feet, (4) drawers, stainless steel top with polyethylene cutting board & (12) 1/6 size plastic pans, ABS interior sides, stainless steel front & sides, 5" casters, front-breathing rear-mounted refrigeration system, R290 Hydrocarbon refrigerant, 0.3 hp, cUL, UL, NSF
- b. 115v/60/1-ph, NEMA 5-15P, standard
- c. Self-contained refrigeration, standard

**ITEM # CRK-13 CHEF'S COUNTER**  
**Quantity: One (1)**  
**Manufacturer: Atlanta Custom Fabricators**  
**Model: CC**

- a. Model CC Chef's counter, all stainless steel and cabinet base construction 9'-10" long x 4'-0" wide X 36" high. Top to be 14 gauge type 304 stainless steel. Counter to be fully welded construction with all welds ground and polished to a uniform finish. All exposed back and end panels to be enclosed, fully welded, ground and polished.
- b. Provide cut-out in counter for roll-in equipment as indicated on plan. (Item 12)
- c. Undermount work sink to be constructed of 14 gauge type 304 stainless steel. Unit to be 20" long X 20" wide X 12" deep with 1-1/2" wide stainless steel perimeter flange. Sink to be provided with T&S Brass #B-3950 Waste Valve, twist handle assembly for 3-1/2" sink opening, 2" drain outlet with 1-1/2" adapter and stainless steel lever waste bracket. Crease bottom of sink bowl to pitch to the drain.

- d. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CRK-13.1      DECK MOUNT FAUCET**  
**Quantity:            One (1)**  
**Manufacturer:        T&S Brass**  
**Model:                B-0325-CC-CR**

- a. Model B-0325-CC-CR Mixing Faucet, deck mount, 4" adjustable centers, 5-3/4" swivel gooseneck spout with Series 1 stream regulator outlet (includes lock washer to convert to rigid), lever handles with color coded indexes, quarter-turn Cerama cartridges with check valves, polished chrome plated brass body, 1/2" NPT male inlets, low lead, cCSAus, ADA Compliant

**ITEM # CRK-14      SPARE NO.**

**ITEM # CRK-15      SPARE NO.**

**ITEM # CRK-16      WALK-IN COOLER**  
**Quantity:            One (1)**  
**Manufacturer:        Thermo-Kool**  
**Model:                WIC**

- a. Model WIC 12' 0" x 8' 8" x 9' 6" High  
 Insulation: 4" DURATHANE, all-urethane foamed-in-place (Class 1)  
 Exterior: Stucco Aluminum  
 Interior Walls: Stucco Aluminum  
 Interior Ceilings: White Stucco Aluminum  
 Interior Floors: Galvanized Steel  
 Cooler, Freezer with Floor - recessed by 8" for tile & grout  
 (2) 36" x 80" Flush Mounted Entrance Door(s), with hardware, Pilot light & switch assembly, vapor proof light & dial thermometer. NSF LISTED  
 (2) Stainless Steel to Interior & Exterior of Door & Frame  
 (2) Door(s) with (3) Hinges per door  
 (2) Kason # 1806 LED light fixture at door(s)  
 (2) Thermo-Kool TK4700 walk-in monitor system with TK4 panic switch, motion detector, battery backups, dry contacts and thermostatically controlled heater wires  
 (2) 14" x 14" peep window w/ heated frame & glass  
 (2) 48"H 1/8" Aluminum Treadplate kickplates and jamb guards int & ext  
 (2) Foot treadle(s)  
 (2) Curtron Polar Pro model PP-C-080-3680-IP vinyl swing door(s) w/ impact plates  
 (2) Center light above door  
 (2) Pressure relief vent(s)  
 (2) Kason 48" LED light fixture(s)  
 (1) 8' x 100' Roll(s) of 6 mil polyethylene sheeting  
 (1) Bluezone 2400  
 Enclosure panels w/ removable access panel  
 Trim  
 1/8" Treadplate wainscot on exp. exterior 48" high (shipped loose for field installation)

**ITEM # CRK-16.1      COOLER EVAPORATOR**  
**Quantity:            One (1)**  
**Manufacturer:        Thermo-Kool**  
**Model:                RL6A094ADA**

- a. Model RL6A094ADA RL6A073ADA 115/60/1 coil (1.6 amps) with Dual Speed EC motor.  
Accessories:  
KE2 Evaporator Defrost Control w/ LLSV.

**ITEM # CRK-16.2      COOLER CONDENSING UNIT**  
**Quantity:            One (1)**  
**Manufacturer:       Thermo-Kool**  
**Model:                RW0130E4SEA**

- a. Model RW0130E4SEA 1 1/3 HP, Remote Pre-Assembled Refrig. System Model RWO130E4SEA 208-230/60/3  
Medium Temperature, base, Scroll, Water-cooled, R448A, Air Defrost Timer (7.2 Compressor RLA).  
Accessories:  
- Heat Exchanger  
- Suction line components  
- Sealed Filter  
- Water-regulating valve

**ITEM # CRK-16.3      FOOD PRESERVATION UNIT**  
**Quantity:            One (1)**  
**Manufacturer:       Evo America, LLC**  
**Model:                10-BZ-2400FP**

- a. Model 10-BZ-2400FP Bluezone Food Preservation for Walk-in Coolers, treats up to 15,000 cu. ft. of air per unit, (4) ozone generating UV bulbs, digital display screen, control panel, mounting rails/feet, 250 watts, 120v/60/1-ph, 3 amps, cETLus, ETL-Sanitation

**ITEM # CRK-17        WALK-IN FREEZER**  
**Quantity:            One (1)**  
**Manufacturer:       Thermo-Kool**  
**Model:                WIF**

- a. Model WIF SEE ITEM CRK-16

**ITEM # CRK-17.1      FREEZER EVAPORATOR**  
**Quantity:            One (1)**  
**Manufacturer:       Thermo-Kool**  
**Model:                ASLE35070DDA**

- a. Model ASLE35070DDA ASLE35070DDA 208-230/60/1 coil (0.9 fan amps, 8 heater amps) with EC motor.

**ITEM # CRK-17.2      FREEZER CONDENSING UNIT**  
**Quantity:            One (1)**  
**Manufacturer:       Thermo-Kool**  
**Model:                RW0250L4SEA**

- a. Model RW0250L4SEA 2 1/2 HP, Remote Pre-Assembled Refrig. System Model RWO250L4SEA 208-230/60/3  
Low Temperature, base, Scroll, Water-cooled, R448A, Std. Defrost Kit (8.7 Compressor RLA).  
Accessories:

- Heat Exchanger
- Water-regulating valve
- Suction line components
- Sealed Filter.

**ITEM # CRK-18**                    **COLD STORAGE SHELVING**  
**Quantity:**                    **Sixteen (16) – (4 COMPLETE UNITS 4 SHELVES EACH)**  
**Manufacturer:**                **Metro**  
**Model:**                        **1842NK3**

- a. Model 1842NK3 Quick Ship - Super Erecta® Shelf, wire, 42"W x 18"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. Model 74PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 74-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

**ITEM # CRK-18.1**                **COLD STORAGE SHELVING**  
**Quantity:**                    **Four (4) – (1 COMPLETE UNIT 4 SHELVES)**  
**Manufacturer:**                **Metro**  
**Model:**                        **1848NK3**

- a. Model 1848NK3 Quick Ship - Super Erecta® Shelf, wire, 48"W x 18"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. Model 74PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 74-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

**ITEM # CRK-18.2**                **COLD STORAGE SHELVING**  
**Quantity:**                    **Eight (8) – (2 COMPLETE UNITS 4 SHELVES EACH)**  
**Manufacturer:**                **Metro**  
**Model:**                        **1836NK3**

- a. Model 1836NK3 Quick Ship - Super Erecta® Shelf, wire, 36"W x 18"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. Model 74PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 74-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

**ITEM # CRK-19**                    **3 COMPARTMENT SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Advance Tabco**  
**Model:**                        **K7-CS-29**

- a. Model K7-CS-29 Convenience Store Sink, 3-compartment, with left & right-hand drainboards, 16" front-to-back x 14" W compartment, 12" deep with 8"H backsplash, stainless steel open frame base, side crossrails, adjustable metal bullet feet, 18 gauge



304 stainless steel, 11-5/8" drainboards, overall 21-1/2" F/B x 70" L/R  
OMIT FAUCET

- b. (2) Model K-472 Faucet hole revision
- c. Model K-4 Support Bracket, for lever waste drain handle, (1) support required for each lever drain

**ITEM # CRK-19.1      WALL / SPLASH MOUNT FAUCET**

**Quantity:**           **Two (2)**  
**Manufacturer:**   **T&S Brass**  
**Model:**               **5F-8WLX10**

- a. Model 5F-8WLX10 Equip Faucet, 8" centers, wall mount, 10" swivel nozzle, lever handles, 2" flange, ceramic cartridges, low lead, ADA Compliant

**ITEM # CRK-20      WALL SHELF W/ POT RACK**

**Quantity:**           **One (1)**  
**Manufacturer:**   **Advance Tabco**  
**Model:**               **PS-12-72**

- a. Model PS-12-72 Shelf with Pot Rack, wall-mounted, 72"W x 12"D, 18/430 stainless steel shelf, 2" x 1/4" stainless steel pot rack, includes: (9) plated double pot hooks, NSF

**ITEM # CRK-21      STORAGE SHELVING**

**Quantity:**           **Four (4) – (1 COMPLETE UNIT 4 SHELVES)**  
**Manufacturer:**   **Metro**  
**Model:**               **2136NK3**

- a. Model 2136NK3 Quick Ship - Super Erecta® Shelf, wire, 36"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. Model 74UPK3 Quick Ship - Super Erecta® SiteSelect™ Post, 73-7/8"H, for use with stem casters, Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
- c. (2) Model 5PC Quick Ship - Super Erecta® Stem Caster, swivel, 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper
- d. (2) Model 5PCB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper

**ITEM # CRK-22      MOP SINK CABINET**

**Quantity:**           **One (1)**  
**Manufacturer:**   **Advance Tabco**  
**Model:**               **9-OPC-84**

- a. Model 9-OPC-84 Cabinet with Mop Sink, 25-3/16"W x 22-3/4"D x 84"H, mop sink base with drain (bowl 16" x 20" x 12"), left hinged door, (2) mop holders, (1) fixed intermediate shelf, slotted side panels for ventilation, 16/304 series stainless steel sink bowl, 18/304 series stainless steel sink bowl apron, 18/430 series stainless steel cabinet, NSF.
- b. Model K-240 Service Sink Faucet, wall mount, heavy duty, 8" OC, 6-1/2" spout, with hose thread & pail hook, vacuum breaker spout, wall braced, chrome-plated brass
- c. Model K-610CF Perforated bottom strainer plate, stainless steel, removable, sits 1" above bottom of sink, fits Advance Tabco Fabricated 16" x 20" sink bowls only

**GR – EVENT LEVEL GREEN ROOM/FAMILY LOUNGE**

**ITEM # GR-1                      UNDER-COUNTER BUFFET WARMER**  
**Quantity:                        Three (3)**  
**Manufacturer:                  CookTek**  
**Model:                             660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # GR-2                      COLD SHELF**  
**Quantity:                        One (1)**  
**Manufacturer:                  Hatco**  
**Model:                             CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA  
b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P, standard.

**ITEM # OMR-1                    CLASSIC TABLE WITH HIDDEN RANGES**  
**Quantity:                        One (1)**  
**Manufacturer:                  Spring USA**  
**Model:                             CLASSIC TABLE**

- a. Model CLASSIC TABLE 84" L x 30"W x 34"H CLASSIC TABLE  
SMARTSTONE TOP WITH WOOD EDGE  
CHOICE IN COLOR AND FINISH OF SMARTSTONE  
WILSONART 7954-12 NATURAL RIFT LAMINATE  
(3) SM-651SS HIDDEN WARMERS - 5.4 AMPS EACH  
20 AMP DEDICATED CIRCUIT REQUIRED  
(1) POWERSTRIP  
HIDDEN CONTROLS  
GROMMET HOLE IN BOTTOM OF TABLE FOR CORDS  
CASTERS

**M1 – EVENT LEVEL MARKET ONE**

**ITEM # M1-1                      POS, SELF-CHECKOUT**  
**Quantity:                        Two (2)**  
**Manufacturer:                  BY OPERATIONS**  
**Model:                             POS**

- a. Model POS PROVIDED BY OPERATIONS

**ITEM # M1-2                      REFRIGERATED MERCHANDISER**  
**Quantity:                        One (1)**  
**Manufacturer:                  True**  
**Model:                             GDM-49-HC~TSL01**

- a. Model GDM-49-HC~TSL01 Refrigerated Merchandiser, two-section, True standard look version 01, (8) shelves, (2) double pane thermal insulated glass hinged doors, LED interior lights, powder coated steel exterior, white interior with stainless steel floor, R290 Hydrocarbon refrigerant, 1/2 HP, 115v/60/1-ph, 8.5 amps, NEMA 5-15P, cULus, UL EPH Classified, Made in USA, ENERGY STAR®
- b. Exterior: Black powder coated steel, standard
- c. Interior: White aluminum, with white shelving, standard
- d. Left door hinged left, right door hinged right standard
- e. Illuminated sign decal: S-TS-02 "TRUE Stripe" graphic, standard

**ITEM # M1-3**                    **COLD FOOD WELL**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Delfield**  
**Model:**                        **N8156BP**

- a. Model N8156BP Drop-In Mechanically Cooled Pan, 56-1/4" W x 26" D, 4-pan size, 1" dia. drain, insulated pan, stainless steel inner liner & top, galvanized steel outer liner, includes adapter bars, self-contained refrigeration, R290 Hydrocarbon refrigerant, 2/7 hp, (55-1/4" x 25" cutout required), cUL, UL, NSF
- b. 115v/60/1-ph, 3.1 amps, NEMA 5-15P, standard

**ITEM # M1-4**                    **DISPLAY MERCHANDISER, HEATED, FOR MULTI-PRODUCT**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Hatco**  
**Model:**                        **GR3SDS-39DCT**

- a. Model GR3SDS-39DCT Glo-Ray® Designer Slant Display Warmer, with curved canopy top, (14) rods, countertop, dual shelf, adjustable thermostat, hardcoated heated base, heated glass shelves, tempered glass side panels, LED display lights, built-in front sign holder (sign not included), 2-1/2" legs, cULus, UL EPH Classified, Made in USA, CE
- b. 120/208-240v/60/1-ph, 2130 watts, 12.8 amps, NEMA L14-20P
- c. Model STANDARD Black designer color, standard
- d. Model 4"LEGS 4-inch adjustable legs, set of 4

**ITEM # M1-5**                    **HOT FOOD CABINET**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Cambro**  
**Model:**                        **PCU800HH615**

- a. Model PCU800HH615 Pro Cart Ultra™ Hot Food Pan Carrier, electric, touch screen, front loading, (2) active hot compartment, Nylon paddle-style latches, spring loaded magnetic door catch, 21.9"W x 34"D x 59"H, (4) 6"heavy duty casters (2 total locking, 2 no lock pin), (8) 4" deep GN 1/1 food pans, 115V/50/60/1-ph, 507 watts, 4.43 amps, cETLus, NSF

**ITEM # M1-6**                    **COLD FOOD CABINET**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Cambro**  
**Model:**                        **PCU800CC615**

- a. Model PCU800CC615 Pro Cart Ultra™ Cold Food Pan Carrier, electric, touch screen, front loading, 2 cold compartments, Nylon paddle-style latches, spring loaded magnetic door catch, 21.9"W x 34"D x 59"H, (4) 6"heavy duty casters (2 total locking, 2 no lock pin), (8) 4" deep GN 1/1 food pans, 115V/50/60/1-ph, 507 watts, 4.43 amps, cETLus

**ITEM # M1-7**                    **HAND SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Advance Tabco**  
**Model:**                        **7-PS-95**

- a. Model 7-PS-95 Hand Sink, pedestal mounted base, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, splash mounted faucet, soap & paper towel dispenser, pedal valves with easy access design, basket drain, wall bracket, NSF, cCSAus
- b. Model 7-PS-17 Welded Side Splash, 7-3/4"H (installed height), both sides, for hand sinks with 14" wide x 10" front-to-back bowl, splash mounted faucets

### **GHB – EVENT LEVEL GRAND HALL BAR**

**ITEM # GHB-1**                    **UNDERBAR HANDSINK**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12HS**

- a. Model TSF12HS TSF Series Underbar Hand Sink Unit, 12"W x 24"D, 10" wide x 14" front-to-back x 9-1/4" deep 18 gauge stainless steel sink, backsplash, 4" OC splash mount faucet holes, (16) oz. pump soap dispenser integrated into front apron, C-fold paper towel dispenser integrated into front apron, stainless steel hinged door with magnetic catches, 1-1/2" NPS male drain, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with 1" adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (4) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # GHB-2**                    **BRIDGE TRASH MODULE**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12BTB**

- a. Model TSF12BTB TSF Series Trash Receptacle Top Cover, 12"W x 24"D x 13-9/16"H, stainless steel construction (wastebasket is not included), 6"H backsplash, 8-3/8" x 6-3/8" opening for trash (requires support by adjacent underbar equipment or accessory end panel & leg kit)
- b. 6" Backsplash standard

**ITEM # GHB-3**                    **UNDERBAR DRAIN BOARD**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12DB**

- a. Model TSF12DB TSF Series Underbar Drainboard, 12"W x 24"D, pitched drainboard top, all stainless steel construction, backsplash, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.

- b. 6" backsplash
- c. (4) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Two (2) Model 1032968-12 TSF Series 12"W Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # GHB-4**                    **POS**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**            **BY OPERATIONS**  
**Model:**                        **POS**

- a. Model POS PROVIDED BY OPERATIONS

**ITEM # GHB-5**                    **UNDERBAR ICE WELL**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**            **Perlick Corporation**  
**Model:**                        **TS24IC10**

- a. Model TS24IC10 TS Series Underbar Ice Bin/Cocktail Unit, modular with cold plate, 24"W x 18-9/16"D, approximately 50-lb. ice capacity, 10-circuit aluminum cold plate concealed under bin liner, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF
- b. 6" Backsplash standard
- c. Model ICC24 Ice Chest Covers, 2-piece sliding assembly, 24"W, front & back, stainless steel.

**ITEM # GHB-5.1**                **SPEED RAIL / RACK**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**            **Perlick Corporation**  
**Model:**                        **SR-D24A**

- a. Model SR-D24A Speed Rail, double, 24" W, stainless steel construction, factory installed

**ITEM # GHB-6**                    **SODA GUN FILLER SECTION**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**            **Perlick Corporation**  
**Model:**                        **TSF4SGB**

- a. Model TSF4SGB TSF Series Soda Gun Filler Section, 4"W x 24"D x 22"H, all stainless steel construction, universal design accepts either Wunder-Bar® & Schroeder America™ 8-14 product soda manifolds & drip cups (accepts only NON-FLOW CONTROL manifolds that don't exceed 3" in overall thickness), interior mounted manifold conceals soda lines, tool-less removal of top cover provides easy access, integrated drip cup mounting allows concealed routing of drip tube to waste drain, accessory speed rails can bypass or terminate on Soda Gun Filler, soda manifold, hose gun & drip cup NOT included, NSF

**ITEM # GHB-7**                    **UNDERBAR BLENDER STATION W/ SINK**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**            **Perlick Corporation**  
**Model:**                        **TSF12BS**

- a. Model TSF12BS TSF Series Underbar Blender Station with 18 gauge stainless steel dump sink, 12"W, backsplash, 9-5/8" wide x 10-5/8" front-to-back x 6" deep sink, 4" OC splash mount faucet holes, recessed blender shelf with access hole & installed junction box, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (4) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # GHB-8**                    **UNDERBAR ICE WELL**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TS30IC10**

- a. Model TS30IC10 TS Series Underbar Ice Bin/Cocktail Unit, modular with cold plate, 30"W x 18-9/16"D, approximately 70-lb. ice capacity, 10-circuit aluminum cold plate concealed under bin liner, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF
- b. 6" Backsplash standard
- c. Model ICC30 Ice Chest Covers, 2-piece sliding assembly, 30"W, front & back, stainless steel.

**ITEM # GHB-8.1**                **SPEED RAIL / RACK**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **SR-D30A**

- a. Model SR-D30A Speed Rail, double, 30" W, stainless steel construction, factory installed

**ITEM # GHB-9**                    **UNDERBAR STORAGE CABINET**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF24SC**

- a. Model TSF24SC Underbar Storage Cabinet 24"W x 24"D, 4" or 6"H backsplash with 1" return at top, pitched drainboard top with 1-1/2" NPS drain socket with 1/2" OD barb & 1/2" ID anti-microbial tubing, 1-1/2" NPS male drain center back of cabinet bottom, (1) adjustable intermediate shelf, stainless steel construction, Perlick Quick Clamp stainless steel legs & adjustable feet, NSF.
- b. 6" backsplash
- c. (4) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 1032968-24 TSF Series 24"W Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- e. Model SC-ES-L End Splash, left, for storage cabinets
- f. Model SC-ES-R End Splash, right, for storage cabinets

**ITEM # GHB-10                      UNDERBAR 3 COMPARTMENT SINK**  
**Quantity:                              One (1)**  
**Manufacturer:                        Perlick Corporation**  
**Model:                                    TS60M3-DB**

- a. Model TS60M3-DB TS Series Underbar Multi-tank Sink Unit, three 18 gauge stainless steel compartment, 60"W x 18-9/16"D, backsplash, 10" wide x 14" front-to-back x 9-1/4" deep compartments, 12" pitched drainboard top on left & right, 4" OC (TS) splash or (TSF) deck mount faucet holes, seamless 18 gauge stainless steel front apron, includes 1-1/2" drains & 8-1/2" removable overflow standpipes, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" backsplash
- c. (2) Model ZZPERL1040635 TS Series, Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- d. Model 934-10LF Front Loading Faucet, wall/splash mount, lead free, 10" swing spout, faucet valves include built-in check valves to prevent back flow or cross flow, (2) 3/8" O.D. x 3/8" O.D. x 18" braided stainless steel supply lines included
- e. (3) Model 54965-1 Drain Screen, for 1-1/2" drain socket

**ITEM # GHB-11                      BACK BAR CABINET, REFRIGERATED**  
**Quantity:                              Two (2)**  
**Manufacturer:                        Perlick Corporation**  
**Model:                                    BBS108**

- a. Model BBS108 Refrigerated Back Bar Cabinet, four-section, 108"W, self-contained refrigeration, 33.5 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 4.2 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Left
- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Left
- n. Door handle, second: full length stainless steel handle, 24"
- o. Shelving style, second: (3) flat shelves
- p. Door type, third: solid, black vinyl/field laminated
- q. Door hinge location, third: Right
- r. Door handle, third: full length stainless steel handle, 24"
- s. Shelving style, third: (3) flat shelves
- t. Door type, fourth: solid, black vinyl/field laminated
- u. Door hinge location, fourth: Right
- v. Door handle, fourth: full length stainless steel handle, 24"
- w. Shelving style, fourth: (3) flat shelves
- x. Crisp White LED
- y. Model 57787 Casters (3-3/4"), set of (6)

**ITEM # GHB-11.1      BACK BAR CABINET, REFRIGERATED**  
**Quantity:              One (1)**  
**Manufacturer:        Perlick Corporation**  
**Model:                 BBS108**

- a. Model BBS108 Refrigerated Back Bar Cabinet, four-section, 108"W, self-contained refrigeration, 33.5 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 4.2 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Left
- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Left
- n. Door handle, second: full length stainless steel handle, 24"
- o. Shelving style, second: (3) flat shelves
- p. Door type, third: solid, black vinyl/field laminated
- q. Door hinge location, third: Right
- r. Door handle, third: full length stainless steel handle, 24"
- s. Shelving style, third: (3) flat shelves
- t. Door type, fourth: solid, black vinyl/field laminated
- u. Door hinge location, fourth: Right
- v. Door handle, fourth: full length stainless steel handle, 24"
- w. Shelving style, fourth: (3) flat shelves
- x. Crisp White LED
- y. Model 57787 Casters (3-3/4"), set of (6)

**ITEM # GHB-12      FROZEN DRINK MACHINE**  
**Quantity:              Four (4)**  
**Manufacturer:        Taylor Company**  
**Model:                 432**

- a. Model 432 Two flavor frozen beverage freezer, counter model, gravity fed, air-cooled, self-contained, (2) 12 QT hopper, (2) 4 QT freezing cylinders, indicator lights, automatic consistency control, lighted display, stainless steel finish, R449A, (2) 1/4 HP beater motor, NSF, cULus listed.
- b. Air-cooled
- c. (1) 208-230V/60/1-ph, Air-Cooled, (1) 14 amp

**ITEM # GHB-13      BAG-IN-BOX RACK**  
**Quantity:              One (1)**  
**Manufacturer:        By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER



**ITEM # GHB-13.1      CARBONATOR**  
**Quantity:            One (1)**  
**Manufacturer:        By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # GHB-14        ICE MACHINE**  
**Quantity:            One (1)**  
**Manufacturer:        Hoshizaki**  
**Model:                KM-660MWJ**

- a. Model KM-660MWJ Ice Maker, Cube-Style, 22"W, water-cooled, self-contained condenser, production capacity up to 647 lb/24 hours at 70°/50° (630 lb AHRI certified at 90°/70°), stainless steel finish, crescent cube style, R-404A refrigerant, 115v/60/1-ph, 12.35 amps, NSF, UL

**ITEM # GHB-14.1     ICE BIN**  
**Quantity:            One (1)**  
**Manufacturer:        Hoshizaki**  
**Model:                B-500SF**

- a. Model B-500SF Ice Bin, 30"W, top-hinged front-opening door, 500-lb ice storage capacity, for top-mounted ice maker, stainless steel exterior, painted legs included, protected with H-GUARD Plus Antimicrobial Agent, ETL, ETL-Sanitation  
b. Model HS-2033 Top Kit, 8", ABS  
c. Model LP-6 LEG Leg Package, (4) x 6" stainless steel legs  
d. Model HS-5607 Scoop Holder Kit

**ITEM # GHB-14.2     WATER FILTER**  
**Quantity:            One (1)**  
**Manufacturer:        Hoshizaki**  
**Model:                H9320-51**

- a. Model H9320-51 Water Filtration System, single configuration, 18.4" H

**ITEM # GHB-15        FLOOR TROUGH**  
**Quantity:            One (1)**  
**Manufacturer:        Atlanta Custom Fabricators**  
**Model:                FT**

- a. Model FT Stainless steel floor trough, 2'-6" long X 1'-0" wide, 2" deep, constructed of 14 gauge type 304 stainless steel with perimeter stainless steel anchor tabs welded approximately 12" O.C., removable washable 1" X 1/4" fiber grate. Grating flat bars to be parallel to pour pattern to minimize splash. Provide with 4" O.D. tailpiece drain connection and removable stainless steel scrap basket.  
b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # GHB-16        MOP SINK CABINET**  
**Quantity:            One (1)**  
**Manufacturer:        Advance Tabco**  
**Model:                9-OPC-84DL**

- a. Model 9-OPC-84DL Cabinet with Mop Sink, 50-3/8"W x 22-3/4"D x 84"H O.A., double hinged doors, left side mop sink 20"W x 16"D front to back x 12" deep (drain included), storage for mop bucket to roll in on right, (2) mop holders, (4) fixed intermediate shelves (3 on right, 1 on left above sink), slotted side panels for ventilation, 16/304 series stainless steel sink bowl, 18/304 series sink bowl apron, 18/430 series stainless steel cabinet, NSF
- b. Model K-240 Service Sink Faucet, wall mount, heavy duty, 8" OC, 6-1/2" spout, with hose thread & pail hook, vacuum breaker spout, wall braced, chrome-plated brass
- c. Model K-610CF Perforated bottom strainer plate, stainless steel, removable, sits 1" above bottom of sink, fits Advance Tabco Fabricated 16" x 20" sink bowls only

**CB1 – CONCOURSE LEVEL BAR 1**

**ITEM # CB1-1                      UNDERBAR BLENDER STATION W/ SINK**  
**Quantity:                            One (1)**  
**Manufacturer:                      Perlick Corporation**  
**Model:                                TSF12BS**

- a. Model TSF12BS TSF Series Underbar Blender Station with 18 gauge stainless steel dump sink, 12"W, backsplash, 9-5/8" wide x 10-5/8" front-to-back x 6" deep sink, 4" OC splash mount faucet holes, recessed blender shelf with access hole & installed junction box, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # CB1-2                      BRIDGE TRASH MODULE**  
**Quantity:                            One (1)**  
**Manufacturer:                      Perlick Corporation**  
**Model:                                TSF12BTB**

- a. Model TSF12BTB TSF Series Trash Receptacle Top Cover, 12"W x 24"D x 13-9/16"H, stainless steel construction (wastebasket is not included), 6"H backsplash, 8-3/8" x 6-3/8" opening for trash (requires support by adjacent underbar equipment or accessory end panel & leg kit)
- b. 6" Backsplash standard

**ITEM # CB1-3                      UNDERBAR ICE WELL**  
**Quantity:                            One (1)**  
**Manufacturer:                      Perlick Corporation**  
**Model:                                TS24IC**

- a. Model TS24IC TS Series Underbar Ice Bin/Cocktail Unit, modular, 24"W x 18-9/16"D, approximately 50-lb. ice capacity, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF
- b. 6" Backsplash standard

- c. Model ICC24 Ice Chest Covers, 2-piece sliding assembly, 24"W, front & back, stainless steel.

**ITEM # CB1-3.1**            **SPEED RAIL**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Perlick Corporation**  
**Model:**                **SR-D24A**

- a. Model SR-D24A Speed Rail, double, 24" W, stainless steel construction, factory installed

**ITEM # CB1-4**            **UNDERBAR DRAINBOARD**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Perlick Corporation**  
**Model:**                **TSF12DB**

- a. Model TSF12DB TSF Series Underbar Drainboard, 12"W x 24"D, pitched drainboard top, all stainless steel construction, backsplash, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" backsplash
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 1032968-12 TSF Series 12"W Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # CB1-5**            **POS**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **BY OPERATIONS**  
**Model:**                **POS**

- a. Model POS PROVIDED BY OPERATIONS

**ITEM # CB1-6**            **UNDERBAR 3 COMPARTMENT SINK**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Perlick Corporation**  
**Model:**                **TS48M3-DBL**

- a. Model TS48M3-DBL TS Series Underbar Multi-tank Sink Unit, three 18 gauge stainless steel compartment, 48"W x 18-9/16"D, backsplash, 10" wide x 14" front-to-back x 9-1/4" deep compartments, 12" pitched drainboard top on the left, 4" OC (TS) splash or (TSF) deck mount faucet holes, seamless 18 gauge stainless steel front apron, includes 1-1/2" drains & 8-1/2" removable overflow standpipes, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" backsplash
- c. (2) Model ZZPERL1040635 TS Series, Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- d. Model 934-10LF Front Loading Faucet, wall/splash mount, lead free, 10" swing spout, faucet valves include built-in check valves to prevent back flow or cross flow, (2) 3/8" O.D. x 3/8" O.D. x 18" braided stainless steel supply lines included
- e. (3) Model 54965-1 Drain Screen, for 1-1/2" drain socket

**ITEM # CB1-7**            **UNDERBAR HANDSINK**  
**Quantity:**            **One (1)**

**Manufacturer:** Perlick Corporation  
**Model:** TSF12HS

- a. Model TSF12HS TSF Series Underbar Hand Sink Unit, 12"W x 24"D, 10" wide x 14" front-to-back x 9-1/4" deep 18 gauge stainless steel sink, backsplash, 4" OC splash mount faucet holes, (16) oz. pump soap dispenser integrated into front apron, C-fold paper towel dispenser integrated into front apron, stainless steel hinged door with magnetic catches, 1-1/2" NPS male drain, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with 1" adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # CB1-8**                    **BACK BAR COOLER, 4 DOOR**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **BBS108**

- a. Model BBS108 Refrigerated Back Bar Cabinet, four-section, 108"W, self-contained refrigeration, 33.5 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 4.2 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Left
- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Left
- n. Door handle, second: full length stainless steel handle, 24"
- o. Shelving style, second: (3) flat shelves
- p. Door type, third: solid, black vinyl/field laminated
- q. Door hinge location, third: Right
- r. Door handle, third: full length stainless steel handle, 24"
- s. Shelving style, third: (3) flat shelves
- t. Door type, fourth: solid, black vinyl/field laminated
- u. Door hinge location, fourth: Right
- v. Door handle, fourth: full length stainless steel handle, 24"
- w. Shelving style, fourth: (3) flat shelves
- x. Crisp White LED
- y. Model 57787 Casters (3-3/4"), set of (6)

**ITEM # CB1-9**                    **FROZEN DRINK MACHINE**  
**Quantity:**                    **One (1)**

**Manufacturer:** Taylor Company  
**Model:** 432

- a. Model 432 Two flavor frozen beverage freezer, counter model, gravity fed, air-cooled, self-contained, (2) 12 QT hopper, (2) 4 QT freezing cylinders, indicator lights, automatic consistency control, lighted display, stainless steel finish, R449A, (2) 1/4 HP beater motor, NSF, cULus listed.
- b. Air-cooled
- c. 208-230v/60/1-ph, 14.0 amps

## **CB2 – CONCOURSE LEVEL BAR 2**

**ITEM # CB2-1**                    **UNDERBAR HANDSINK**  
**Quantity:** Two (2)  
**Manufacturer:** Perlick Corporation  
**Model:** TSF12HS

- a. Model TSF12HS TSF Series Underbar Hand Sink Unit, 12"W x 24"D, 10" wide x 14" front-to-back x 9-1/4" deep 18 gauge stainless steel sink, backsplash, 4" OC splash mount faucet holes, (16) oz. pump soap dispenser integrated into front apron, C-fold paper towel dispenser integrated into front apron, stainless steel hinged door with magnetic catches, 1-1/2" NPS male drain, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with 1" adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (4) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6", for TS or TSF series
- f. Model 7054L End Splash, left, 6", for TS or TSF series

**ITEM # CB2-2**                    **BRIDGE TRASH MODULE**  
**Quantity:** Two (2)  
**Manufacturer:** Perlick Corporation  
**Model:** TSF12BTB

- a. Model TSF12BTB TSF Series Trash Receptacle Top Cover, 12"W x 24"D x 13-9/16"H, stainless steel construction (wastebasket is not included), 6"H backsplash, 8-3/8" x 6-3/8" opening for trash (requires support by adjacent underbar equipment or accessory end panel & leg kit)
- b. 6" Backsplash standard

**ITEM # CB2-3**                    **SODA GUN STATION**  
**Quantity:** Two (2)  
**Manufacturer:** Perlick Corporation  
**Model:** TSF4SGB

- a. Model TSF4SGB TSF Series Soda Gun Filler Section, 4"W x 24"D x 22"H, all stainless steel construction, universal design accepts either Wunder-Bar® & Schroeder America™ 8-14 product soda manifolds & drip cups (accepts only NON-FLOW CONTROL manifolds that don't exceed 3" in overall thickness), interior mounted manifold conceals soda lines, tool-less removal of top cover provides easy access, integrated drip cup mounting allows

concealed routing of drip tube to waste drain, accessory speed rails can bypass or terminate on Soda Gun Filler, soda manifold, hose gun & drip cup NOT included, NSF

**ITEM # CB2-4**                    **UNDERBAR ICE WELL**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TS30IC10**

- a. Model TS30IC10 TS Series Underbar Ice Bin/Cocktail Unit, modular with cold plate, 30"W x 18-9/16"D, approximately 70-lb. ice capacity, 10-circuit aluminum cold plate concealed under bin liner, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF
- b. 6" Backsplash standard
- c. Model ICC30 Ice Chest Covers, 2-piece sliding assembly, 30"W, front & back, stainless steel.

**ITEM # CB2-4.1**                **SPEED RAIL**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **SR-D30A**

- a. Model SR-D30A Speed Rail, double, 30" W, stainless steel construction, factory installed

**ITEM # CB2-5**                    **UNDERBAR DRAINBOARD**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12DB**

- a. Model TSF12DB TSF Series Underbar Drainboard, 12"W x 24"D, pitched drainboard top, all stainless steel construction, backsplash, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet (replaces TSF12 TSD12)
- b. 6" backsplash
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 1032968-12 TSF Series 12"W Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # CB2-6**                    **UNDERBAR STORAGE CABINET**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF24SC**

- a. Model TSF24SC Underbar Storage Cabinet 24"W x 24"D, 4" or 6"H backsplash with 1" return at top, pitched drainboard top with 1-1/2" NPS drain socket with 1/2" OD barb & 1/2" ID anti-microbial tubing, 1-1/2" NPS male drain center back of cabinet bottom, (1) adjustable intermediate shelf, stainless steel construction, Perlick Quick Clamp stainless steel legs & adjustable feet, NSF.
- b. 6" backsplash
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs

- d. Model 1032968-24 TSF Series 24"W Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- e. Model DR24SC Field reversable door and lock set for 24"W storage cabinets, Factory Installed
- f. Model SC-ES-L End Splash, left, for storage cabinets
- g. Model SC-ES-R End Splash, right, for storage cabinets

**ITEM # CB2-7**                    **POS**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**            **BY OPERATIONS**  
**Model:**                        **POS**

- a. Model POS PROVIDED BY OPERATIONS

**ITEM # CB2-8**                    **UNDERBAR BLENDER STATION**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Perlick Corporation**  
**Model:**                        **TSF12BS**

- a. Model TSF12BS TSF Series Underbar Blender Station with 18 gauge stainless steel dump sink, 12"W, backsplash, 9-5/8" wide x 10-5/8" front-to-back x 6" deep sink, 4" OC splash mount faucet holes, recessed blender shelf with access hole & installed junction box, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6", for TS or TSF series
- f. Model 7054L End Splash, left, 6", for TS or TSF series

**ITEM # CB2-9**                    **UNDERBAR 3 COMPARTMENT SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Perlick Corporation**  
**Model:**                        **TS48M3-DBL**

- a. Model TS48M3-DBL TS Series Underbar Multi-tank Sink Unit, three 18 gauge stainless steel compartment, 48"W x 18-9/16"D, backsplash, 10" wide x 14" front-to-back x 9-1/4" deep compartments, 12" pitched drainboard top on the left, 4" OC (TS) splash or (TSF) deck mount faucet holes, seamless 18 gauge stainless steel front apron, includes 1-1/2" drains & 8-1/2" removable overflow standpipes, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" backsplash
- c. Model ZZPERL1040635 TS Series, Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- d. Model 934-10LF Front Loading Faucet, wall/splash mount, lead free, 10" swing spout, faucet valves include built-in check valves to prevent back flow or cross flow, (2) 3/8" O.D. x 3/8" O.D. x 18" braided stainless steel supply lines included
- e. (3) Model 54965-1 Drain Screen, for 1-1/2" drain socket

**ITEM # CB2-10**                  **BACK BAR COOLER, 4 DOOR**  
**Quantity:**                    **One (1)**

**Manufacturer:** Perlick Corporation  
**Model:** BBS108

- a. Model BBS108 Refrigerated Back Bar Cabinet, four-section, 108"W, self-contained refrigeration, 33.5 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 4.2 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Right
- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Left
- n. Door handle, second: full length stainless steel handle, 24"
- o. Shelving style, second: (3) flat shelves
- p. Door type, third: solid, black vinyl/field laminated
- q. Door hinge location, third: Right
- r. Door handle, third: full length stainless steel handle, 24"
- s. Shelving style, third: (3) flat shelves
- t. Door type, fourth: solid, black vinyl/field laminated
- u. Door hinge location, fourth: Right
- v. Door handle, fourth: full length stainless steel handle, 24"
- w. Shelving style, fourth: (3) flat shelves
- x. Crisp White LED
- y. Model 57787 Casters (3-3/4"), set of (6)

**ITEM # CB2-11**                    **BACK BAR COOLER, 4 DOOR**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Perlick Corporation**  
**Model:**                         **BBS108**

- a. Model BBS108 Refrigerated Back Bar Cabinet, four-section, 108"W, self-contained refrigeration, 33.5 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 4.2 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Left
- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Left
- n. Door handle, second: full length stainless steel handle, 24"



- o. Shelving style, second: (3) flat shelves
- p. Door type, third: solid, black vinyl/field laminated
- q. Door hinge location, third: Right
- r. Door handle, third: full length stainless steel handle, 24"
- s. Shelving style, third: (3) flat shelves
- t. Door type, fourth: solid, black vinyl/field laminated
- u. Door hinge location, fourth: Right
- v. Door handle, fourth: full length stainless steel handle, 24"
- w. Shelving style, fourth: (3) flat shelves
- x. Crisp White LED
- y. Model 57787 Casters (3-3/4"), set of (6)

**ITEM # CB2-12                      FROZEN DRINK MACHINE**  
**Quantity:                              Two (2)**  
**Manufacturer:                        Taylor Company**  
**Model:                                    432**

- a. Model 432 Two flavor frozen beverage freezer, counter model, gravity fed, air-cooled, self-contained, (2) 12 QT hopper, (2) 4 QT freezing cylinders, indicator lights, automatic consistency control, lighted display, stainless steel finish, R449A, (2) 1/4 HP beater motor, NSF, cULus listed.
- b. Air-cooled
- c. 208-230v/60/1-ph, 14.0 amps

### **CB3 – CONCOURSE LEVEL BAR 3**

**ITEM # CB3-1                      UNDERBAR HANDSINK**  
**Quantity:                              Two (2)**  
**Manufacturer:                        Perlick Corporation**  
**Model:                                    TSF12HS**

- a. Model TSF12HS TSF Series Underbar Hand Sink Unit, 12"W x 24"D, 10" wide x 14" front-to-back x 9-1/4" deep 18 gauge stainless steel sink, backsplash, 4" OC splash mount faucet holes, (16) oz. pump soap dispenser integrated into front apron, C-fold paper towel dispenser integrated into front apron, stainless steel hinged door with magnetic catches, 1-1/2" NPS male drain, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with 1" adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (4) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6", for TS or TSF series
- f. Model 7054L End Splash, left, 6", for TS or TSF series

**ITEM # CB3-2                      BRIDGE TRASH MODULE**  
**Quantity:                              Three (3)**  
**Manufacturer:                        Perlick Corporation**  
**Model:                                    TSF12BTB**

- a. Model TSF12BTB TSF Series Trash Receptacle Top Cover, 12"W x 24"D x 13-9/16"H, stainless steel construction (wastebasket is not included), 6"H backsplash, 8-3/8" x 6-3/8"

opening for trash (requires support by adjacent underbar equipment or accessory end panel & leg kit)

- b. 6" Backsplash standard

**ITEM # CB3-3                      UNDERBAR BLENDER STATION W/ SINK**  
**Quantity:                      Four (4)**  
**Manufacturer:                  Perlick Corporation**  
**Model:                          TSF12BS**

- a. Model TSF12BS TSF Series Underbar Blender Station with 18 gauge stainless steel dump sink, 12"W, backsplash, 9-5/8" wide x 10-5/8" front-to-back x 6" deep sink, 4" OC splash mount faucet holes, recessed blender shelf with access hole & installed junction box, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (8) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # CB3-4                      SODA GUN STATION**  
**Quantity:                      Four (4)**  
**Manufacturer:                  Perlick Corporation**  
**Model:                          TSF4SGB**

- a. Model TSF4SGB TSF Series Soda Gun Filler Section, 4"W x 24"D x 22"H, all stainless steel construction, universal design accepts either Wunder-Bar® & Schroeder America™ 8-14 product soda manifolds & drip cups (accepts only NON-FLOW CONTROL manifolds that don't exceed 3" in overall thickness), interior mounted manifold conceals soda lines, tool-less removal of top cover provides easy access, integrated drip cup mounting allows concealed routing of drip tube to waste drain, accessory speed rails can bypass or terminate on Soda Gun Filler, soda manifold, hose gun & drip cup NOT included, NSF

**ITEM # CB3-5                      UNDERBAR ICE WELL**  
**Quantity:                      Four (4)**  
**Manufacturer:                  Perlick Corporation**  
**Model:                          TS36IC10**

- a. Model TS36IC10 TS Series Underbar Ice Bin/Cocktail Unit, modular with cold plate, 36"W x 18-9/16"D, approximately 85-lb. ice capacity, 10-circuit aluminum cold plate concealed under bin liner, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF
- b. 6" Backsplash standard
- c. Model ICC36 Ice Chest Covers, 2-piece sliding assembly, 36"W, front & back, stainless steel.

**ITEM # CB3-5.1                  SPEED RAIL**  
**Quantity:                      Four (4)**

**Manufacturer:** Perlick Corporation  
**Model:** SR-D36A

- a. Model SR-D36A Speed Rail, double, 36" W, stainless steel construction, factory installed

**ITEM # CB3-6**                    **UNDERBAR STORAGE CABINET**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF24SC**

- a. Model TSF24SC Underbar Storage Cabinet 24"W x 24"D, 4" or 6"H backsplash with 1" return at top, pitched drainboard top with 1-1/2" NPS drain socket with 1/2" OD barb & 1/2" ID anti-microbial tubing, 1-1/2" NPS male drain center back of cabinet bottom, (1) adjustable intermediate shelf, stainless steel construction, Perlick Quick Clamp stainless steel legs & adjustable feet, NSF.
- b. 6" backsplash
- c. (8) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 1032968-24 TSF Series 24"W Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- e. Model DR24SC Field reversable door and lock set for 24"W storage cabinets
- f. Model SC-ES-L End Splash, left, for storage cabinets
- g. Model SC-ES-R End Splash, right, for storage cabinets

**ITEM # CB3-7**                    **POS**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**              **BY OPERATIONS**  
**Model:**                        **POS**

- a. Model POS PROVIDED BY OPERATIONS

**ITEM # CB3-8**                    **UNDERBAR DRAINBOARD**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12DB**

- a. Model TSF12DB TSF Series Underbar Drainboard, 12"W x 24"D, pitched drainboard top, all stainless steel construction, backsplash, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" backsplash
- c. (4) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 1032968-12 TSF Series 12"W Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction.

**ITEM # CB3-9**                    **UNDERBAR 3 COMPARTMENT SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TS60M3-DB**

- a. Model TS60M3-DB TS Series Underbar Multi-tank Sink Unit, three 18 gauge stainless steel compartment, 60"W x 18-9/16"D, backsplash, 10" wide x 14" front-to-back x 9-1/4" deep compartments, 12" pitched drainboard top on left & right, 4" OC (TS) splash or (TSF) deck mount faucet holes, seamless 18 gauge stainless steel front apron, includes

- 1-1/2" drains & 8-1/2" removable overflow standpipes, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" backsplash
  - c. Model ZZPERL1040635 TS Series, Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
  - d. Model 934-10LF Front Loading Faucet, wall/splash mount, lead free, 10" swing spout, faucet valves include built-in check valves to prevent back flow or cross flow, (2) 3/8" O.D. x 3/8" O.D. x 18" braided stainless steel supply lines included
  - e. (3) Model 54965-1 Drain Screen, for 1-1/2" drain socket

**ITEM # CB3-10**                    **BACK BAR COOLER, 3 DOOR**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **BBS84**

- a. Model BBS84 Refrigerated Back Bar Cabinet, three-section, 84"W, self-contained refrigeration, 24.8 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 4.2 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Right
- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Right
- n. Door handle, second: full length stainless steel handle, 24"
- o. Shelving style, second: (3) flat shelves
- p. Door type, third: solid, black vinyl/field laminated
- q. Door hinge location, third: Right
- r. Door handle, third: full length stainless steel handle, 24"
- s. Shelving style, third: (3) flat shelves
- t. Crisp White LED
- u. Model 57787 Casters (3-3/4"), set of (6)

**ITEM # CB3-11**                    **BACK BAR COOLER, 2 DOOR**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **BBS60**

- a. Model BBS60 Refrigerated Back Bar Cabinet, two-section, 60"W, self-contained refrigeration, 16 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/5 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 2.5 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Right

- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Right
- n. Door handle, second: full length stainless steel handle, 24"
- o. Shelving style, second: (3) flat shelves
- p. Crisp White LED
- q. Model 57786 Casters, 3-3/4", set of (4)

**ITEM # CB3-12                      BACK BAR COOLER, 3 DOOR**  
**Quantity:                              One (1)**  
**Manufacturer:                        Perlick Corporation**  
**Model:                                    BBS84**

- a. Model BBS84 Refrigerated Back Bar Cabinet, three-section, 84"W, self-contained refrigeration, 24.8 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 4.2 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Left
- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Left
- n. Door handle, second: full length stainless steel handle, 24"
- o. Shelving style, second: (3) flat shelves
- p. Door type, third: solid, black vinyl/field laminated
- q. Door hinge location, third: Right
- r. Door handle, third: full length stainless steel handle, 24"
- s. Shelving style, third: (3) flat shelves
- t. Crisp White LED
- u. Model 57787 Casters (3-3/4"), set of (6)

**ITEM # CB3-13                      UNDERCOUNTER SODA SYSTEM SYRUP RACK**  
**Quantity:                              Two (2)**  
**Manufacturer:                        By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # CB3-13.1                    CARBONATOR**  
**Quantity:                              Two (2)**  
**Manufacturer:                        By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # CB3-14**                    **FROZEN DRINK MACHINE**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**              **Taylor Company**  
**Model:**                        **432**

- a. Model 432 Two flavor frozen beverage freezer, counter model, gravity fed, air-cooled, self-contained, (2) 12 QT hopper, (2) 4 QT freezing cylinders, indicator lights, automatic consistency control, lighted display, stainless steel finish, R449A, (2) 1/4 HP beater motor, NSF, cULus listed.
- b. Air-cooled
- c. 208-230v/60/1-ph, 14.0 amps

#### **CB4 – CONCOURSE LEVEL BAR 4**

**ITEM # CB4-1**                    **UNDERBAR HANDSINK**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12HS**

- a. Model TSF12HS TSF Series Underbar Hand Sink Unit, 12"W x 24"D, 10" wide x 14" front-to-back x 9-1/4" deep 18 gauge stainless steel sink, backsplash, 4" OC splash mount faucet holes, (16) oz. pump soap dispenser integrated into front apron, C-fold paper towel dispenser integrated into front apron, stainless steel hinged door with magnetic catches, 1-1/2" NPS male drain, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with 1" adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (4) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # CB4-2**                    **BRIDGE TRASH MODULE**  
**Quantity:**                    **Three (3)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12BTB**

- a. Model TSF12BTB TSF Series Trash Receptacle Top Cover, 12"W x 24"D x 13-9/16"H, stainless steel construction (wastebasket is not included), 6"H backsplash, 8-3/8" x 6-3/8" opening for trash (requires support by adjacent underbar equipment or accessory end panel & leg kit)
- b. 6" Backsplash standard

**ITEM # CB4-3**                    **SODA GUN STATION**  
**Quantity:**                    **Three (3)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF4SGB**

- a. Model TSF4SGB TSF Series Soda Gun Filler Section, 4"W x 24"D x 22"H, all stainless steel construction, universal design accepts either Wunder-Bar® & Schroeder America™

8-14 product soda manifolds & drip cups (accepts only NON-FLOW CONTROL manifolds that don't exceed 3" in overall thickness), interior mounted manifold conceals soda lines, tool-less removal of top cover provides easy access, integrated drip cup mounting allows concealed routing of drip tube to waste drain, accessory speed rails can bypass or terminate on Soda Gun Filler, soda manifold, hose gun & drip cup NOT included, NSF

**ITEM # CB4-4**                    **UNDERBAR ICE WELL**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TS24IC10**

- a. Model TS24IC10 TS Series Underbar Ice Bin/Cocktail Unit, modular with cold plate, 24"W x 18-9/16"D, approximately 50-lb. ice capacity, 10-circuit aluminum cold plate concealed under bin liner, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF
- b. 6" Backsplash standard
- c. Model ICC24 Ice Chest Covers, 2-piece sliding assembly, 24"W, front & back, stainless steel.

**ITEM # CB4-4.1**                **SPEED RAIL**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **SR-D24A**

- a. Model SR-D24A Speed Rail, double, 24" W, stainless steel construction, factory installed

**ITEM # CB4-5**                    **UNDERBAR STORAGE CABINET**  
**Quantity:**                    **Three (3)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF24SC**

- a. Model TSF24SC Underbar Storage Cabinet 24"W x 24"D, 4" or 6"H backsplash with 1" return at top, pitched drainboard top with 1-1/2" NPS drain socket with 1/2" OD barb & 1/2" ID anti-microbial tubing, 1-1/2" NPS male drain center back of cabinet bottom, (1) adjustable intermediate shelf, stainless steel construction, Perlick Quick Clamp stainless steel legs & adjustable feet, NSF Listed (replaces SC24)
- b. 6" backsplash
- c. (6) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 1032968-24 TSF Series 24"W Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- e. Model DR24SC Field reversable door and lock set for 24"W storage cabinets.
- f. Model SC-ES-L End Splash, left, for storage cabinets
- g. Model SC-ES-R End Splash, right, for storage cabinets

**ITEM # CB4-6**                    **POS**  
**Quantity:**                    **Three (3)**  
**Manufacturer:**              **BY OPERATIONS**  
**Model:**                        **POS**

- a. Model POS PROVIDED BY OPERATIONS

**ITEM # CB4-7**                    **UNDERBAR BLENDER STATION W/ SINK**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12BS**

- a. Model TSF12BS TSF Series Underbar Blender Station with 18 gauge stainless steel dump sink, 12"W, backsplash, 9-5/8" wide x 10-5/8" front-to-back x 6" deep sink, 4" OC splash mount faucet holes, recessed blender shelf with access hole & installed junction box, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (4) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # CB4-8**                    **UNDERBAR ICE WELL**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TS30IC10**

- a. Model TS30IC10 TS Series Underbar Ice Bin/Cocktail Unit, modular with cold plate, 30"W x 18-9/16"D, approximately 70-lb. ice capacity, 10-circuit aluminum cold plate concealed under bin liner, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF
- b. 6" Backsplash standard
- c. Model ICC30 Ice Chest Covers, 2-piece sliding assembly, 30"W, front & back, stainless steel.

**ITEM # CB4-8.1**                **SPEED RAIL**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **SR-D30A**

- a. Model SR-D30A Speed Rail, double, 30" W, stainless steel construction, factory installed

**ITEM # CB4-9**                    **UNDERBAR 3 COMPARTMENT SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TS48M3-DBL**

- a. Model TS48M3-DBL TS Series Underbar Multi-tank Sink Unit, three 18 gauge stainless steel compartment, 48"W x 18-9/16"D, backsplash, 10" wide x 14" front-to-back x 9-1/4" deep compartments, 12" pitched drainboard top on the left, 4" OC (TS) splash or (TSF) deck mount faucet holes, seamless 18 gauge stainless steel front apron, includes 1-1/2" drains & 8-1/2" removable overflow standpipes, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" backsplash



- c. Model ZZPERL1040635 TS Series, Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- d. Model 934-10LF Front Loading Faucet, wall/splash mount, lead free, 10" swing spout, faucet valves include built-in check valves to prevent back flow or cross flow, (2) 3/8" O.D. x 3/8" O.D. x 18" braided stainless steel supply lines included
- e. (3) Model 54965-1 Drain Screen, for 1-1/2" drain socket

**ITEM # CB4-10**                    **BACK BAR COOLER, 4 DOOR**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **BBS108**

- a. Model BBS108 Refrigerated Back Bar Cabinet, four-section, 108"W, self-contained refrigeration, 33.5 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 4.2 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Right
- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Left
- n. Door handle, second: full length stainless steel handle, 24"
- o. Shelving style, second: (3) flat shelves
- p. Door type, third: solid, black vinyl/field laminated
- q. Door hinge location, third: Right
- r. Door handle, third: full length stainless steel handle, 24"
- s. Shelving style, third: (3) flat shelves
- t. Door type, fourth: solid, black vinyl/field laminated
- u. Door hinge location, fourth: Right
- v. Door handle, fourth: full length stainless steel handle, 24"
- w. Shelving style, fourth: (3) flat shelves
- x. Crisp White LED
- y. Model 57787 Casters (3-3/4"), set of (6)

**ITEM # CB4-11**                    **BACK BAR COOLER, 4 DOOR**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **BBS108**

- a. Model BBS108 Refrigerated Back Bar Cabinet, four-section, 108"W, self-contained refrigeration, 33.5 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 4.2 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Left

- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Left
- n. Door handle, second: full length stainless steel handle, 24"
- o. Shelving style, second: (3) flat shelves
- p. Door type, third: solid, black vinyl/field laminated
- q. Door hinge location, third: Right
- r. Door handle, third: full length stainless steel handle, 24"
- s. Shelving style, third: (3) flat shelves
- t. Door type, fourth: solid, black vinyl/field laminated
- u. Door hinge location, fourth: Right
- v. Door handle, fourth: full length stainless steel handle, 24"
- w. Shelving style, fourth: (3) flat shelves
- x. Crisp White LED
- y. Model 57787 Casters (3-3/4"), set of (6)

**ITEM # CB4-12                    UNDERCOUNTER SODA SYSTEM SYRUP RACK**  
**Quantity:                        One (1)**  
**Manufacturer:                    By Product Supplier**

- a. One (1) PROVIDED BY PRODUCT SUPPLIER

**ITEM # CB4-12.1                CARBONATOR**  
**Quantity:                        One (1)**  
**Manufacturer:                    By Product Supplier**

- a. One (1) PROVIDED BY PRODUCT SUPPLIER

**ITEM # CB4-13                    FROZEN DRINK MACHINE**  
**Quantity:                        Three (3)**  
**Manufacturer:                    Taylor Company**  
**Model:                             432**

- a. Model 432 Two flavor frozen beverage freezer, counter model, gravity fed, air-cooled, self-contained, (2) 12 QT hopper, (2) 4 QT freezing cylinders, indicator lights, automatic consistency control, lighted display, stainless steel finish, R449A, (2) 1/4 HP beater motor, NSF, cULus listed.
- b. Air-cooled
- c. 208-230v/60/1-ph, 14.0 amps

#### **CCM – CONCOURSE CORNER MARKET**

**ITEM # CCM-1                    REFRIGERATED MERCHANDISER**  
**Quantity:                        One (1)**  
**Manufacturer:                    True**  
**Model:                             GDM-49-HC~TSL01**

- a. Model GDM-49-HC~TSL01 Refrigerated Merchandiser, two-section, True standard look version 01, (8) shelves, (2) double pane thermal insulated glass hinged doors, LED

interior lights, powder coated steel exterior, white interior with stainless steel floor, R290 Hydrocarbon refrigerant, 1/2 HP, 115v/60/1-ph, 8.5 amps, NEMA 5-15P, cULus, UL EPH Classified, Made in USA, ENERGY STAR®

- b. Self-contained refrigeration standard
- c. Exterior: Black powder coated steel, standard
- d. Interior: White aluminum, with white shelving, standard
- e. Left door hinged left, right door hinged right standard
- f. Illuminated sign decal: S-TS-02 "TRUE Stripe" graphic, standard

**ITEM # CCM-2                      REFRIGERATED DISPLAY**

**Quantity:                      One (1)**

**Manufacturer:                Structural Concepts**

**Model:                         B57R**

- a. Model B57R Oasis® Refrigerated Self-Service Case, 59-5/8"W x 34-1/4"D x 82-1/4"H, Warmest average product temperature of 40°F or less, LED top light, (4) metal shelves, Breeze with self-contained refrigeration, condensate pan, magnetic air filter, non-locking casters with levelers, end panels with mirrored stainless interior, black exterior, R290 Hydrocarbon refrigerant, cETLus, ETL-Sanitation
- b. Exterior Color: Powder coated SCC Standard Silversan Black (FDA compliant)
- c. Interior Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- d. Lower Front Panel Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- e. Rear Exterior Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- f. Base support: Casters (non-locking) w/ levelers
- g. End Panel Left: Full with stainless steel mirror interior, standard
- h. End Panel Right: Full with stainless steel mirror interior, standard
- i. Cover/Curtain: Roll-down security cover, locking.
- j. Rear Doors: None (solid back panel), standard
- k. Shelving: Metal shelves (4), lighted (LED 4000K)
- l. Top Light: LED 4000K, standard
- m. Electrical Connection: 6' Straight blade power cord, standard
- n. Clean Sweep: None, standard
- o. Refrigeration: Breeze-E (Type II) self-contained refrigeration, standard
- p. Refrigerant: Hydrocarbon refrigerant (R290)
- q. Thermometer: Spirit filled thermometer, standard
- r. Heat Treated Crating: None, standard
- s. Vinyl Graphics: None, standard

**ITEM # CCM-3                      HEATED MERCHANDISER, OPEN DISPLAY**

**Quantity:                      One (1)**

**Manufacturer:                Structural Concepts**

**Model:                         B3632H**

- a. Model B3632H Oasis® Self-Service Heated Merchandiser, 36-3/4"W, high profile, flat upper front panel & header, open front, (4) lighted stainless steel shelves, top light, stainless steel interior, full end panels with mirror, casters, 6 ft cord, cETLus, ETL-Sanitation
- b. Exterior Color: Laminate standard color 909-58 Black
- c. Model GRAIN DIRECTION Standard laminate grain directions (when applicable):  
- Front Panels (Upper Header and Lower Panels): Horizontal grain direction

- End Panels: Vertical grain direction
- Blend & Reveal Cases Only: Horizontal grain direction on front and end panels
- d. Rear Doors: None (solid back panel), standard
- e. Rear Exterior Color: Black, standard
- f. Shelving: Individually controlled solid heated shelves
- g. Lower Front Panel Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- h. End Panel Left: Full with stainless steel mirror interior, standard
- i. End Panel Right: Full with stainless steel mirror interior, standard

**ITEM # CCM-4**                    **AMBIENT MERCHANDISER, OPEN DISPLAY**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Structural Concepts**  
**Model:**                        **B37D**

- a. Model B37D Oasis® Self-Service Case, non-refrigerated, 35-5/8"W x 34-1/4"D x 82-1/4"H, LED top light, (4) metal shelves, non-locking casters with levelers, end panels with mirrored stainless interior, black exterior, cETLus, ETL-Sanitation
- b. Exterior Color: Powder coated SCC Standard Silversan Black (FDA compliant)
- c. Interior Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- d. Lower Front Panel Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- e. Rear Exterior Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- f. Base support: Casters (non-locking) w/ levelers
- g. End Panel Left: Full with stainless steel mirror interior, standard
- h. End Panel Right: Full with stainless steel mirror interior, standard
- i. Cover/Curtain: Roll-down security cover, locking.
- j. Rear Doors: None (solid back panel), standard
- k. Shelving: Metal shelves (4), lighted (LED 4000K)
- l. Top Light: LED 4000K, standard
- m. Electrical Connection: 6' Straight blade power cord, standard
- n. Extended Warranty: None, standard
- o. Heat Treated Crating: None, standard
- p. Vinyl Graphics: None, standard

**ITEM # CCM-5**                    **POS, SELF-CHECKOUT**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **BY OPERATIONS**  
**Model:**                        **POS**

- a. Model POS PROVIDED BY OPERATIONS

### **CM1 – CONCOURSE LEVEL MARKET 1**

**ITEM # CM1-1**                    **HEATED MERCHANDISER, OPEN DISPLAY**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Structural Concepts**  
**Model:**                        **B3632H**

- a. Model B3632H Oasis® Self-Service Heated Merchandiser, 36-3/4"W, high profile, flat upper front panel & header, open front, (4) lighted stainless steel shelves, top light, stainless steel interior, full end panels with mirror, casters, 6 ft cord, cETLus, ETL-Sanitation

- b. Exterior Color: Laminate standard color 909-58 Black
- c. Model GRAIN DIRECTION Standard laminate grain directions (when applicable):
  - Front Panels (Upper Header and Lower Panels): Horizontal grain direction
  - End Panels: Vertical grain direction
  - Blend & Reveal Cases Only: Horizontal grain direction on front and end panels
- d. Rear Doors: None (solid back panel), standard
- e. Rear Exterior Color: Black, standard
- f. Shelving: Individually controlled solid heated shelves
- g. Lower Front Panel Color: Powder coated SCC Standard Silversan Black standard
- h. End Panel Left: Full with stainless steel mirror interior, standard
- i. End Panel Right: Full with stainless steel mirror interior, standard

**ITEM # CM1-2**                      **REFRIGERATED DISPLAY**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **Structural Concepts**  
**Model:**                         **B57R**

- a. Model B57R Oasis® Refrigerated Self-Service Case, 59-5/8"W x 34-1/4"D x 82-1/4"H, Warmest average product temperature of 40°F or less, LED top light, (4) metal shelves, Breeze with self-contained refrigeration, condensate pan, magnetic air filter, non-locking casters with levelers, end panels with mirrored stainless interior, black exterior, R290 Hydrocarbon refrigerant, cETLus, ETL-Sanitation
- b. Exterior Color: Powder coated SCC Standard Silversan Black (FDA compliant)
- c. Interior Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- d. Lower Front Panel Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- e. Rear Exterior Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- f. Base support: Casters (non-locking) w/ levelers
- g. End Panel Left: Full with stainless steel mirror interior, standard
- h. End Panel Right: Full with stainless steel mirror interior, standard
- i. Cover/Curtain: Roll-down security cover, locking.
- j. Rear Doors: None (solid back panel), standard
- k. Shelving: Metal shelves (4), lighted (LED 4000K)
- l. Top Light: LED 4000K, standard
- m. Electrical Connection: 6' Straight blade power cord, standard
- n. Clean Sweep: None, standard
- o. Refrigeration: Breeze-E (Type II) self-contained refrigeration, standard
- p. Refrigerant: Hydrocarbon refrigerant (R290)
- q. Thermometer: Spirit filled thermometer, standard
- r. Vinyl Graphics: None, standard

**ITEM # CM1-3**                      **REFRIGERATED SELF-SERVE ISLAND**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **Structural Concepts**  
**Model:**                         **FSI660R**

- a. Model FSI660R Oasis® Refrigerated Self-Service Island, 60"H, open air screen, (3) non-lit non-adjustable metal shelves, top light, black interior, includes price tag moulding (matches interior color), laminated exterior, levelers, Breeze-E (Type II) with EnergyWise self-contained refrigeration system, cETLus, ETL-Sanitation
- b. Refrigeration: Breeze self-contained refrigeration, standard

- c. Electrical Connection: 6' NEMA 6-30P, 208-240v/60/1-ph straight blade power cord, standard
- d. Base Support: Casters with levelers (self-cont.), standard
- e. Interior Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- f. Exterior Color: Laminate standard color 909-58 Black
- g. Model GRAIN DIRECTION Standard laminate grain directions (when applicable):
  - Front Panels (Upper Header and Lower Panels): Horizontal grain direction
  - End Panels: Vertical grain direction
  - Blend & Reveal Cases Only: Horizontal grain direction on front and end panels
- h. Thermometer: Digital fahrenheit thermometer, standard
- i. Shelving: (3) LED Lighted non-adjustable metal shelves

**ITEM # CM1-4**                    **ICE MAKER**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Ice-O-Matic**  
**Model:**                        **CIM0836FA**

- a. Model CIM0836FA Elevation Series™ Modular Cube Ice Maker, air-cooled, self-contained condenser, dual exhaust top/side air discharge, 30" W, approximately 896 lb production/24 hours at 70°/50° (711 lb at 90°/70°), full-size cubes, PURE ICE® built-in antimicrobial protection, LED status display, one touch sanitize/descaling controls, dishwasher safe food zone components, cULus, NSF, CE, BPA Free
- b. 208-230v/60/1-ph, 13.4 amps, standard

**ITEM # CM1-4.1**                **SODA DISPENSER**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # CM1-4.2**                **WATER FILTER**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Ice-O-Matic**  
**Model:**                        **IFQ2**

- a. Model IFQ2 Water Filter Manifold, dual filter designed for ice makers producing between 1050 & 1400 lbs. (476.3 to 635 Kg.) of ice per day, 3.0 gpm maximum flow rate, IsoNet® scale inhibitor, .5 micron particle reduction.

**ITEM # CM1-5**                    **UNDERCOUNTER SODA SYSTEM SYRUP RACK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # CM1-5.1**                **CARBONATOR**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **By Product Supplier**

- a. One (1) PROVIDED BY PRODUCT SUPPLIER

**ITEM # CM1-6**                    **CONDIMENT CADDY**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Dispense-Rite**

**Model: NLO-STK-1BT**

- a. Model NLO-STK-1BT Lid, Straw & Condiment Organizer, 7-1/8" H x 8" W x 19-1/8" D, narrow, removable section dividers, polystyrene, black

**ITEM # CM1-7 POS, SELF-CHECKOUT**

**Quantity: Four (4)**  
**Manufacturer: BY OPERATIONS**  
**Model: POS**

- a. Model POS PROVIDED BY OPERATIONS

**ITEM # CM1-8 ROLL-IN REFRIGERATOR**

**Quantity: One (1)**  
**Manufacturer: Delfield**  
**Model: GARRI1P-S**

- a. Model GARRI1P-S Specification Line® Refrigerator, Roll-In, one-section, 37.0 cubic feet capacity, top-mounted self-contained refrigeration system, (1) full-height hinged solid door (locking), 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, 1" tall stainless steel ramp, stainless steel exterior front, sides & interior, GreenGenius™ R290 Hydrocarbon refrigerant, 0.35 HP, 115v/60/1-ph, 6.0 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®
- b. Full height solid door, standard
- c. Door hinged on left

**ITEM # CM1-9 ROLL-IN HEATED CABINET**

**Quantity: One (1)**  
**Manufacturer: Delfield**  
**Model: GAHRI2-S**

- a. Model GAHRI2-S Specification Line® Heated Cabinet, Roll-In, two-section, 76.5 cubic feet capacity, (2) full-height hinged solid doors (locking), 4.3" easyTouch® screen temperature display/control with remote monitoring, incandescent interior lighting, 1" tall stainless steel ramp, stainless steel exterior front, sides & interior, 208-240v/60/1-ph, 10.5 amps, NEMA 6-20P, NSF, cULus, ENERGY STAR®
- b. Left door hinged on left, right door hinged on right, standard
- c. Full height solid doors, standard
- d. Model AS269-AFJ-0043 Raised Ramp, for roll in/roll thru, standard

**ITEM # CM1-10 UNIVERSAL ROLL-IN RACK**

**Quantity: Three (3)**  
**Manufacturer: Cres Cor**  
**Model: 207UA12AC**

- a. Model 207UA12AC Rack, Roll-In Refrigerator, open frame design, (12) universal slides for 12" x 20" thru 18" x 26" pans on 4-1/2" centers, adjustable at 1-1/2" intervals, welded extruded aluminum frame, NSF
- b. Model 1032 001 Pan Stop, mounted to rear, prevents accidental push through of pans
- c. Model 1056 002 Corner Bumpers, add 2" to OA dimensions, non-marking, gray

**ITEM # CM1-11 HAND SINK**

**Quantity: One (1)**  
**Manufacturer: Advance Tabco**

**Model:** 7-PS-66

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus

**ITEM # CM1-12**                    **STORAGE SHELVING**  
**Quantity:**                    **Five (5) – (1 COMPLETE UNIT 5 SHELVES)**  
**Manufacturer:**              **Metro**  
**Model:**                        **2142NK3**

- a. Model 2142NK3 Quick Ship - Super Erecta® Shelf, wire, 42"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. (4) Model 86PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 86-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

## **CM2 – CONCOURSE LEVEL MARKET 2**

**ITEM # CM2-1**                    **HEATED SELF-SERVE DISPLAY CASE**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Structural Concepts**  
**Model:**                        **GHSS856HLB**

- a. Model GHSS856HLB Fusion® Heated Self-Service Case, 97-1/2"W x 30-1/8"D x 55-3/8"H, Heated deck and shelving, LED top & shelf lights, stainless steel rear exterior, (3) solid heated shelves, cETLus, ETL-Sanitation
- b. Exterior Color: Laminate standard color 909-58 Black
- c. Model GRAIN DIRECTION Standard laminate grain directions (when applicable):  
- Front Panels (Upper Header and Lower Panels): Horizontal grain direction  
- End Panels: Vertical grain direction  
- Blend & Reveal Cases Only: Horizontal grain direction on front and end panels
- d. Interior Color: Stainless steel, standard
- e. Lower Front Panel Color: Powder coated SCC Standard Silversan Black
- f. Base Support: Rail system for shims, standard
- g. Bumper Front: 1" Boston bumper (specify color), standard
- h. Bumper note: Standard Boston colors Black, Silver Gray & Cool Gray
- i. Bumper Left End: None, standard
- j. Bumper Right End: None, standard
- k. End panel left: Full with stainless steel mirror interior, standard
- l. End Panel Right: Full with stainless steel mirror interior, standard
- m. Rear Doors: None (solid back panel), standard
- n. Shelving: Solid heated shelves, 3 levels, standard
- o. Lights: LED 3500K with frost lens, standard
- p. Electrical Connection: Electrical leads (remote)

**ITEM # CM2-2**                    **FREEZER MERCHANDISER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **True**  
**Model:**                        **GDM-72F-HC~TSL01**



- a. Model GDM-72F-HC~TSL01 Freezer Merchandiser, three-section, True standard look version 01, -10°F, (12) shelves, (3) triple-pane thermal glass hinged door, LED interior lights, powder coated steel exterior, white interior with stainless steel floor, R290 Hydrocarbon refrigerant, All Units Manufactured Before April 4th, 2021 are pre-wired at the factory and is ready for final connection to a single 115/208-230/60Hz single phase, NEMA 14-20R dedicated outlet. All Units Manufactured After April 4th, 2021 are pre-wired at the factory and is ready for final connection to a single 115/60Hz single phase, NEMA 5-20R dedicated outlet cULus, UL EPH Classified, Made in USA
- b. Self-contained refrigeration standard
- c. Exterior: White powder coated steel, standard
- d. Interior: White aluminum, with white shelving, standard
- e. Left door hinged left, center & right doors hinged right, standard
- f. Illuminated sign decal: S-TS-02 "TRUE Stripe" graphic, standard

**ITEM # CM2-3                      REFRIGERATED MERCHANDISER**  
**Quantity:                          Three (3)**  
**Manufacturer:                      True**  
**Model:                                GDM-49-HC~TSL01**

- a. Model GDM-49-HC~TSL01 Refrigerated Merchandiser, two-section, True standard look version 01, (8) shelves, (2) double pane thermal insulated glass hinged doors, LED interior lights, powder coated steel exterior, white interior with stainless steel floor, R290 Hydrocarbon refrigerant, 1/2 HP, 115v/60/1-ph, 8.5 amps, NEMA 5-15P, cULus, UL EPH Classified, Made in USA, ENERGY STAR®
- b. Self-contained refrigeration standard
- c. Exterior: Black powder coated steel, standard
- d. Interior: White aluminum, with white shelving, standard
- e. Left door hinged left, right door hinged right standard
- f. Illuminated sign decal: S-TS-02 "TRUE Stripe" graphic, standard

**ITEM # CM2-4                      POS, SELF-CHECKOUT**  
**Quantity:                          Four (4)**  
**Manufacturer:                      BY OPERATIONS**  
**Model:                                POS**

- a. Model POS PROVIDED BY OPERATIONS

### **CM3 – CONCOURSE LEVEL MARKET 3**

**ITEM # CM3-1                      HAND SINK**  
**Quantity:                          Two (2)**  
**Manufacturer:                      Advance Tabco**  
**Model:                                7-PS-95**

- a. Model 7-PS-95 Hand Sink, pedestal mounted base, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, splash mounted faucet, soap & paper towel dispenser, pedal valves with easy access design, basket drain, wall bracket, NSF, cCSAus
- b. Model 7-PS-17 Welded Side Splash, 7-3/4"H (installed height), both sides, for hand sinks with 14" wide x 10" front-to-back bowl, splash mounted faucets

**ITEM # CM3-2                      WORK TABLE**  
**Quantity:                          One (1)**  
**Manufacturer:                      Atlanta Custom Fabricators**

**Model:** **WT**

- a. Model WT Work table, all stainless steel construction, 5'-6" long X 2'-6" wide X 36" high. Table to be fully welded construction with all welds fully ground and polished to a uniform finish. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges, 4" back splash and left end splash with 2" return on 45 degree angle and 1" turned down, attach with stainless steel Z clips, stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Unit to be further constructed in accordance with shop drawings  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM3-2.1** **WALL MOUNTED OVER SHELF**  
**Quantity:** **One (1)**  
**Manufacturer:** **Atlanta Custom Fabricators**  
**Model:** **WMO**

- a. Model WMO Wall mounted over shelf, 5'-6" long X 12" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM3-3** **HOT FOOD HOLDING CABINET**  
**Quantity:** **One (1)**  
**Manufacturer:** **Alto-Shaam**  
**Model:** **750-CTUS**

- a. Model 750-CTUS Halo Heat® Hot Food Storage Unit, 1-compartment, capacity (6) 12" x 20" full-size pans, French doors with (2) positive latch door handles, ON/OFF adjustable thermostat, indicator light, exterior temperature gauge, thermostat for 60° F - 200° F, stainless steel exterior & interior, EcoSmart®, cULus, NSF
- b. 120v/50/60/1-ph, 18.8 amps, 2.25kW, NEMA L5-30P
- c. Model 14227 Casters, 3" (76mm), set of (4)

**ITEM # CM3-4** **EXHAUST HOOD**  
**Quantity:** **One (1)**  
**Manufacturer:** **Accurex**  
**Model:** **XBEW-104-S**

- a. Model XBEW-104-S  
 A. Type I, exhaust only wall canopy suitable for all types of cooking applications. The hood(s) shall be U.L. 710 Listed without a fire damper (with optional) for medium, heavy, or extra-heavy duty rated cooking appliances. Make-up air shall be independently provided. The hood(s) exterior shall be constructed of a minimum of 18-gauge 300 series stainless steel. The hood(s) shall be constructed using the standing seam method for optimum strength and with a Performance Enhancing Lip (PEL) to improve capture efficiency by turning air back into the hood. Front panels shall be of single wall construction. An integral 3-inch air space is provided to meet NFPA® 96 clearance requirements against limited combustible walls. Integral 3-inch air space may be omitted for non-combustible construction. All seams, joints and penetrations of the hood enclosure shall be welded and/or liquid tight. Lighter material gauges, alternate material types and finishes are not acceptable. All unexposed interior surfaces shall be

constructed of a minimum 18-gauge corrosion resistant stainless steel including, but not limited to ducts, plenum, and brackets.

B. The hood(s) shall include a filter housing constructed of the same material as the hood. The filters shall be stainless steel baffle type (non-stick coating optional), U.L. 1046 Classified, and in sufficient number and size to ensure optimum performance. The filter housing shall terminate in a pitched, full length grease trough which shall drain into a removable grease container. These filters shall have a grease removal efficiency of 28% at 8 microns (16% from 3-10 microns) and static pressure drop of 0.5-0.6 in WC. Vapor proof, U.L.

C. LED light fixtures shall be pre-wired to a junction box located at the top of the hood for field connection. The wiring shall conform to the requirements of the NFPA® 70.

D. The canopy hood(s) shall be built in accordance with the NFPA® 96, IMC, UMC, and bear the NSF Seal of Approval. The hood manufacturer shall provide, on request, the necessary data that confirms compliance with the code authorities listed above.

E. Continuous Capture - UL listed connection to join multiple sections.

F. Provide Accurex Controls: XKC-CV-S Controls system shall be a UL listed outlet center which shall standardly consist of a NEMA-1 Stainless Steel Enclosure within a Stainless-Steel Enclosure Panel, Printed Circuit Board (PCB), with Full Color Touchscreen, audible alarm, sensor (s) and motor starters. The constant volume Accurex Controls shall utilize resistive type temperature sensors that are mounted in the capture tank of the hood to monitor exhaust air temperatures, and an optional room temperature sensor, shipped loose, to be installed to detect ambient air temperatures in the kitchen space. Temperature sensors shall be made of stainless steel and shall be installed in a UL approved coupling.

G. Fire System – Provide factory pre-piped for Ansul R-102 fire protection system located in an integral utility cabinet on the right end of the hood. The system shall provide surface, duct, and plenum protection for items of cooking equipment located beneath the hood in accordance with all applicable codes and provisions of NFPA 17A and 96. All system piping shall be concealed where possible with exposed portions of either chrome fittings or stainless-steel sleeving. The system shall be wired with shunt trip breaker and electric/gas shut-off valve serving items of cooking equipment beneath the hood to provide power and fuel shut-off in the event of system actuation.

H. Exhaust fan(s) and supply fan(s) to be supplied by Mechanical Contractor

I. 304 Stainless Steel inside and out. No galvanized metal.

J. Provide wall mounted fire cabinet.

K. Provide stainless steel backsplash for entire length of hood with 18" to extend right and 18" to extend left of the hood we applicable.

L. Provide stainless steel hood enclosure panel. Top of hood to have a minimum of 3" above the ceiling

**ITEM # CM3-4.1**      **FIRE SYSTEM**  
**Quantity:**      **One (1)**  
**Manufacturer:**      **Accurex**  
**Model:**      **ANSUL**

a. Model ANSUL WALL MOUNT - INCLUDED WITH HOOD

**ITEM # CM3-5**      **HIGH VOLUME GRIDDLE**  
**Quantity:**      **One (1)**  
**Manufacturer:**      **Southbend**  
**Model:**      **HDG-48V**

- a. Model HDG-48V High Volume Griddle, countertop, gas, 48", 1" thick polished steel plate, thermostatic controls, battery spark ignition, flame failure safety device, stainless steel front, sides, towel bar & integrated stand, 120,000 BTU, CSA, NSF
- b. Natural Gas
- c. T&S Brass Model HG-2D-48SK-PS Safe-T-Link Gas Connector Kit, 3/4" connection, 48" hose, stainless steel braiding with extruded coating, (2) SwiveLink fittings, 360° rotatable hex nut, with 90° elbow & installation kit (includes restraining cable & ball valve), Posi-Set, 215,000 BTU/ hr minium flow capacity

**ITEM # CM3-6**                    **FRYER**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**            **Henny Penny**  
**Model:**                        **OFE321.0**

- a. Model OFE321.0 OFE-321 Open Fryer, floor model, electric, 1 well, stainless steel construction, rectangular fry pot, includes filter drain pan, stainless steel Max oil filtration system, 2 PHT filter envelopes, 4" swiveling casters (2 locking), basket support included in each vat, BUILT-TO-ORDER CONFIGURATION, ENERGY STAR®
- b. F Full well configuration, standard
- c. 480v/60/3-ph, 14.4 kW, 17.0 amps, 3+G wires
- d. C1 Computron® 1000 control with melt mode, idle mode, two 4-character LED displays per control
- e. Without direct connect shortening disposal system plumbing
- f. Full Size Basket
- g. Model 180156 Crumb Catcher, for single well drain pans
- h. Model 03629 Fryer Pot Cover, 32x full pot

**ITEM # CM3-7**                    **REACH-IN FREEZER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Delfield**  
**Model:**                        **GAF1P-SH**

- a. Model GAF1P-SH Specification Line® Freezer, Reach-In, one-section, 21.0 cubic feet capacity, top-mounted self-contained refrigeration system, (2) half-height hinged solid doors (locking), (3) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, pilaster with shelf clips, stainless steel exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.55 HP, 115v/60/1-ph, 7.2 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®
- b. Door hinged on left
- c. Set of (4) 5" locking casters, standard

**ITEM # CM3-8**                    **REFRIGERATED PREP TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Delfield**  
**Model:**                        **4448NP-12**

- a. Model 4448NP-12 Sandwich/Salad Top Refrigerator, two-section, 48" W, 16.0 cubic feet, (2) doors, stainless steel top with polyethylene cutting board & (12) 1/6 size plastic pans, ABS interior sides, stainless steel front & sides, 5" casters, front-breathing rear-mounted refrigeration system, R290 Hydrocarbon refrigerant, 0.3 hp, cUL, UL, NSF
- b. 115v/60/1-ph, NEMA 5-15P, standard
- c. Self-contained refrigeration, standard

- d. Door(s) standard
- e. Telescoping lid, standard
- f. MUST confirm the quantity of lids required per cutout

**ITEM # CM3-9                    SPARE NO.**

**ITEM # CM3-10                    STORAGE SHELVING**  
**Quantity:                        Four (4) – (1 COMPLETE UNIT 4 SHELVES)**  
**Manufacturer:                    Metro**  
**Model:                             2136NK3**

- a. Model 2136NK3 Quick Ship - Super Erecta® Shelf, wire, 36"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. Model 74UPK3 Quick Ship - Super Erecta® SiteSelect™ Post, 73-7/8"H, for use with stem casters, Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
- c. (2) Model 5PC Quick Ship - Super Erecta® Stem Caster, swivel, 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper
- d. (2) Model 5PCB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper

**ITEM # CM3-11                    3 COMPARTMENT SINK**  
**Quantity:                        One (1)**  
**Manufacturer:                    Advance Tabco**  
**Model:                             K7-CS-29**

- a. Model K7-CS-29 Convenience Store Sink, 3-compartment, with left & right-hand drainboards, 16" front-to-back x 14" W compartment, 12" deep with 8"H backsplash, stainless steel open frame base, side crossrails, adjustable metal bullet feet, 18 gauge 304 stainless steel, 11-5/8" drainboards, overall 21-1/2" F/B x 70" L/R  
OMIT FAUCET
- b. (2) Model K-472 Faucet hole revision
- c. (3) Model K-4 Support Bracket, for lever waste drain handle, (1) support required for each lever drain

**ITEM # CM3-11.1                FAUCET**  
**Quantity:                        Two (2)**  
**Manufacturer:                    T&S Brass**  
**Model:                             5F-8WLX10**

- a. Model 5F-8WLX10 Equip Faucet, 8" centers, wall mount, 10" swivel nozzle, lever handles, 2" flange, ceramic cartridges, low lead, ADA Compliant

**ITEM # CM3-12                    WALL SHELF W/ POT RACK**  
**Quantity:                        One (1)**  
**Manufacturer:                    Advance Tabco**  
**Model:                             PS-12-72**

- a. Model PS-12-72 Shelf with Pot Rack, wall-mounted, 72"W x 12"D, 18/430 stainless steel shelf, 2" x 1/4" stainless steel pot rack, includes: (9) plated double pot hooks, NSF

**ITEM # CM3-13**                    **1 COMPARTMENT SINK PREP TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **1CSPT**

- a. Model 1CSPT Prep table with 1-Compartment Sink, 5'-0" long X 2'-6" wide X 36" high, all 14 gauge type 304 stainless steel construction. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be provided with 8" high back splash, 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel Z-clips, marine edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flanged feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Sink to be 20" long X 20" wide X 12" deep, provided with T&S Brass #B-3950 Waste Valve, twist handle assembly for 3-1/2" sink opening, 2" drain outlet with 1-1/2" adapter and stainless steel lever waste bracket. Crease bottom of sink bowl to pitch to the drain. Provide stainless steel skirt to cover sink bowl.
- c. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- d. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM3-13.1**              **FAUCET**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **T&S Brass**  
**Model:**                        **B-0231-CR**

- a. Model B-0231-CR Faucet, 12" swing nozzle, 8" wall mount base, 1/2" NPT female Inlets, quarter-turn Cerama cartridges, low lead, ADA Compliant

**ITEM # CM3-14**                    **WALL MOUNTED OVER SHELF**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **WMO**

- a. Model WMO Wall mounted over shelf, 5'-0" long X 12" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM3-15**                    **REACH-IN REFRIGERATOR**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Delfield**  
**Model:**                        **GAR2P-S**

- a. Model GAR2P-S Specification Line® Refrigerator, Reach-In, two-section, 46.0 cubic feet capacity, top-mounted self-contained refrigeration system, (2) full-height hinged solid doors (locking), (6) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, stainless steel

exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.35 HP, 115v/60/1-ph, 6.0 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®

- b. Left door hinged on left, right door hinged on right, standard
- c. Set of (4) 5" locking casters, standard

**ITEM # CM3-16                    SPARE NO.**

**ITEM # CM3-17                    SPARE NO.**

**ITEM # CM3-18                    FREEZER MERCHANDISER**

**Quantity:                        One (1)**

**Manufacturer:                    True**

**Model:                             GDM-26F-HC~TSL01**

- a. Model GDM-26F-HC~TSL01 Freezer Merchandiser, one-section, True standard look version 01, -10°F, (4) shelves, (1) triple-pane thermal glass hinged door, LED interior lights, powder coated steel exterior, white interior with stainless steel floor, R290 Hydrocarbon refrigerant, 1 HP, 115v/60/1-ph, 9.5 amps, NEMA 5-15P, cULus, UL EPH Classified, Made in USA
- b. Self-contained refrigeration standard
- c. Exterior: Black powder coated steel
- d. Interior: White aluminum, with white shelving, standard
- e. Left door hinging
- f. Illuminated sign decal: S-TS-02 "TRUE Stripe" graphic, standard

**ITEM # CM3-19                    REFRIGERATED MERCHANDISER**

**Quantity:                        One (1)**

**Manufacturer:                    True**

**Model:                             GDM-49-HC~TSL01**

- a. Model GDM-49-HC~TSL01 Refrigerated Merchandiser, two-section, True standard look version 01, (8) shelves, (2) double pane thermal insulated glass hinged doors, LED interior lights, powder coated steel exterior, white interior with stainless steel floor, R290 Hydrocarbon refrigerant, 1/2 HP, 115v/60/1-ph, 8.5 amps, NEMA 5-15P, cULus, UL EPH Classified, Made in USA, ENERGY STAR®
- b. Self-contained refrigeration standard
- c. Exterior: Black powder coated steel, standard
- d. Interior: White aluminum, with white shelving, standard
- e. Left door hinged left, right door hinged right standard
- f. Illuminated sign decal: S-TS-02 "TRUE Stripe" graphic, standard

**ITEM # CM3-20                    DECORATIVE HEAT LAMP**

**Quantity:                        Three (3)**

**Manufacturer:                    Hatco**

**Model:                             DLH-725**

- a. DLH-725 Decorative Heat Lamp, High Wattage, (1) bulb type (not included), 8-1/2"H x 9-1/2" diameter shade, 375 watt max, CE, cULus, UL EPH Classified, Made in USA
- b. 120v/60/1-ph, 375 watt, standard
- c. Model WHITE-CTD-120H Lamp Bulb, 375 Watt clear, coated
- d. Model SPECIFY Finish to be selected by arch / interiors.
- e. Model SPECIFYN/C Finish to be selected by arch / interiors.

- f. Model RCT Mounting Style - Retractable mount to track adapter (specify cord & track color) - retractable Straight cord mount, 8-1/2" Shade adjusts from 27" to 77" & 10-1/2" Shade adjusts from 29" to 77"
- g. Model R Switch Location - Remote
- h. Model DL-CORD-BK Black Cord, standard,
- i. (1) Model DL-TRACK-4B Track Mount Bar, 4', black
- j. Model DL-ADAPT-BK Black Track Adapter

**ITEM # CM3-21                    HEATED SHELF FOOD WARMER**  
**Quantity:                    One (1)**  
**Manufacturer:                Hatco**  
**Model:                        GRSB-60-O**

- a. Model GRSB-60-O Glo-Ray® Drop In Heated Shelf with Recessed Top, 61-1/2" x 31-1/2", 1/2" deep recessed surface area, hardcoat aluminum top, control thermostat, illuminated on/off switch & mounting bracket, NSF, CE, cUL, UL, UL EPH Classified, CSA
- b. 120v/60/1-ph, 1750 watts, 14.6 amps, NEMA 5-20P (domestic voltage), standard
- c. Thermostat control with lighted rocker switch.

**ITEM # CM3-22                    DISPLAY MERCHANDISER, HEATED, FOR MULTI-PRODUCT**  
**Quantity:                    Two (2)**  
**Manufacturer:                Hatco**  
**Model:                        GR3SDS-39DCT**

- a. Model GR3SDS-39DCT Glo-Ray® Designer Slant Display Warmer, with curved canopy top, (14) rods, countertop, dual shelf, adjustable thermostat, hardcoated heated base, heated glass shelves, tempered glass side panels, LED display lights, built-in front sign holder (sign not included), 2-1/2" legs, cULus, UL EPH Classified, Made in USA, CE
- b. 120/208-240v/60/1-ph, 2130 watts, 12.8 amps, NEMA L14-20P
- c. Model STANDARD Black designer color, standard
- d. Model 4"LEGS 4-inch adjustable legs, set of 4

**ITEM # CM3-23                    POS, SELF-CHECKOUT**  
**Quantity:                    Four (4)**  
**Manufacturer:                BY OPERATIONS**  
**Model:                        POS**

- a. Model POS PROVIDED BY OPERATIONS

**ITEM # CM3-24                    LANDING TABLE**  
**Quantity:                    One (1)**  
**Manufacturer:                Advance Tabco**  
**Model:                        TFMS-123**

- a. Model TFMS-123 Equipment Filler Table, 12"W x 36"D, 16 gauge 304 stainless steel top with 1-1/2"H rear up-turn, stainless steel legs & adjustable bullet feet, NSF.

**ITEM # CM3-25                    MOP SINK CABINET**  
**Quantity:                    One (1)**  
**Manufacturer:                Advance Tabco**  
**Model:                        9-OPC-84**

- a. Model 9-OPC-84 Cabinet with Mop Sink, 25-3/16"W x 22-3/4"D x 84"H, mop sink base with drain (bowl 16" x 20" x 12"), left hinged door, (2) mop holders, (1) fixed intermediate



- shelf, slotted side panels for ventilation, 16/304 series stainless steel sink bowl, 18/304 series stainless steel sink bowl apron, 18/430 series stainless steel cabinet, NSF.
- b. Model K-240 Service Sink Faucet, wall mount, heavy duty, 8" OC, 6-1/2" spout, with hose thread & pail hook, vacuum breaker spout, wall braced, chrome-plated brass
  - c. Model K-610CF Perforated bottom strainer plate, stainless steel, removable, sits 1" above bottom of sink, fits Advance Tabco Fabricated 16" x 20" sink bowls only.

#### **CM4 – CONCOURSE LEVEL MARKET 4**

**ITEM # CM4-1**                      **REACH-IN REFRIGERATOR**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **Delfield**  
**Model:**                            **GAR1P-S**

- a. Model GAR1P-S Specification Line® Refrigerator, Reach-In, one-section, 21.0 cubic feet capacity, top-mounted self-contained refrigeration system, (1) full-height hinged solid door (locking), (3) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, stainless steel exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.22 HP, 115v/60/1-ph, 4.2 amps, NEMA 5-15P, NSF, cULus
- b. Door hinged on left
- c. Set of (4) 5" locking casters, standard

**ITEM # CM4-2**                      **EXHAUST HOOD W/FIRE SYSTEM**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **Accurex**  
**Model:**                            **XBEW-56.00-S**

- a. Model XBEW-56.00-S
  - A. Type I, exhaust only wall canopy suitable for all types of cooking applications. The hood(s) shall be U.L. 710 Listed without a fire damper (with optional) for medium, heavy, or extra-heavy duty rated cooking appliances. Make-up air shall be independently provided. The hood(s) exterior shall be constructed of a minimum of 18-gauge 300 series stainless steel. The hood(s) shall be constructed using the standing seam method for optimum strength and with a Performance Enhancing Lip (PEL) to improve capture efficiency by turning air back into the hood. Front panels shall be of single wall construction. An integral 3-inch air space is provided to meet NFPA® 96 clearance requirements against limited combustible walls. Integral 3-inch air space may be omitted for non-combustible construction. All seams, joints and penetrations of the hood enclosure shall be welded and/or liquid tight. Lighter material gauges, alternate material types and finishes are not acceptable. All unexposed interior surfaces shall be constructed of a minimum 18-gauge corrosion resistant stainless steel including, but not limited to ducts, plenum, and brackets.
  - B. The hood(s) shall include a filter housing constructed of the same material as the hood. The filters shall be stainless steel baffle type (non-stick coating optional), U.L. 1046 Classified, and in sufficient number and size to ensure optimum performance. The filter housing shall terminate in a pitched, full length grease trough which shall drain into a removable grease container. These filters shall have a grease removal efficiency of 28% at 8 microns (16% from 3-10 microns) and static pressure drop of 0.5-0.6 in WC. Vapor proof, U.L.
  - C. LED light fixtures shall be pre-wired to a junction box located at the top of the hood for field connection. The wiring shall conform to the requirements of the NFPA® 70.
  - D. The canopy hood(s) shall be built in accordance with the NFPA® 96, IMC, UMC, and bear the NSF Seal of Approval. The hood manufacturer shall provide, on request, the

necessary data that confirms compliance with the code authorities listed above.

E. Continuous Capture - UL listed connection to join multiple sections.

F. Provide Accurex Controls: XKC-CV-S Controls system shall be a UL listed outlet center which shall standardly consist of a NEMA-1 Stainless Steel Enclosure within a Stainless-Steel Enclosure Panel, Printed Circuit Board (PCB), with Full Color Touchscreen, audible alarm, sensor (s) and motor starters. The constant volume Accurex Controls shall utilize resistive type temperature sensors that are mounted in the capture tank of the hood to monitor exhaust air temperatures, and an optional room temperature sensor, shipped loose, to be installed to detect ambient air temperatures in the kitchen space. Temperature sensors shall be made of stainless steel and shall be installed in a UL approved coupling.

G. Fire System – Provide factory pre-piped for Ansul R-102 fire protection system located in an integral utility cabinet on the right end of the hood. The system shall provide surface, duct, and plenum protection for items of cooking equipment located beneath the hood in accordance with all applicable codes and provisions of NFPA 17A and 96. All system piping shall be concealed where possible with exposed portions of either chrome fittings or stainless-steel sleeving. The system shall be wired with shunt trip breaker and electric/gas shut-off valve serving items of cooking equipment beneath the hood to provide power and fuel shut-off in the event of system actuation.

H. Exhaust fan(s) and supply fan(s) to be supplied by Mechanical Contractor

I. 304 Stainless Steel inside and out. No galvanized metal.

J. Provide fire cabinet on right end of hood.

K. Provide stainless steel backsplash for entire length of hood with 18" to extend right and 18" to extend left of the hood we applicable.

L. Provide stainless steel hood enclosure panel. Top of hood to have a minimum of 3" above the ceiling.

**ITEM # CM4-3**                      **PRESSURE FRYER**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **Henny Penny**  
**Model:**                         **PFE561.0**

- a. Model PFE561.0 PFE-561 Pressure Fryer, Electric, 69 pound oil capacity, 18 pound food capacity, 12 psi o.p., safety valve @ 14.5 psi, stainless steel construction, stainless steel rectangular frypot, aluminum lid, stainless steel Max oil filter system with 2 PHT envelopes
- b. 480v/60/3-ph
- c. COMPUTRON 1000 Control, with melt mode, idle mode, time and 4-character LED display
- d. Short frame with (4) casters (2-locking)
- e. Without rinse hose attachment
- f. Standard basket, full-size basket and basket handle

**ITEM # CM4-4**                      **FRYER**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **Henny Penny**  
**Model:**                         **OFE321.0**

- a. Model OFE321.0 OFE-321 Open Fryer, floor model, electric, 1 well, stainless steel construction, rectangular fry pot, includes filter drain pan, stainless steel Max oil filtration system, 2 PHT filter envelopes, 4" swiveling casters (2 locking), basket support included in each vat, BUILT-TO-ORDER CONFIGURATION, ENERGY STAR®
- b. F Full well configuration, standard
- c. 480v/60/3-ph, 14.4 kW, 17.0 amps, 3+G wires

- d. C1 Computron® 1000 control with melt mode, idle mode, two 4-character LED displays per control
- e. Without direct connect shortening disposal system plumbing
- f. Full Size Basket
- g. Model 180156 Crumb Catcher, for single well drain pans
- h. Model 03629 Fryer Pot Cover, 32x full pot

**ITEM # CM4-4.1**            **LANDING TABLE**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Advance Tabco**  
**Model:**                **TFMS-153**

- a. Model TFMS-153 Equipment Filler Table, 15"W x 36"D, 16 gauge 304 stainless steel top with 1-1/2"H rear up-turn, stainless steel legs & adjustable bullet feet, NSF.

**ITEM # CM4-5**            **REACH-IN FREEZER**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Delfield**  
**Model:**                **GAF1P-SH**

- a. Model GAF1P-SH Specification Line® Freezer, Reach-In, one-section, 21.0 cubic feet capacity, top-mounted self-contained refrigeration system, (2) half-height hinged solid doors (locking), (3) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, pilaster with shelf clips, stainless steel exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.55 HP, 115v/60/1-ph, 7.2 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®
- b. Door hinged on right standard
- c. Set of (4) 5" locking casters, standard

**ITEM # CM4-6**            **STORAGE SHELVING**  
**Quantity:**            **Four (4) – (1 COMPLETE UNIT 4 SHELVES)**  
**Manufacturer:**      **Metro**  
**Model:**                **2136NK3**

- a. Model 2136NK3 Quick Ship - Super Erecta® Shelf, wire, 36"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. Model 74UPK3 Quick Ship - Super Erecta® SiteSelect™ Post, 73-7/8"H, for use with stem casters, Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
- c. (2) Model 5PC Quick Ship - Super Erecta® Stem Caster, swivel, 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper
- d. (2) Model 5PCB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper

**ITEM # CM4-7**            **3 COMPARTMENT SINK**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Advance Tabco**  
**Model:**                **K7-CS-29**

- a. Model K7-CS-29 Convenience Store Sink, 3-compartment, with left & right-hand drainboards, 16" front-to-back x 14" W compartment, 12" deep with 8"H backsplash, stainless steel open frame base, side crossrails, adjustable metal bullet feet, 18 gauge 304 stainless steel, 11-5/8" drainboards, overall 21-1/2" F/B x 70" L/R  
OMIT FAUCET
- b. (2) Model K-472 Faucet hole revision
- c. (3) Model K-4 Support Bracket, for lever waste drain handle, (1) support required for each lever drain
- d. Model K-454 Side splash, integral (welded), for NSF sinks & dish tables, height matches backsplash height - LEFT SIDE

**ITEM # CM4-7.1**            **FAUCET**  
**Quantity:**            **Two (2)**  
**Manufacturer:**       **T&S Brass**  
**Model:**                **5F-8WLX10**

- a. Model 5F-8WLX10 Equip Faucet, 8" centers, wall mount, 10" swivel nozzle, lever handles, 2" flange, ceramic cartridges, low lead, ADA Compliant

**ITEM # CM4-8**            **WALL SHELF W/ POT RACK**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Advance Tabco**  
**Model:**                **PS-12-72**

- a. Model PS-12-72 Shelf with Pot Rack, wall-mounted, 72"W x 12"D, 18/430 stainless steel shelf, 2" x 1/4" stainless steel pot rack, includes: (9) plated double pot hooks, NSF

**ITEM # CM4-9**            **HAND SINK**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Advance Tabco**  
**Model:**                **7-PS-66**

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus

**ITEM # CM4-10**         **SPARE NO.**

**ITEM # CM4-11**         **CONVEYOR TOASTER**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Antunes**  
**Model:**                **GST-2H-9210962**

- a. Model GST-2H-9210962 Gold Standard Toaster, horizontal, (2) lanes, dual-belt, moving conveyor, electronic temperature controller, programmable temperature & motor speed, 6 ft. grounded power cord, 2000 watts, 208v/50/60/1-ph, NEMA 6-20P, cETLus, ETL-Sanitation, CE

**ITEM # CM4-12**         **WORK TABLE**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Atlanta Custom Fabricators**  
**Model:**                **WT**

- a. Model WT Work table, all stainless steel construction, 6'-5" long X 2'-0" wide X 36" high. Table to be fully welded construction with all welds fully ground and polished to a uniform finish. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges, attach with stainless steel Z clips, stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished. Omit back splash at pass through window and coordinate height for a smooth transition. Provide trim strip and / or seal transition edge at pass through as required.
- b. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- c. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM4-13**                    **WORK TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **WT**

- a. Model WT Work table, all stainless steel construction, 7'-0" long X 2'-0" wide X 36" high. Table to be fully welded construction with all welds fully ground and polished to a uniform finish. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges, attach with stainless steel Z clips, stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- c. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM4-14**                    **DECORATIVE HEAT LAMP**  
**Quantity:**                    **Five (5)**  
**Manufacturer:**              **Hatco**  
**Model:**                        **DLH-725**

- a. Model DLH-725 Decorative Heat Lamp, High Wattage, (1) bulb type (not included), 8-1/2"H x 9-1/2" diameter shade, 375 watt max, CE, cULus, UL EPH Classified, Made in USA
- b. 120v/60/1-ph, 375 watt, standard
- c. Model WHITE-CTD-120H Lamp Bulb, 375 Watt clear, coated
- d. Model SPECIFY Finish to be selected by arch / interiors.
- e. Model SPECIFYN/C Finish to be selected by arch / interiors.
- f. Model RCT Mounting Style - Retractable mount to track adapter (specify cord & track color) - retractable Straight cord mount, 8-1/2" Shade adjusts from 27" to 77" & 10-1/2" Shade adjusts from 29" to 77"
- g. Model R Switch Location - Remote
- h. Model DL-CORD-BK Black Cord, standard,
- i. (1) Model DL-TRACK-8B Two 4' Track Mount Bars with Coupler, Black
- j. Model DL-ADAPT-BK Black Track Adapter

**ITEM # CM4-15            SPARE NO.**

**ITEM # CM4-16            SPARE NO.**

**ITEM # CM4-17            SPARE NO.**

**ITEM # CM4-18            REFRIGERATED DISPLAY**  
**Quantity:                Two (2)**  
**Manufacturer:            Structural Concepts**  
**Model:                    B47R**

- a. Model B47R Oasis® Refrigerated Self-Service Case, 47-5/8"W x 34-1/4"D x 82-1/4"H, Warmest average product temperature of 40°F or less, LED top light, (4) metal shelves, Breeze with self-contained refrigeration, condensate pan, magnetic air filter, non-locking casters with levelers, end panels with mirrored stainless interior, black exterior, R290 Hydrocarbon refrigerant, cETLus, ETL-Sanitation
- b. Exterior Color: Powder coated SCC Standard Silversan Black
- c. Interior Color: Powder coated SCC Standard Silversan Black
- d. Lower Front Panel Color: Powder coated SCC Standard Silversan Black
- e. Rear Exterior Color: Powder coated SCC Standard Silversan Black
- f. Base support: Casters (non-locking) w/ levelers
- g. End Panel Left: Full with stainless steel mirror interior, standard
- h. End Panel Right: Full with stainless steel mirror interior, standard
- i. Cover/Curtain: Roll-down security cover, locking (Requires two end panels (full or cutaway) per case) (One cover/curtain type per model)
- j. Rear Doors: Rear loading hinged doors, locking
- k. Shelving: Metal shelves (4), lighted (LED 4000K)
- l. Top Light: LED 4000K, standard
- m. Electrical Connection: 6' Straight blade power cord, standard
- n. Clean Sweep: None, standard
- o. Refrigeration: Breeze-E (Type II) self-contained refrigeration, standard
- p. Refrigerant: Hydrocarbon refrigerant (R290)
- q. Thermometer: Spirit filled thermometer, standard
- r. Vinyl Graphics: None, standard

**ITEM # CM4-19            HEATED MERCHANDISER**  
**Quantity:                Three (3)**  
**Manufacturer:            Hatco**  
**Model:                    GR3SDS-39DCT**

- a. Model GR3SDS-39DCT Glo-Ray® Designer Slant Display Warmer, with curved canopy top, (14) rods, countertop, dual shelf, adjustable thermostat, hardcoated heated base, heated glass shelves, tempered glass side panels, LED display lights, built-in front sign holder (sign not included), 2-1/2" legs, cULus, UL EPH Classified, Made in USA, CE
- b. 120/208-240v/60/1-ph, 2130 watts, 12.8 amps, NEMA L14-20P
- c. Model STANDARD Black designer color, standard
- d. Model 4"LEGS 4-inch adjustable legs, set of 4

**ITEM # CM4-20            REFRIGERATED SELF-SERVICE ISLAND**  
**Quantity:                One (1)**  
**Manufacturer:            Structural Concepts**  
**Model:                    FSI660R**

- a. Model FSI660R Oasis® Refrigerated Self-Service Island, 60"H, open air screen, (3) non-lit non-adjustable metal shelves, top light, black interior, includes price tag moulding (matches interior color), laminated exterior, levelers, Breeze-E (Type II) with EnergyWise self-contained refrigeration system, cETLus, ETL-Sanitation
- b. Refrigeration: Breeze self-contained refrigeration, standard
- c. Electrical Connection: 6' NEMA 6-30P, 208-240v/60/1-ph straight blade power cord, standard
- d. Base Support: Casters with levelers (self-cont.), standard
- e. Interior Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- f. Exterior Color: Laminate standard color 909-58 Black
- g. Model GRAIN DIRECTION Standard laminate grain directions (when applicable):
  - Front Panels (Upper Header and Lower Panels): Horizontal grain direction
  - End Panels: Vertical grain direction
  - Blend & Reveal Cases Only: Horizontal grain direction on front and end panels
- h. Thermometer: Digital fahrenheit thermometer, standard
- i. Shelving: (3) LED Lighted non-adjustable metal shelves
- j. Vinyl Graphics: None, standard

**ITEM # CM4-21                    ICE MAKER**  
**Quantity:                        Two (2)**  
**Manufacturer:                 Ice-O-Matic**  
**Model:                            CIM0836FA**

- a. CIM0836FA Elevation Series™ Modular Cube Ice Maker, air-cooled, self-contained condenser, dual exhaust top/side air discharge, 30" W, approximately 896 lb production/24 hours at 70°/50° (711 lb at 90°/70°), full-size cubes, PURE ICE® built-in antimicrobial protection, LED status display, one touch sanitize/descaling controls, dishwasher safe food zone components, cULus, NSF, CE, BPA Free
- b. 208-230v/60/1-ph, 13.4 amps, standard

**ITEM # CM4-21.1                SODA DISPENSER**  
**Quantity:                        Two (2)**  
**Manufacturer:                 By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # CM4-21.2                WATER FILTER**  
**Quantity:                        Two (2)**  
**Manufacturer:                 Ice-O-Matic**  
**Model:                            IFQ2**

- a. Model IFQ2 Water Filter Manifold, dual filter designed for ice makers producing between 1050 & 1400 lbs. (476.3 to 635 Kg.) of ice per day, 3.0 gpm maximum flow rate, IsoNet® scale inhibitor, .5 micron particle reduction.

**ITEM # CM4-22                    UNDERCOUNTER SODA SYSTEM SYRUP RACK**  
**Quantity:                        One (1)**  
**Manufacturer:                 By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # CM4-22.1                CARBONATOR**  
**Quantity:                        One (1)**  
**Manufacturer:                 By Product Supplier**

## a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # CM4-23**                    **CONDIMENT CADDY**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**                **Dispense-Rite**  
**Model:**                        **NLO-STK-1BT**

- a. Model NLO-STK-1BT Lid, Straw & Condiment Organizer, 7-1/8" H x 8" W x 19-1/8" D, narrow, removable section dividers, polystyrene, black

**ITEM # CM4-24**                    **POS, SELF-CHECKOUT**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**                **BY OPERATIONS**  
**Model:**                        **POS**

- a. Model POS PROVIDED BY OPERATIONS

**CM5 – CONCOURSE LEVEL MARKET 5**

**ITEM # CM5-1**                    **PIZZA PREP TABLE**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**                **Delfield**  
**Model:**                        **18672PDLP**

- a. Model 18672PDLP LiquiTec® Refrigerated Pizza Table, two-section, 72" W, (6) 12" x 20" pan capacity, (2) doors, (2) 1/1 GN shelves, stainless steel removable hinged covers, 17" polyurethane cutting board, flush mount LiquiTec® raised rails, on/off switch, 18 gauge stainless steel top, stainless steel construction, 4" casters, self-contained side-mounted refrigeration system, R290 refrigerant, 1/5 & 1/3 HP, cUL, UL, NSF
- b. 115v/60/1-ph, 12.7 amps, NEMA 5-20P, standard

**ITEM # CM5-2**                    **PIZZA PAN RACK**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**                **Admiral Craft Equipment Corp.**  
**Model:**                        **PZ-19029**

- a. Model PZ-19029 Pizza Rack, 27" high, 15 slots, holds pans 9" to 18" diameter, 1-3/8" spacing, chrome plated steel rods.  
 TO BE WALL MOUNTED

**ITEM # CM5-3**                    **PIZZA DECK OVEN**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**                **PizzaMaster**  
**Model:**                        **PM 823ED**

- a. Model PM 823ED PizzaMaster® 800 Series Pizza Oven, deck-type, electric, (3) decks, 32.3" W x 32.3" D internal dimensions per deck, (4) 16" pizza capacity per deck, digital display with electronic controls, 932°F max operating temperature, (2) 16"W stones per deck, timer, halogen lighting, Turbo-Start, oven door with heat-reflecting glass, retractable front loading shelf, stainless steel front, legs with locking casters, 9.0kW (per deck), UL,UL EPH Classified
- b. 480v/60/3-ph+N, 10.9 amps, per deck, custom order
- c. Stainless steel front, standard



- d. Model 80072 High temperature control, 500°C/932°F, per deck
- e. Model 80054-01 Extra retractable frontal unloading shelf PM 820

**ITEM # CM5-4**                    **HAND SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Advance Tabco**  
**Model:**                        **7-PS-95**

- a. Model 7-PS-95 Hand Sink, pedestal mounted base, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, splash mounted faucet, soap & paper towel dispenser, pedal valves with easy access design, basket drain, wall bracket, NSF, cCSAus
- b. Model 7-PS-17 Welded Side Splash, 7-3/4"H (installed height), both sides, for hand sinks with 14" wide x 10" front-to-back bowl, splash mounted faucets

**ITEM # CM5-5**                    **3 COMPARTMENT SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Advance Tabco**  
**Model:**                        **K7-CS-29**

- a. Model K7-CS-29 Convenience Store Sink, 3-compartment, with left & right-hand drainboards, 16" front-to-back x 14" W compartment, 12" deep with 8"H backsplash, stainless steel open frame base, side crossrails, adjustable metal bullet feet, 18 gauge 304 stainless steel, 11-5/8" drainboards, overall 21-1/2" F/B x 70" L/R  
OMIT FAUCET
- b. (2) Model K-472 Faucet hole revision.
- c. (3) Model K-4 Support Bracket, for lever waste drain handle, (1) support required for each lever drain

**ITEM # CM5-5.1**                **FAUCET**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **T&S Brass**  
**Model:**                        **5F-8WLX10**

- a. Model 5F-8WLX10 Equip Faucet, 8" centers, wall mount, 10" swivel nozzle, lever handles, 2" flange, ceramic cartridges, low lead, ADA Compliant

**ITEM # CM5-6**                    **WALL SHELF W/ POT RACK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Advance Tabco**  
**Model:**                        **PS-12-72**

- a. Model PS-12-72 Shelf with Pot Rack, wall-mounted, 72"W x 12"D, 18/430 stainless steel shelf, 2" x 1/4" stainless steel pot rack, includes: (9) plated double pot hooks, NSF

**ITEM # CM5-7**                    **STORAGE SHELVING**  
**Quantity:**                    **Four (4) – (1 COMPLETE UNIT 4 SHELVES)**  
**Manufacturer:**              **Metro**  
**Model:**                        **2136NK3**

- a. Model 2136NK3 Quick Ship - Super Erecta® Shelf, wire, 36"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF

- b. Model 74UPK3 Quick Ship - Super Erecta® SiteSelect™ Post, 73-7/8"H, for use with stem casters, Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
- c. (2) Model 5PC Quick Ship - Super Erecta® Stem Caster, swivel, 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper
- d. (2) Model 5PCB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper

**ITEM # CM5-8**                    **REACH-IN REFRIGERATOR**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Delfield**  
**Model:**                        **GAR1P-S**

- a. Model GAR1P-S Specification Line® Refrigerator, Reach-In, one-section, 21.0 cubic feet capacity, top-mounted self-contained refrigeration system, (1) full-height hinged solid door (locking), (3) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, stainless steel exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.22 HP, 115v/60/1-ph, 4.2 amps, NEMA 5-15P, NSF, cULus
- b. Door hinged on left
- c. Set of (4) 5" locking casters, standard

**ITEM # CM5-9**                    **MOP SINK CABINET**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Advance Tabco**  
**Model:**                        **9-OPC-84**

- a. Model 9-OPC-84 Cabinet with Mop Sink, 25-3/16"W x 22-3/4"D x 84"H, mop sink base with drain (bowl 16" x 20" x 12"), left hinged door, (2) mop holders, (1) fixed intermediate shelf, slotted side panels for ventilation, 16/304 series stainless steel sink bowl, 18/304 series stainless steel sink bowl apron, 18/430 series stainless steel cabinet, NSF.
- b. Model K-240 Service Sink Faucet, wall mount, heavy duty, 8" OC, 6-1/2" spout, with hose thread & pail hook, vacuum breaker spout, wall braced, chrome-plated brass
- c. Model K-610CF Perforated bottom strainer plate, stainless steel, removable, sits 1" above bottom of sink, fits Advance Tabco Fabricated 16" x 20" sink bowls only

**ITEM # CM5-10**                **SPARE NO.**

**ITEM # CM5-11**                **SPARE NO.**

**ITEM # CM5-12**                **HEATED SHELF WARMER**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Hatco**  
**Model:**                        **GR2S-72**

- a. Model GR2S-72 Heated Shelf, Designer, free-standing, (5) 12" x 20" pan capacity, hardcoat aluminum top & blanket type foil element, designer exterior panels & corner caps, 4" legs, CE, cULus, UL EPH Classified, Made in USA
- b. 120v/60/1-ph, 1100 watts, 9.2 amps, NEMA 5-15P, standard
- c. Model STANDARD Clear Anodized Aluminum housing, finish, standard
- d. Model STANDARDBLACK Black, designer inset panel color, standard
- e. Model BLACK Black, designer corner cap color

**ITEM # CM5-13**                    **HEATED MERCHANDISER**  
**Quantity:**                    **Three (3)**  
**Manufacturer:**                **Hatco**  
**Model:**                        **GR3SDS-39DCT**

- a. Model GR3SDS-39DCT Glo-Ray® Designer Slant Display Warmer, with curved canopy top, (14) rods, countertop, dual shelf, adjustable thermostat, hardcoated heated base, heated glass shelves, tempered glass side panels, LED display lights, built-in front sign holder (sign not included), 2-1/2" legs, cULus, UL EPH Classified, Made in USA, CE
- b. 120/208-240v/60/1-ph, 2130 watts, 12.8 amps, NEMA L14-20P
- c. Model STANDARD Black designer color, standard
- d. Model 4"LEGS 4-inch adjustable legs, set of 4

**ITEM # CM5-14**                    **REFRIGERATED DISPLAY**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**                **Structural Concepts**  
**Model:**                        **B57R**

- a. Model B57R Oasis® Refrigerated Self-Service Case, 59-5/8"W x 34-1/4"D x 82-1/4"H, Warmest average product temperature of 40°F or less, LED top light, (4) metal shelves, Breeze with self-contained refrigeration, condensate pan, magnetic air filter, non-locking casters with levelers, end panels with mirrored stainless interior, black exterior, R290 Hydrocarbon refrigerant, cETLus, ETL-Sanitation
- b. Exterior Color: Powder coated SCC Standard Silversan Black (FDA compliant)
- c. Interior Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- d. Lower Front Panel Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- e. Rear Exterior Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- f. Base support: Casters (non-locking) w/ levelers
- g. End Panel Left: Full with stainless steel mirror interior, standard
- h. End Panel Right: Full with stainless steel mirror interior, standard
- i. Cover/Curtain: Roll-down security cover, locking (Requires two end panels (full or cutaway) per case) (One cover/curtain type per model)
- j. Rear Doors: None (solid back panel), standard
- k. Shelving: Metal shelves (4), lighted (LED 4000K)
- l. Top Light: LED 4000K, standard
- m. Electrical Connection: 6' Straight blade power cord, standard
- n. Clean Sweep: None, standard
- o. Refrigeration: Breeze-E (Type II) self-contained refrigeration, standard
- p. Refrigerant: Hydrocarbon refrigerant (R290)
- q. Thermometer: Spirit filled thermometer, standard
- r. Vinyl Graphics: None, standard

**ITEM # CM5-15**                    **REFRIGERATED MERCHANDISER**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**                **True**  
**Model:**                        **GDM-49-HC~TSL01**

- a. Model GDM-49-HC~TSL01 Refrigerated Merchandiser, two-section, True standard look version 01, (8) shelves, (2) double pane thermal insulated glass hinged doors, LED interior lights, powder coated steel exterior, white interior with stainless steel floor, R290

Hydrocarbon refrigerant, 1/2 HP, 115v/60/1-ph, 8.5 amps, NEMA 5-15P, cULus, UL EPH  
Classified, Made in USA, ENERGY STAR®

- b. Self-contained refrigeration standard
- c. Exterior: Black powder coated steel, standard
- d. Interior: White aluminum, with white shelving, standard
- e. Left door hinged left, right door hinged right standard
- f. Illuminated sign decal: S-TS-02 "TRUE Stripe" graphic, standard

**ITEM # CM5-16**                    **FREEZER MERCHANDISER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **True**  
**Model:**                      **GDM-23F-HC~TSL01**

- a. Model GDM-23F-HC~TSL01 Freezer Merchandiser, one-section, True standard look version 01, -10°F, (4) shelves, (1) triple-pane thermal glass hinged door, LED interior lights, powder coated steel exterior, white interior with stainless steel floor, R290 Hydrocarbon refrigerant, 1 HP, 115v/60/1-ph, 9.5 amps, NEMA 5-15P, cULus, UL EPH Classified, Made in USA
- b. Self-contained refrigeration standard
- c. Exterior: Black powder coated steel, standard
- d. Interior: White aluminum, with white shelving, standard
- e. Left door hinging
- f. Illuminated sign decal: S-TS-02 "TRUE Stripe" graphic, standard

**ITEM # CM5-17**                    **AMBIENT SELF SERVICE CASE**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**            **Structural Concepts**  
**Model:**                      **NR3647DSSV**

- a. Model NR3647DSSV Reveal® Self-Service Non-Refrigerated Case, freestanding, 35-3/4"W, 47-1/8"H, (2) removable & adjustable clear glass shelving, LED top & shelf lights, full end panels, solid rear panel, one piece formed ABS plastic tub, black exterior & interior, adjustable locking casters, cETLus, ETL-Sanitation
- b. Electrical: 110-120v/60/1-ph, 0.70 amps, 11.0 watts, standard
- c. Electrical Connection: 6' Straight blade power cord with NEMA 5-15P, standard
- d. Interior Color: Powder coated SCC Standard Silversan Black (FDA compliant)
- e. Frame Exterior: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- f. Panel Exterior Color: Laminate standard color 909-58 Black
- g. Model GRAIN DIRECTION Standard laminate grain directions (when applicable):  
- Front Panels (Upper Header and Lower Panels): Horizontal grain direction  
- End Panels: Vertical grain direction  
- Blend & Reveal Cases Only: Horizontal grain direction on front and end panels
- h. End Panel Left: Full end panel
- i. End Panel Right: Full end panel
- j. Lower Front Panel Color: Powder coated SCC Standard Silversan Black
- k. Lower Rear Panel Color: Powder coated SCC Standard Silversan Black
- l. Rear Doors: None (solid back panel), standard
- m. Lights: LED 3500K with frost lens, standard
- n. Removable clear acrylic security cover, locking
- o. Base Support: Adjustable, locking casters (self-cont.), standard
- p. Base Support: Adjustable, locking casters, standard

**ITEM # CM5-18**            **ICE MAKER**  
**Quantity:**            **Two (2)**  
**Manufacturer:**      **Ice-O-Matic**  
**Model:**                **CIM0836FA**

- a. Model CIM0836FA Elevation Series™ Modular Cube Ice Maker, air-cooled, self-contained condenser, dual exhaust top/side air discharge, 30" W, approximately 896 lb production/24 hours at 70°/50° (711 lb at 90°/70°), full-size cubes, PURE ICE® built-in antimicrobial protection, LED status display, one touch sanitize/descaling controls, dishwasher safe food zone components, cULus, NSF, CE, BPA Free
- b. 208-230v/60/1-ph, 13.4 amps, standard

**ITEM # CM5-18.1**        **SODA DISPENSER**  
**Quantity:**            **Two (2)**  
**Manufacturer:**      **By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # CM5-18.2**        **WATER FILTER**  
**Quantity:**            **Two (2)**  
**Manufacturer:**      **Ice-O-Matic**  
**Model:**                **IFQ2**

- a. Model IFQ2 Water Filter Manifold, dual filter designed for ice makers producing between 1050 & 1400 lbs. (476.3 to 635 Kg.) of ice per day, 3.0 gpm maximum flow rate, IsoNet® scale inhibitor, .5 micron particle reduction

**ITEM # CM5-19**            **CONDIMENT CADDY**  
**Quantity:**            **Two (2)**  
**Manufacturer:**      **Dispense-Rite**  
**Model:**                **NLO-STK-1BT**

- a. Model NLO-STK-1BT Lid, Straw & Condiment Organizer, 7-1/8" H x 8" W x 19-1/8" D, narrow, removable section dividers, polystyrene, black

**ITEM # CM5-20**            **UNDERCOUNTER SODA SYSTEM SYRUP RACK**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # CM5-20.1**        **CARBONATOR**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # CM5-21**            **POS, SELF-CHECKOUT**  
**Quantity:**            **Three (3)**  
**Manufacturer:**      **BY OPERATIONS**  
**Model:**                **POS**

- a. Model POS PROVIDED BY OPERATIONS

**ITEM # CM5-21.1**      **POS, SELF-CHECKOUT**  
**Quantity:**            **Two (2)**  
**Manufacturer:**      **BY OPERATIONS**  
**Model:**                **POS**

- a. Model POS PROVIDED BY OPERATIONS

### **CM6 – CONCOURSE LEVEL MARKET 6**

**ITEM # CM6-1**            **WORK TABLE**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Atlanta Custom Fabricators**  
**Model:**                **WT**

- a. Model WT Work table, all stainless steel construction, 5'-0" long X 2'-6" wide X 36" high. Table to be fully welded construction with all welds fully ground and polished to a uniform finish. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges, 8" back splash with 2" return on 45 degree angle and 1" turned down, attach with stainless steel Z clips, stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- c. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM6-2**            **COUNTER TOP HEATED WELL**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Hatco**  
**Model:**                **CHW-43**

- a. Model CHW-43 Food Warmer/Cooker, electric, countertop, (4) 1/3 pan capacity, wet/dry operation, thermostatic controls, stainless steel construction, 1800 watts, 15.0 amps, CE, cULus, UL EPH Classified
- b. 120v/60/1-ph, 1800 watts, 15.0 amps, NEMA 5-15P, standard

**ITEM # CM6-3**            **WALL MOUNTED OVER SHELF**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Atlanta Custom Fabricators**  
**Model:**                **WMO**

- a. Model WMO Wall mounted over shelf, 5'-0" long X 12" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM6-3.1**        **WALL MOUNTED OVER SHELF**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Atlanta Custom Fabricators**  
**Model:**                **WMO**

- a. Model WMO Wall mounted over shelf, 5'-0" long X 14" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM6-4**                    **1 COMPARTMENT SINK PREP TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **1CSPT**

- a. Model 1CSPT Prep table with 1-Compartment Sink, 8'-0" long X 2'-6" wide X 36" high, all 14 gauge type 304 stainless steel construction. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be provided with 8" high back splash and left end splash, 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel Z-clips, marine edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flanged feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Sink to be 20" long X 20" wide X 12" deep, provided with T&S Brass #B-3950 Waste Valve, twist handle assembly for 3-1/2" sink opening, 2" drain outlet with 1-1/2" adapter and stainless steel lever waste bracket. Crease bottom of sink bowl to pitch to the drain. Provide stainless steel skirt to cover sink bowl.
- c. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- d. Unit to be further constructed in accordance with shop drawings  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM6-4.1**              **FAUCET**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **T&S Brass**  
**Model:**                        **B-0231-CR**

- a. Model B-0231-CR Faucet, 12" swing nozzle, 8" wall mount base, 1/2" NPT female Inlets, quarter-turn Cerama cartridges, low lead, ADA Compliant

**ITEM # CM6-5**                    **WALL MOUNTED OVER SHELF**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **WMO**

- a. Model WMO Wall mounted over shelf, 8'-0" long X 12" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM6-5.1**              **WALL MOUNTED OVER SHELF**  
**Quantity:**                    **One (1)**

**Manufacturer:** Atlanta Custom Fabricators  
**Model:** WMO

- a. Model WMO Wall mounted over shelf, 8'-0" long X 14" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
 APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM6-6**                    **ROLL-IN HEATED CABINET**  
**Quantity:** One (1)  
**Manufacturer:** Delfield  
**Model:** GAHRI2-S

- a. Model GAHRI2-S Specification Line® Heated Cabinet, Roll-In, two-section, 76.5 cubic feet capacity, (2) full-height hinged solid doors (locking), 4.3" easyTouch® screen temperature display/control with remote monitoring, incandescent interior lighting, 1" tall stainless steel ramp, stainless steel exterior front, sides & interior, 208-240v/60/1-ph, 10.5 amps, NEMA 6-20P, NSF, cULus, ENERGY STAR®
- b. Left door hinged on left, right door hinged on right, standard
- c. Full height solid doors, standard
- d. Model AS269-AFJ-0043 Raised Ramp, for roll in/roll thru, standard

**ITEM # CM6-7**                    **UNIVERSAL ROLL-IN RACK**  
**Quantity:** Three (3)  
**Manufacturer:** Cres Cor  
**Model:** 207UA12AC

- a. Model 207UA12AC Rack, Roll-In Refrigerator, open frame design, (12) universal slides for 12" x 20" thru 18" x 26" pans on 4-1/2" centers, adjustable at 1-1/2" intervals, welded extruded aluminum frame, NSF
- b. Model 1032 001 Pan Stop, mounted to rear, prevents accidental push through of pans
- c. Model 1056 002 Corner Bumpers, add 2" to OA dimensions, non-marking, gray

**ITEM # CM6-8**                    **HAND SINK**  
**Quantity:** One (1)  
**Manufacturer:** Advance Tabco  
**Model:** 7-PS-66

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus

**ITEM # CM6-9**                    **REACH-IN REFRIGERATOR**  
**Quantity:** One (1)  
**Manufacturer:** Delfield  
**Model:** GAR1P-S

- a. Model GAR1P-S Specification Line® Refrigerator, Reach-In, one-section, 21.0 cubic feet capacity, top-mounted self-contained refrigeration system, (1) full-height hinged solid door (locking), (3) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, stainless steel exterior front,



- sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.22 HP, 115v/60/1-ph, 4.2 amps, NEMA 5-15P, NSF, cULus
- b. Door hinged on left
  - c. Set of (4) 5" locking casters, standard

**ITEM # CM6-10**                    **MOP SINK CABINET**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Advance Tabco**  
**Model:**                        **9-OPC-84**

- a. Model 9-OPC-84 Cabinet with Mop Sink, 25-3/16"W x 22-3/4"D x 84"H, mop sink base with drain (bowl 16" x 20" x 12"), left hinged door, (2) mop holders, (1) fixed intermediate shelf, slotted side panels for ventilation, 16/304 series stainless steel sink bowl, 18/304 series stainless steel sink bowl apron, 18/430 series stainless steel cabinet, NSF.
- b. Model CAB-R Change door to right-side hinge
- c. Model K-240 Service Sink Faucet, wall mount, heavy duty, 8" OC, 6-1/2" spout, with hose
- d. Model K-610CF Perforated bottom strainer plate, stainless steel, removable, sits 1" above bottom of sink, fits Advance Tabco Fabricated 16" x 20" sink bowls only

**ITEM # CM6-11**                    **SPARE NO.**

**ITEM # CM6-12**                    **HAND SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Advance Tabco**  
**Model:**                        **7-PS-95**

- a. Model 7-PS-95 Hand Sink, pedestal mounted base, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, splash mounted faucet, soap & paper towel dispenser, pedal valves with easy access design, basket drain, wall bracket, NSF, cCSAus
- b. Model 7-PS-17 Welded Side Splash, 7-3/4"H (installed height), both sides, for hand sinks with 14" wide x 10" front-to-back bowl, splash mounted faucets

**ITEM # CM6-13**                    **WORK TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **WT**

- a. Model WT Work table, all stainless steel construction, 7'-0" long X 2'-6" wide X 36" high. Table to be fully welded construction with all welds fully ground and polished to a uniform finish. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges, 8" back splash with 2" return on 45 degree angle and 1" turned down, attach with stainless steel Z clips, stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- c. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM6-14**                    **WALL MOUNTED OVER SHELF**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **WMO**

- a. Model WMO Wall mounted over shelf, 7'-0" long X 12" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM6-15**                    **REFRIGERATED PREP TABLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Delfield**  
**Model:**                        **4448NP-18M**

- a. Model 4448NP-18M Mega Top Sandwich/Salad Top Refrigerator, two-section, 48" W, 16.0 cubic feet, (2) doors, (2) 1/1 GN shelves, stainless steel top with polyethylene cutting board & (18) 1/6 size plastic pans, ABS interior sides, stainless steel front & sides, 5" casters, front-breathing rear-mounted refrigeration system, R290 Hydrocarbon refrigerant, 0.3 hp, cUL, UL, NSF
- b. 115v/60/1-ph, NEMA 5-15P, standard
- c. Self-Contained refrigeration, standard
- d. Door(s) standard
- e. Model 44CLEARLID Clear plexi lid (per opening)
- f. MUST confirm the quantity of lids required per cutout

**ITEM # CM6-16**                    **SPARE NO.**

**ITEM # CM6-17**                    **SPARE NO.**

**ITEM # CM6-18**                    **REACH-IN FREEZER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Delfield**  
**Model:**                        **GAF1P-SH**

- a. Model GAF1P-SH Specification Line® Freezer, Reach-In, one-section, 21.0 cubic feet capacity, top-mounted self-contained refrigeration system, (2) half-height hinged solid doors (locking), (3) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, pilaster with shelf clips, stainless steel exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.55 HP, 115v/60/1-ph, 7.2 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®
- b. Door hinged on right standard
- c. Set of (4) 5" locking casters, standard

**ITEM # CM6-19**                    **EXHAUST HOOD**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Accurex**  
**Model:**                        **XBEW-104.00-S**

- a. Model XBEW-104.00-S

- A. Type I, exhaust only wall canopy suitable for all types of cooking applications. The hood(s) shall be U.L. 710 Listed without a fire damper (with optional) for medium, heavy, or extra-heavy duty rated cooking appliances. Make-up air shall be independently provided. The hood(s) exterior shall be constructed of a minimum of 18-gauge 300 series stainless steel. The hood(s) shall be constructed using the standing seam method for optimum strength and with a Performance Enhancing Lip (PEL) to improve capture efficiency by turning air back into the hood. Front panels shall be of single wall construction. An integral 3-inch air space is provided to meet NFPA® 96 clearance requirements against limited combustible walls. Integral 3-inch air space may be omitted for non-combustible construction. All seams, joints and penetrations of the hood enclosure shall be welded and/or liquid tight. Lighter material gauges, alternate material types and finishes are not acceptable. All unexposed interior surfaces shall be constructed of a minimum 18-gauge corrosion resistant stainless steel including, but not limited to ducts, plenum, and brackets.
- B. The hood(s) shall include a filter housing constructed of the same material as the hood. The filters shall be stainless steel baffle type (non-stick coating optional), U.L. 1046 Classified, and in sufficient number and size to ensure optimum performance. The filter housing shall terminate in a pitched, full length grease trough which shall drain into a removable grease container. These filters shall have a grease removal efficiency of 28% at 8 microns (16% from 3-10 microns) and static pressure drop of 0.5-0.6 in WC. Vapor proof, U.L.
- C. LED light fixtures shall be pre-wired to a junction box located at the top of the hood for field connection. The wiring shall conform to the requirements of the NFPA® 70.
- D. The canopy hood(s) shall be built in accordance with the NFPA® 96, IMC, UMC, and bear the NSF Seal of Approval. The hood manufacturer shall provide, on request, the necessary data that confirms compliance with the code authorities listed above.
- E. Continuous Capture - UL listed connection to join multiple sections.
- F. Provide Accurex Controls: XKC-CV-S Controls system shall be a UL listed outlet center which shall standardly consist of a NEMA-1 Stainless Steel Enclosure within a Stainless-Steel Enclosure Panel, Printed Circuit Board (PCB), with Full Color Touchscreen, audible alarm, sensor (s) and motor starters. The constant volume Accurex Controls shall utilize resistive type temperature sensors that are mounted in the capture tank of the hood to monitor exhaust air temperatures, and an optional room temperature sensor, shipped loose, to be installed to detect ambient air temperatures in the kitchen space. Temperature sensors shall be made of stainless steel and shall be installed in a UL approved coupling.
- G. Fire System – Provide factory pre-piped for Ansul R-102 fire protection system located in an integral utility cabinet on the right end of the hood. The system shall provide surface, duct, and plenum protection for items of cooking equipment located beneath the hood in accordance with all applicable codes and provisions of NFPA 17A and 96. All system piping shall be concealed where possible with exposed portions of either chrome fittings or stainless-steel sleeving. The system shall be wired with shunt trip breaker and electric/gas shut-off valve serving items of cooking equipment beneath the hood to provide power and fuel shut-off in the event of system actuation.
- H. Exhaust fan(s) and supply fan(s) to be supplied by Mechanical Contractor
- I. 304 Stainless Steel inside and out. No galvanized metal.
- J. Provide wall mounted fire cabinet.
- K. Provide stainless steel backsplash for entire length of hood with 18" to extend right and 18" to extend left of the hood we applicable.
- L. Provide stainless steel hood enclosure panel. Top of hood to have a minimum of 3" above the ceiling.

**ITEM # CM6-19.1      FIRE SYSTEM**  
**Quantity:              One (1)**

**Manufacturer:** Accurex  
**Model:** ANSUL

- a. Model ANSUL WALL MOUNTED - INCLUDED WITH HOOD

**ITEM # CM6-20**            **FRYER**  
**Quantity:**            **Two (2)**  
**Manufacturer:**      **Henny Penny**  
**Model:**                **OFE321.0**

- a. Model OFE321.0 OFE-321 Open Fryer, floor model, electric, 1 well, stainless steel construction, rectangular fry pot, includes filter drain pan, stainless steel Max oil filtration system, 2 PHT filter envelopes, 4" swiveling casters (2 locking), basket support included in each vat, BUILT-TO-ORDER CONFIGURATION, ENERGY STAR®
- b. F Full well configuration, standard
- c. 480v/60/3-ph, 14.4 kW, 17.0 amps, 3+G wires
- d. TC1 Computron® 1000 control with melt mode, idle mode, two 4-character LED displays per control
- e. Without direct connect shortening disposal system plumbing
- f. Full Size Basket
- g. Model 180156 Crumb Catcher, for single well drain pans
- h. Model 03629 Fryer Pot Cover, 32x full pot

**ITEM # CM6-21**            **GRIDDLE, HIGH VOLUME**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Southbend**  
**Model:**                **HDG-48V**

- a. Model HDG-48V High Volume Griddle, countertop, gas, 48", 1" thick polished steel plate, thermostatic controls, battery spark ignition, flame failure safety device, stainless steel front, sides, towel bar & integrated stand, 120,000 BTU, CSA, NSF
- b. T&S Brass Model HG-2D-48SK-PS Safe-T-Link Gas Connector Kit, 3/4" connection, 48" hose, stainless steel braiding with extruded coating, (2) SwiveLink fittings, 360° rotatable hex nut, with 90° elbow & installation kit (includes restraining cable & ball valve), Posi-Set, 215,000 BTU/ hr minium flow capacity

**ITEM # CM6-22**            **REACH-IN REFRIGERATOR**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Delfield**  
**Model:**                **GAR1P-S**

- a. Model GAR1P-S Specification Line® Refrigerator, Reach-In, one-section, 21.0 cubic feet capacity, top-mounted self-contained refrigeration system, (1) full-height hinged solid door (locking), (3) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, stainless steel exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.22 HP, 115v/60/1-ph, 4.2 amps, NEMA 5-15P, NSF, cULus
- b. Door hinged on left
- c. Set of (4) 5" locking casters, standard

**ITEM # CM6-23**            **REFRIGERATED PREP TABLE**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Delfield**  
**Model:**                **4448NP-18M**

- a. Model 4448NP-18M Mega Top Sandwich/Salad Top Refrigerator, two-section, 48" W, 16.0 cubic feet, (2) doors, (2) 1/1 GN shelves, stainless steel top with polyethylene cutting board & (18) 1/6 size plastic pans, ABS interior sides, stainless steel front & sides, 5" casters, front-breathing rear-mounted refrigeration system, R290 Hydrocarbon refrigerant, 0.3 hp, cUL, UL, NSF
- b. 115v/60/1-ph, NEMA 5-15P, standard
- c. Self-contained refrigeration, standard
- d. Model AS000-B4V-003E Stainless steel back panel
- e. Model 4400EXTHERM Exterior Digital thermometer
- f. Door(s) standard
- g. Model 44CLEARLID Clear plexi lid (per opening)
- h. MUST confirm the quantity of lids required per cutout
- i. Model AS000-AQS-0032 Overshelf, Single Tier, 48Lx16Wx20H

**ITEM # CM6-24                    HOT FOOD HOLDING CABINET**  
**Quantity:                        Three (3)**  
**Manufacturer:                  Alto-Shaam**  
**Model:                             750-CTUS**

- a. Model 750-CTUS Halo Heat® Hot Food Storage Unit, 1-compartment, capacity (6) 12" x 20" full-size pans, French doors with (2) positive latch door handles, ON/OFF adjustable thermostat, indicator light, exterior temperature gauge, thermostat for 60° F - 200° F, stainless steel exterior & interior, EcoSmart®, cULus, NSF
- b. 120v/50/60/1-ph, 18.8 amps, 2.25kW, NEMA L5-30P
- c. Model 14227 Casters, 3" (76mm), set of (4)

**ITEM # CM6-25                    DROP-IN SINK W/ FAUCET**  
**Quantity:                        One (1)**  
**Manufacturer:                  Advance Tabco**  
**Model:                             DI-1-10**

- a. Model DI-1-10 Drop-In Sink, 1-compartment, 10" wide x 14" front-to-back x 10" deep bowl, 20 gauge 304 stainless steel, with deck mounted gooseneck faucet, basket drain, NSF
- b. Model K-614B Removable 3-sided splash for counter-mount drop in sink, 8" tall, includes posts to be installed in countertop.

**ITEM # CM6-26                    SPARE NO.**

**ITEM # CM6-27                    1 COMPARTMENT SINK PREP TABLE**  
**Quantity:                        One (1)**  
**Manufacturer:                  Atlanta Custom Fabricators**  
**Model:                             1CSPT**

- a. Model 1CSPT Prep table with 1-Compartment Sink, 7'-0" long X 2'-6" wide X 36" high, all 14 gauge type 304 stainless steel construction. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be provided with 8" high left end splash splash, 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel Z-clips, marine edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flanged feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Sink to be 20" long X 20" wide X 12" deep, provided with T&S Brass #B-3950 Waste Valve, twist handle assembly for 3-1/2" sink opening, 2" drain outlet with 1-1/2" adapter

and stainless steel lever waste bracket. Crease bottom of sink bowl to pitch to the drain. Provide stainless steel skirt to cover sink bowl.

- c. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- d. Unit to be further constructed in accordance with shop drawings  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM6-27.1      FAUCET**  
**Quantity:            One (1)**  
**Manufacturer:        T&S Brass**  
**Model:                B-0231-CR**

- a. Model B-0231-CR Faucet, 12" swing nozzle, 8" wall mount base, 1/2" NPT female Inlets, quarter-turn Cerama cartridges, low lead, ADA Compliant

**ITEM # CM6-28        STORAGE SHELVING**  
**Quantity:            Four (4) – (1 COMPLETE UNIT 4 SHELVES)**  
**Manufacturer:        Metro**  
**Model:                2136NK3**

- a. Model 2136NK3 Quick Ship - Super Erecta® Shelf, wire, 36"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. Model 74UPK3 Quick Ship - Super Erecta® SiteSelect™ Post, 73-7/8"H, for use with stem casters, Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
- c. (2) Model 5PC Quick Ship - Super Erecta® Stem Caster, swivel, 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper
- d. (2) Model 5PCB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper

**ITEM # CM6-29        3 COMPARTMENT SINK**  
**Quantity:            One (1)**  
**Manufacturer:        Advance Tabco**  
**Model:                K7-CS-29**

- a. Model K7-CS-29 Convenience Store Sink, 3-compartment, with left & right-hand drainboards, 16" front-to-back x 14" W compartment, 12" deep with 8"H backsplash, stainless steel open frame base, side crossrails, adjustable metal bullet feet, 18 gauge 304 stainless steel, 11-5/8" drainboards, overall 21-1/2" F/B x 70" L/R  
OMIT FAUCET
- b. (2) Model K-472 Faucet hole revision
- c. (3) Model K-4 Support Bracket, for lever waste drain handle, (1) support required for each lever drain

**ITEM # CM6-29.1      FAUCET**  
**Quantity:            Two (2)**  
**Manufacturer:        T&S Brass**  
**Model:                5F-8WLX10**

- a. Model 5F-8WLX10 Equip Faucet, 8" centers, wall mount, 10" swivel nozzle, lever handles, 2" flange, ceramic cartridges, low lead, ADA Compliant

**ITEM # CM6-30**                    **WALL SHELF W/ POT RACK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Advance Tabco**  
**Model:**                        **PS-12-72**

- a. Model PS-12-72 Shelf with Pot Rack, wall-mounted, 72"W x 12"D, 18/430 stainless steel shelf, 2" x 1/4" stainless steel pot rack, includes: (9) plated double pot hooks, NSF

**ITEM # CM6-31**                    **HAND SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Advance Tabco**  
**Model:**                        **7-PS-66**

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus

**ITEM # CM6-32**                    **ROLL-IN REFRIGERATOR**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Delfield**  
**Model:**                        **GARRI1P-S**

- a. Model GARRI1P-S Specification Line® Refrigerator, Roll-In, one-section, 37.0 cubic feet capacity, top-mounted self-contained refrigeration system, (1) full-height hinged solid door (locking), 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, 1" tall stainless steel ramp, stainless steel exterior front, sides & interior, GreenGenius™ R290 Hydrocarbon refrigerant, 0.35 HP, 115v/60/1-ph, 6.0 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®
- b. Full height solid door, standard
- c. Door hinged on left

**ITEM # CM6-33**                    **SPARE NO.**

**ITEM # CM6-34**                    **REFRIGERATED DISPLAY**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Structural Concepts**  
**Model:**                        **B57R**

- a. Model B57R Oasis® Refrigerated Self-Service Case, 59-5/8"W x 34-1/4"D x 82-1/4"H, Warmest average product temperature of 40°F or less, LED top light, (4) metal shelves, Breeze with self-contained refrigeration, condensate pan, magnetic air filter, non-locking casters with levelers, end panels with mirrored stainless interior, black exterior, R290 Hydrocarbon refrigerant, cETLus, ETL-Sanitation
- b. Exterior Color: Powder coated SCC Standard Silversan Black (FDA compliant)
- c. Interior Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- d. Lower Front Panel Color: Powder coated SCC Standard Silversan Black
- e. Rear Exterior Color: Powder coated SCC Standard Silversan Black
- f. Base support: Casters (non-locking) w/ levelers
- g. End Panel Left: Full with stainless steel mirror interior, standard
- h. End Panel Right: Full with stainless steel mirror interior, standard

- i. Cover/Curtain: Roll-down security cover, locking (Requires two end panels (full or cutaway) per case) (One cover/curtain type per model)
- j. Rear Doors: Rear loading hinged doors, locking
- k. Shelving: Metal shelves (4), lighted (LED 4000K)
- l. Top Light: LED 4000K, standard
- m. Electrical Connection: 6' Straight blade power cord, standard
- n. Clean Sweep: None, standard
- o. Refrigeration: Breeze-E (Type II) self-contained refrigeration, standard
- p. Refrigerant: Hydrocarbon refrigerant (R290)
- q. Thermometer: Spirit filled thermometer, standard
- r. Vinyl Graphics: None, standard

**ITEM # CM6-35**                    **HEATED MERCHANDISER**  
**Quantity:**                    **Three (3)**  
**Manufacturer:**              **Hatco**  
**Model:**                        **GR3SDS-39DCT**

- a. Model GR3SDS-39DCT Glo-Ray® Designer Slant Display Warmer, with curved canopy top, (14) rods, countertop, dual shelf, adjustable thermostat, hardcoated heated base, heated glass shelves, tempered glass side panels, LED display lights, built-in front sign holder (sign not included), 2-1/2" legs, cULus, UL EPH Classified, Made in USA, CE
- b. 120/208-240v/60/1-ph, 2130 watts, 12.8 amps, NEMA L14-20P
- c. Model STANDARD Black designer color, standard
- d. Model 4"LEGS 4-inch adjustable legs, set of 4

**ITEM # CM6-36**                    **REFRIGERATED MERCHANDISER**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **True**  
**Model:**                        **GDM-49-HC~TSL01**

- a. Model GDM-49-HC~TSL01 Refrigerated Merchandiser, two-section, True standard look version 01, (8) shelves, (2) double pane thermal insulated glass hinged doors, LED interior lights, powder coated steel exterior, white interior with stainless steel floor, R290 Hydrocarbon refrigerant, 1/2 HP, 115v/60/1-ph, 8.5 amps, NEMA 5-15P, cULus, UL EPH Classified, Made in USA, ENERGY STAR®
- b. Exterior: Black powder coated steel, standard
- c. Interior: White aluminum, with white shelving, standard
- d. Left door hinged left, right door hinged right standard
- e. Illuminated sign decal: S-TS-02 "TRUE Stripe" graphic, standard

**ITEM # CM6-37**                    **FREEZER MERCHANDISER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **True**  
**Model:**                        **GDM-49F-HC~TSL01**

- a. Model GDM-49F-HC~TSL01 Freezer Merchandiser, two-section, True standard look version 01, -10°F, (8) shelves, (2) triple-pane thermal glass hinged door, LED interior lights, powder coated steel exterior, white interior with stainless steel floor, R290 Hydrocarbon refrigerant, All Units Manufactured Before April 4th, 2021 are pre-wired at the factory and is ready for final connection to a single 115/208-230/60Hz single phase, NEMA 14-20R dedicated outlet. All Units Manufactured After April 4th, 2021 are pre-wired at the factory and is ready for final connection to a single 115/60Hz single phase, NEMA 5-20R dedicated outlet. \*\*\*Please contact the factory to verify your unit's electrical specifications\*\*\*, cULus, UL EPH Classified, Made in USA, ENERGY STAR®



- b. Self-contained refrigeration standard
- c. Exterior: Black powder coated steel, standard
- d. Interior: White aluminum, with white shelving, standard
- e. Left door hinged left, right door hinged right standard
- f. Illuminated sign decal: S-TS-02 "TRUE Stripe" graphic, standard

**ITEM # CM6-38**                    **POS, SELF-CHECKOUT**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**              **BY OPERATIONS**  
**Model:**                        **POS**

- a. Model POS PROVIDED BY OPERATIONS

### **CM7 – CONCOURSE LEVEL MARKET 7**

**ITEM # CM7-1**                    **MOBILE HEATED CABINET**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Winston Foodservice**  
**Model:**                        **HOV5-14SP**

- a. Model HOV5-14SP CVap® Holding Cabinet, mobile, full-size, insulated, convection holding, accommodates (14) 18" x 26" sheet pans or (28) 13" x 18" sheet pans or (14) 12" x 20" hotel pans, load limit 65 lbs (29.25 kg) per rack, (2) field reversible hinged solid dutch doors, magnetic door handle, C-Touch control with processor, HACCP temperature downloads, USB & audio ports, manual water fill, stainless steel interior & exterior, CE, UL EPH ANSI/NSF4, cUL, UL-Sanitation
- b. 120v/60/1-ph, 2292 watts, 19.1 amps, NEMA 5-20P
- c. Left hand
- d. Window in both upper & lower front doors
- e. 5" Plate casters (2) with locking, standard
- f. Full-perimeter bumpers with 5" casters (2 locking, 2 non-locking)
- g. Allows cord to be wrapped on rear of cabinet

**ITEM # CM7-2**                    **1 COMPARTMENT SINK PREP TABLE**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Atlanta Custom Fabricators**  
**Model:**                        **1CSPT**

- a. Model 1CSPT Prep table with 1-Compartment Sink, 8'-0" long X 2'-6" wide X 36" high, all 14 gauge type 304 stainless steel construction. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be provided with 8" high back splash, 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel Z-clips, marine edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flanged feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Sink to be 20" long X 20" wide X 12" deep, provided with T&S Brass #B-3950 Waste Valve, twist handle assembly for 3-1/2" sink opening, 2" drain outlet with 1-1/2" adapter and stainless steel lever waste bracket. Crease bottom of sink bowl to pitch to the drain.
- c. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.

- d. Unit to be further constructed in accordance with shop drawings  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM7-2.1**            **FAUCET**  
**Quantity:**            **Two (2)**  
**Manufacturer:**        **T&S Brass**  
**Model:**                **B-0231-CR**

- a. Model B-0231-CR Faucet, 12" swing nozzle, 8" wall mount base, 1/2" NPT female Inlets, quarter-turn Cerama cartridges, low lead, ADA Compliant

**ITEM # CM7-3**            **WALL MOUNTED OVER SHELF**  
**Quantity:**            **Two (2)**  
**Manufacturer:**        **Atlanta Custom Fabricators**  
**Model:**                **WMO**

- a. Model WMO Wall mounted over shelf, 8'-0" long X 12"deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM7-4**            **MOBILE HEATED CABINET**  
**Quantity:**            **Two (2)**  
**Manufacturer:**        **Winston Foodservice**  
**Model:**                **HOV5-14SP**

- a. Model HOV5-14SP CVap® Holding Cabinet, mobile, full-size, insulated, convection holding, accommodates (14) 18" x 26" sheet pans or (28) 13" x 18" sheet pans or (14) 12" x 20" hotel pans, load limit 65 lbs (29.25 kg) per rack, (2) field reversible hinged solid dutch doors, magnetic door handle, C-Touch control with processor, HACCP temperature downloads, USB & audio ports, manual water fill, stainless steel interior & exterior, CE, UL EPH ANSI/NSF4, cUL, UL-Sanitation
- b. 120v/60/1-ph, 2292 watts, 19.1 amps, NEMA 5-20P
- c. Right hand
- d. Window in both upper & lower front doors
- e. 5" Plate casters (2) with locking, standard
- f. Full-perimeter bumpers with 5" casters (2 locking, 2 non-locking)
- g. Allows cord to be wrapped on rear of cabinet

**ITEM # CM7-5**            **REACH-IN REFRIGERATOR**  
**Quantity:**            **One (1)**  
**Manufacturer:**        **Delfield**  
**Model:**                **GAR2P-S**

- a. Model GAR2P-S Specification Line® Refrigerator, Reach-In, two-section, 46.0 cubic feet capacity, top-mounted self-contained refrigeration system, (2) full-height hinged solid doors (locking), (6) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, stainless steel exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.35 HP, 115v/60/1-ph, 6.0 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®
- b. Left door hinged on left, right door hinged on right, standard

- c. Set of (4) 5" locking casters, standard

**ITEM # CM7-6**                    **HAND SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Advance Tabco**  
**Model:**                        **7-PS-95**

- a. Model 7-PS-95 Hand Sink, pedestal mounted base, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, splash mounted faucet, soap & paper towel dispenser, pedal valves with easy access design, basket drain, wall bracket, NSF, cCSAus  
 Model 7-PS-17 Welded Side Splash, 7-3/4"H (installed height), both sides, for hand sinks with 14" wide x 10" front-to-back bowl, splash mounted faucets

**ITEM # CM7-7**                    **EXHAUST HOOD W/ FIRE SYSTEM**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Accurex**  
**Model:**                        **XBEW-155.00-S**

- a. Model XBEW-155.00-S  
 A. Type I, exhaust only wall canopy suitable for all types of cooking applications. The hood(s) shall be U.L. 710 Listed without a fire damper (with optional) for medium, heavy, or extra-heavy duty rated cooking appliances. Make-up air shall be independently provided. The hood(s) exterior shall be constructed of a minimum of 18-gauge 300 series stainless steel. The hood(s) shall be constructed using the standing seam method for optimum strength and with a Performance Enhancing Lip (PEL) to improve capture efficiency by turning air back into the hood. Front panels shall be of single wall construction. An integral 3-inch air space is provided to meet NFPA® 96 clearance requirements against limited combustible walls. Integral 3-inch air space may be omitted for non-combustible construction. All seams, joints and penetrations of the hood enclosure shall be welded and/or liquid tight. Lighter material gauges, alternate material types and finishes are not acceptable. All unexposed interior surfaces shall be constructed of a minimum 18-gauge corrosion resistant stainless steel including, but not limited to ducts, plenum, and brackets.  
 B. The hood(s) shall include a filter housing constructed of the same material as the hood. The filters shall be stainless steel baffle type (non-stick coating optional), U.L. 1046 Classified, and in sufficient number and size to ensure optimum performance. The filter housing shall terminate in a pitched, full length grease trough which shall drain into a removable grease container. These filters shall have a grease removal efficiency of 28% at 8 microns (16% from 3-10 microns) and static pressure drop of 0.5-0.6 in WC. Vapor proof, U.L.  
 C. LED light fixtures shall be pre-wired to a junction box located at the top of the hood for field connection. The wiring shall conform to the requirements of the NFPA® 70.  
 D. The canopy hood(s) shall be built in accordance with the NFPA® 96, IMC, UMC, and bear the NSF Seal of Approval. The hood manufacturer shall provide, on request, the necessary data that confirms compliance with the code authorities listed above.  
 E. Continuous Capture - UL listed connection to join multiple sections.  
 F. Provide Accurex Controls: XKC-CV-S Controls system shall be a UL listed outlet center which shall standardly consist of a NEMA-1 Stainless Steel Enclosure within a Stainless-Steel Enclosure Panel, Printed Circuit Board (PCB), with Full Color Touchscreen, audible alarm, sensor (s) and motor starters. The constant volume Accurex Controls shall utilize resistive type temperature sensors that are mounted in the capture tank of the hood to monitor exhaust air temperatures, and an optional room temperature sensor, shipped loose, to be installed to detect ambient air temperatures in the kitchen

space. Temperature sensors shall be made of stainless steel and shall be installed in a UL approved coupling.

G. Fire System – Provide factory pre-piped for Ansul R-102 fire protection system located in an integral utility cabinet on the right end of the hood. The system shall provide surface, duct, and plenum protection for items of cooking equipment located beneath the hood in accordance with all applicable codes and provisions of NFPA 17A and 96. All system piping shall be concealed where possible with exposed portions of either chrome fittings or stainless-steel sleeving. The system shall be wired with shunt trip breaker and electric/gas shut-off valve serving items of cooking equipment beneath the hood to provide power and fuel shut-off in the event of system actuation.

H. Exhaust fan(s) and supply fan(s) to be supplied by Mechanical Contractor

I. 304 Stainless Steel inside and out. No galvanized metal.

J. Provide fire cabinet on right end of hood.

K. Provide stainless steel backsplash for entire length of hood with 18" to extend right and 18" to extend left of the hood we applicable.

L. Provide stainless steel hood enclosure panel. Top of hood to have a minimum of 3" above the ceiling.

**ITEM # CM7-8**                      **CONVECTION STEAMER W/ KETTLE**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **Crown**  
**Model:**                         **ECX-10-10**

- a. Model ECX-10-10 Convection Steamer/Kettle, electric, (2) compartment, (1) 10 gallon kettle, (5) 12" x 20" x 2-1/2" pan capacity per compartment, 48" cabinet base, automatic blowdown, 60 minute timer per compartment, deck mount faucet valve, swing nozzle & integral sink, CSD-1 code package, includes water filter system, 316 stainless steel interior, 304 stainless steel exterior, 6" legs with adjustable flanged feet, cCSAus, NSF
- b. Model EBVS-2 480V-3PH - 57.7 AMPS
- c. Drain tempering valve, for 140 degree temperature requirement. Requires 1/2" cold water connection.
- d. Model C-10 Cover, lift off, for 10 gallon kettle

**ITEM # CM7-8.1**                **FILTER SYSTEM**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **Crown**  
**Model:**                         **71528211**

- a. Model 71528211 TruH2O Water Treatment System (multi-stage pack), neutralizes scale, up to 99% chlorine reduction, 5 micron filtration, quick disconnect, easy cartridge change out

**ITEM # CM7-9**                      **FRYER BANK**  
**Quantity:**                      **Two (2)**  
**Manufacturer:**                **Henny Penny**  
**Model:**                         **OFE342.0**

- a. Model OFE342.0 OFE-342 Open Fryer, electric, 2 wells, 80 pound fat and 18 pound food capacity per well, stainless steel construction and rectangular fry pot, built-in filter, (2) basket supports, (4) casters (2 locking)
- b. 480v/60/3-ph, 22 kW, 26.5 amps, 3-wire + ground connections (USA option) (left)
- c. 480v/60/3-ph, 22 kW, 26.5 amps, 3-wire + ground connections (USA option) (right)
- d. C1 Computron® 1000 control with melt mode, idle mode, two 4-character LED displays per control, standard

- e. Without direct connect system, standard
- f. Station 1: Full Size Basket
- g. Station 2: (2) Half Baskets
- h. Filter drain pan, two well capacity
- i. Model 03552 Filter Pan Dolly, for open fryers, compatible with two well capacity filter pan of OGA/OEA/OFG/OFE-342 open fryer
- j. Model 03638 Fryer Pot Cover, 34x full pot

**ITEM # CM7-10**            **REACH-IN FREEZER**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Delfield**  
**Model:**                **GAF1P-SH**

- a. Model GAF1P-SH Specification Line® Freezer, Reach-In, one-section, 21.0 cubic feet capacity, top-mounted self-contained refrigeration system, (2) half-height hinged solid doors (locking), (3) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, pilaster with shelf clips, stainless steel exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.55 HP, 115v/60/1-ph, 7.2 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®
- b. Door hinged on right standard
- c. Set of (4) 5" locking casters, standard

**ITEM # CM7-11**            **SPARE NO.**

**ITEM # CM7-12**            **SPARE NO.**

**ITEM # CM7-13**            **REACH-IN FREEZER**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Delfield**  
**Model:**                **6151XL-SH**

- a. Model 6151XL-SH Freezer, Reach-In, two-section, 41.5 cubic feet capacity, top-mounted self-contained refrigeration system, (4) half-height hinged solid door (locking), (6) adjustable chrome wire shelves, digital thermometer with visual high/low temp alarms, LED interior lighting, stainless steel front shroud & sides, Seamless, Delrite® ABS interior liner 30 molded shelf supports spaced 3" (76mm) apart, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.68 HP, 115v/60/1-ph, 12.0 amps, NEMA 5-15P, NSF, cULus, UL, ENERGY STAR®

**ITEM # CM7-14**            **REACH-IN REFRIGERATOR**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Delfield**  
**Model:**                **GAR2P-S**

- a. Model GAR2P-S Specification Line® Refrigerator, Reach-In, two-section, 46.0 cubic feet capacity, top-mounted self-contained refrigeration system, (2) full-height hinged solid doors (locking), (6) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, stainless steel exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.35 HP, 115v/60/1-ph, 6.0 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®
- b. Left door hinged on left, right door hinged on right, standard
- c. Set of (4) 5" locking casters, standard

**ITEM # CM7-15**                    **STORAGE SHELVING**  
**Quantity:**                    **Four (4) – (1 COMPLETE UNIT 4 SHELVES)**  
**Manufacturer:**                **Metro**  
**Model:**                        **2148NK3**

- a. Model 2148NK3 Quick Ship - Super Erecta® Shelf, wire, 48"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. Model 74UPK3 Quick Ship - Super Erecta® SiteSelect™ Post, 73-7/8"H, for use with stem casters, Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
- c. (2) Model 5PC Quick Ship - Super Erecta® Stem Caster, swivel, 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper
- d. (2) Model 5PCB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper

**ITEM # CM7-16**                    **ICE MACHINE, FLAKER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Hoshizaki**  
**Model:**                        **F-1002MWJ**

- a. Model F-1002MWJ Ice Maker, Flake-Style, 22"W, water-cooled, self-contained condenser, production capacity up to 955 lb/24 hours at 70°/50° (833 lb AHRI certified at 90°/70°), stainless steel finish, Advanced CleanCycle24™, infrared bin sensor, R-404A refrigerant, 115v/60/1-ph, 13.7 amps, NSF, UL

**ITEM # CM7-16.1**                **ICE BIN**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Hoshizaki**  
**Model:**                        **B-800SF**

- a. Model B-800SF Ice Bin, 48"W, top-hinged front-opening door, 800-lb ice storage capacity, for top-mounted ice makers, stainless steel exterior, painted legs included, protected with H-GUARD Plus Antimicrobial Agent, ETL, ETL-Sanitation
- b. Model HS-2035 Top Kit, 22", ABS
- c. Model HS-2032 Top Kit, 4", ABS
- d. Model LP-6 LEG Leg Package, (4) x 6" stainless steel legs
- e. Model HS-5607 Scoop Holder Kit

**ITEM # CM7-16.2**                **WATER FILTER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Hoshizaki**  
**Model:**                        **H9320-51**

- a. Model H9320-51 Water Filtration System, single configuration.

**ITEM # CM7-17**                    **FLOOR TROUGH**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Atlanta Custom Fabricators**  
**Model:**                        **FT**

- a. Model FT Stainless steel floor trough, 4'-0" long X 1'-0" wide, 2" deep, constructed of 14 gauge type 304 stainless steel with perimeter stainless steel anchor tabs welded approximately 12" O.C., removable washable 1" X 1/4" fiber grate. Grating flat bars to be parallel to pour pattern to minimize splash. Provide with 4" O.D. tailpiece drain connection and removable stainless steel scrap basket.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM7-18**            **HAND SINK**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Advance Tabco**  
**Model:**                **7-PS-66**

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus

**ITEM # CM7-19**            **3 COMPARTMENT SINK**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Advance Tabco**  
**Model:**                **K7-CS-29**

- a. Model K7-CS-29 Convenience Store Sink, 3-compartment, with left & right-hand drainboards, 16" front-to-back x 14" W compartment, 12" deep with 8"H backsplash, stainless steel open frame base, side crossrails, adjustable metal bullet feet, 18 gauge 304 stainless steel, 11-5/8" drainboards, overall 21-1/2" F/B x 70" L/R  
OMIT FAUCET
- b. (2) Model K-472 Faucet hole revision.
- c. (3) Model K-4 Support Bracket, for lever waste drain handle, (1) support required for each lever drain

**ITEM # CM7-19.1**        **WALL / SPLASH MOUNT FAUCET**  
**Quantity:**            **Two (2)**  
**Manufacturer:**       **T&S Brass**  
**Model:**                **5F-8WLX10**

- a. Model 5F-8WLX10 Equip Faucet, 8" centers, wall mount, 10" swivel nozzle, lever handles, 2" flange, ceramic cartridges, low lead, ADA Compliant

**ITEM # CM7-20**            **WALL SHELF W/ POT RACK**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Advance Tabco**  
**Model:**                **PS-12-72**

- a. Model PS-12-72 Shelf with Pot Rack, wall-mounted, 72"W x 12"D, 18/430 stainless steel shelf, 2" x 1/4" stainless steel pot rack, includes: (9) plated double pot hooks, NSF

**ITEM # CM7-21**            **ROLL-IN REFRIGERATOR**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Delfield**  
**Model:**                **GARRI2P-S**

- a. Model GARRI2P-S Specification Line® Refrigerator, Roll-In, two-section, 76.5 cubic feet capacity, top-mounted self-contained refrigeration system, (2) full-height hinged solid

doors (locking), 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, 1" tall stainless steel ramp, stainless steel exterior front, sides & interior, GreenGenius™ R290 Hydrocarbon refrigerant, 0.38 HP, 115v/60/1-ph, 6.5 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®

- b. Full height solid door, standard
- c. Door hinged on left standard
- d. Door hinged on right standard

**ITEM # CM7-22                      UNIVERSAL ROLL-IN RACK**  
**Quantity:                              Two (2)**  
**Manufacturer:                        Cres Cor**  
**Model:                                    207UA12AC**

- a. Model 207UA12AC Rack, Roll-In Refrigerator, open frame design, (12) universal slides for 12" x 20" thru 18" x 26" pans on 4-1/2" centers, adjustable at 1-1/2" intervals, welded extruded aluminum frame, NSF
- b. Model 1032 001 Pan Stop, mounted to rear, prevents accidental push through of pans
- c. Model 1056 002 Corner Bumpers, add 2" to OA dimensions, non-marking, gray

**ITEM # CM7-23                      1 COMPARTMENT SINK PREP TABLE**  
**Quantity:                              One (1)**  
**Manufacturer:                        Atlanta Custom Fabricators**  
**Model:                                    1CSPT**

- a. Model 1CSPT Prep table with 1-Compartment Sink, 7'-0" long X 2'-6" wide X 36" high, all 14 gauge type 304 stainless steel construction. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be provided with 8" high back splash 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel Z-clips, marine edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flanged feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished. Cut out top to accommodate drop-in ice well, item 23.2.
- b. Sink to be 20" long X 20" wide X 12" deep, provided with T&S Brass #B-3950 Waste Valve, twist handle assembly for 3-1/2" sink opening, 2" drain outlet with 1-1/2" adapter and stainless steel lever waste bracket. Crease bottom of sink bowl to pitch to the drain. Provide stainless steel skirt to cover sink bowl.
- c. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- d. Unit to be further constructed in accordance with shop drawings  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM7-23.1                    FAUCET**  
**Quantity:                              One (1)**  
**Manufacturer:                        T&S Brass**  
**Model:                                    B-0231-CR**

- a. Model B-0231-CR Faucet, 12" swing nozzle, 8" wall mount base, 1/2" NPT female Inlets, quarter-turn Cerama cartridges, low lead, ADA Compliant

**ITEM # CM7-23.2                    DROP-IN ICE WELLS**  
**Quantity:                              One (1)**



**Manufacturer:** Hatco  
**Model:** IWB-2

- a. Model IWB-2 Drop-In Cold Food Unit, iced cold pan, 32"L x 27"D, (2) pan size (pans not included), insulated, bezel design, 1" brass drain with screen, stainless steel construction, Made in USA

**ITEM # CM7-24**            **WALL MOUNTED OVER SHELF**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Atlanta Custom Fabricators**  
**Model:**                **WMO**

- a. Model WMO Wall mounted over shelf, 7'-0" long X 12" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CM7-25**            **HAND SINK**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Advance Tabco**  
**Model:**                **7-PS-95**

- a. Model 7-PS-95 Hand Sink, pedestal mounted base, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, splash mounted faucet, soap & paper towel dispenser, pedal valves with easy access design, basket drain, wall bracket, NSF, cCSAus
- b. Model 7-PS-17 Welded Side Splash, 7-3/4"H (installed height), both sides, for hand sinks with 14" wide x 10" front-to-back bowl, splash mounted faucets

**ITEM # CM7-26**            **SPARE NO.**

**ITEM # CM7-27**            **SPARE NO.**

**ITEM # CM7-28**            **SPARE NO.**

**ITEM # CM7-29**            **DROP-IN ICE WELL**  
**Quantity:**            **Two (2)**  
**Manufacturer:**       **Hatco**  
**Model:**                **IWB-6**

- a. Model IWB-6 Drop-In Cold Food Unit, iced cold pan, 84"L x 27"D, (6) pan size (pans not included), insulated, bezel design, 1" brass drain with screen, stainless steel construction, Made in USA
- b. Model 6FB8 False Bottom, (3) 3-pan inserts, allows 8" ice depth, attaches to pan bottom, for IWB-6
- c. Model IWB-6SLANT Slant option, for IWB-6
- d. Model BEZELGASKET-6 Rubber Gasket, for (6) pan size drop-in food wells, factory installed, eliminates the need for silicone or other sealants

**ITEM # CM7-30**            **DROP-IN ICE WELL**  
**Quantity:**            **One (1)**  
**Manufacturer:**       **Hatco**

**Model: IWB-3**

- a. Model IWB-3 Drop-In Cold Food Unit, iced cold pan, 45"L x 27"D, (3) pan size (pans not included), insulated, bezel design, 1" brass drain with screen, stainless steel construction, Made in USA
- b. Model 3FB8 False Bottom, (1) 1-pan insert & (1) 2-pan insert, allows 8" ice depth, attaches to pan bottom, for IWB-3
- c. Model IWB-3SLANT Slant option, for IWB-3
- d. Model BEZELGASKET-3 Rubber Gasket, for (3) pan size drop-in food wells, factory installed, eliminates the need for silicone or other sealants

**ITEM # CM7-31 REFRIGERATED DISPLAY****Quantity: Two (2)****Manufacturer: Structural Concepts****Model: B57R**

- a. Model B57R Oasis® Refrigerated Self-Service Case, 59-5/8"W x 34-1/4"D x 82-1/4"H, Warmest average product temperature of 40°F or less, LED top light, (4) metal shelves, Breeze with self-contained refrigeration, condensate pan, magnetic air filter, non-locking casters with levelers, end panels with mirrored stainless interior, black exterior, R290 Hydrocarbon refrigerant, cETLus, ETL-Sanitation
- b. Exterior Color: Powder coated SCC Standard Silversan Black (FDA compliant)
- c. Interior Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- d. Lower Front Panel Color: Powder coated SCC Standard Silversan Black
- e. Rear Exterior Color: Powder coated SCC Standard Silversan Black
- f. Base support: Casters (non-locking) w/ levelers
- g. End Panel Left: Full with stainless steel mirror interior, standard
- h. End Panel Right: Full with stainless steel mirror interior, standard
- i. Cover/Curtain: Roll-down security cover, locking (Requires two end panels (full or cutaway) per case) (One cover/curtain type per model)
- j. Rear Doors: Rear loading hinged doors, locking
- k. Shelving: Metal shelves (4), lighted (LED 4000K)
- l. Top Light: LED 4000K, standard
- m. Electrical Connection: 6' Straight blade power cord, standard
- n. Clean Sweep: None, standard
- o. Refrigeration: Breeze-E (Type II) self-contained refrigeration, standard
- p. Refrigerant: Hydrocarbon refrigerant (R290)
- q. Thermometer: Spirit filled thermometer, standard
- r. Vinyl Graphics: None, standard

**ITEM # CM7-32 REFRIGERATED DISPLAY****Quantity: One (1)****Manufacturer: Structural Concepts****Model: B47R**

- a. Model B47R Oasis® Refrigerated Self-Service Case, 47-5/8"W x 34-1/4"D x 82-1/4"H, Warmest average product temperature of 40°F or less, LED top light, (4) metal shelves, Breeze with self-contained refrigeration, condensate pan, magnetic air filter, non-locking casters with levelers, end panels with mirrored stainless interior, black exterior, R290 Hydrocarbon refrigerant, cETLus, ETL-Sanitation
- b. Exterior Color: Powder coated SCC Standard Silversan Black
- c. Interior Color: Powder coated SCC Standard Silversan Black
- d. Lower Front Panel Color: Powder coated SCC Standard Silversan Black
- e. Rear Exterior Color: Powder coated SCC Standard Silversan Black standard

- f. Base support: Casters (non-locking) w/ levelers
- g. End Panel Left: Full with stainless steel mirror interior, standard
- h. End Panel Right: Full with stainless steel mirror interior, standard
- i. Cover/Curtain: Roll-down security cover, locking.
- j. Rear Doors: Rear loading hinged doors, locking
- k. Shelving: Metal shelves (4), lighted (LED 4000K)
- l. Top Light: LED 4000K, standard
- m. Electrical Connection: 6' Straight blade power cord, standard
- n. Clean Sweep: None, standard
- o. Refrigeration: Breeze-E (Type II) self-contained refrigeration, standard
- p. Refrigerant: Hydrocarbon refrigerant (R290)
- q. Thermometer: Spirit filled thermometer, standard
- r. Vinyl Graphics: None, standard

**ITEM # CM7-33                    HEATED MERCHANDISER**  
**Quantity:                        Five (5)**  
**Manufacturer:                  Hatco**  
**Model:                             GR3SDS-39DCT**

- a. Model GR3SDS-39DCT Glo-Ray® Designer Slant Display Warmer, with curved canopy top, (14) rods, countertop, dual shelf, adjustable thermostat, hardcoated heated base, heated glass shelves, tempered glass side panels, LED display lights, built-in front sign holder (sign not included), 2-1/2" legs, cULus, UL EPH Classified, Made in USA, CE
- b. 120/208-240v/60/1-ph, 2130 watts, 12.8 amps, NEMA L14-20P
- c. Model STANDARD Black designer color, standard
- d. Model 4"LEGS 4-inch adjustable legs, set of 4

**ITEM # CM7-34                    REFRIGERATED SELF-SERVE ISLAND**  
**Quantity:                        One (1)**  
**Manufacturer:                  Structural Concepts**  
**Model:                             FSI660R**

- a. Model FSI660R Oasis® Refrigerated Self-Service Island, 60"H, open air screen, (3) non-lit non-adjustable metal shelves, top light, black interior, includes price tag moulding (matches interior color), laminated exterior, levelers, Breeze-E (Type II) with EnergyWise self-contained refrigeration system, cETLus, ETL-Sanitation
- b. Refrigeration: Breeze self-contained refrigeration, standard
- c. Electrical Connection: 6' NEMA 6-30P, 208-240v/60/1-ph straight blade power cord, standard
- d. Base Support: Casters with levelers (self-cont.), standard
- e. Interior Color: Powder coated SCC Standard Silversan Black (FDA compliant), standard
- f. Exterior Color: Laminate standard color 909-58 Black
- g. Model GRAIN DIRECTION Standard laminate grain directions (when applicable):
  - Front Panels (Upper Header and Lower Panels): Horizontal grain direction
  - End Panels: Vertical grain direction
  - Blend & Reveal Cases Only: Horizontal grain direction on front and end panels
- h. Thermometer: Digital fahrenheit thermometer, standard
- i. Shelving: (3) LED Lighted non-adjustable metal shelves

**ITEM # CM7-35                    ICE MAKER**  
**Quantity:                        Two (2)**  
**Manufacturer:                  Ice-O-Matic**  
**Model:                             CIM0836FA**

- a. Model CIM0836FA Elevation Series™ Modular Cube Ice Maker, air-cooled, self-contained condenser, dual exhaust top/side air discharge, 30" W, approximately 896 lb production/24 hours at 70°/50° (711 lb at 90°/70°), full-size cubes, PURE ICE® built-in antimicrobial protection, LED status display, one touch sanitize/descaling controls, dishwasher safe food zone components, cULus, NSF, CE, BPA Free
- b. 208-230v/60/1-ph, 13.4 amps, standard

**ITEM # CM7-35.1      SODA DISPENSER**  
**Quantity:            Two (2)**  
**Manufacturer:        By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # CM7-35.2      WATER FILTER**  
**Quantity:            Two (2)**  
**Manufacturer:        Ice-O-Matic**  
**Model:                IFQ2**

- a. Model IFQ2 Water Filter Manifold, dual filter designed for ice makers producing between 1050 & 1400 lbs. (476.3 to 635 Kg.) of ice per day, 3.0 gpm maximum flow rate, IsoNet® scale inhibitor, .5 micron particle reduction.

**ITEM # CM7-36        UNDERCOUNTER SODA SYSTEM SYRUP RACK**  
**Quantity:            One (1)**  
**Manufacturer:        By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # CM7-36.1      CARBONATOR**  
**Quantity:            One (1)**  
**Manufacturer:        By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # CM7-37        CONDIMENT CADDY**  
**Quantity:            Two (2)**  
**Manufacturer:        Dispense-Rite**  
**Model:                NLO-STK-1BT**

- a. Model NLO-STK-1BT Lid, Straw & Condiment Organizer, 7-1/8" H x 8" W x 19-1/8" D, narrow, removable section dividers, polystyrene, black

**ITEM # CM7-38        POS, SELF-CHECKOUT**  
**Quantity:            Six (6)**  
**Manufacturer:        BY OPERATIONS**  
**Model:                POS**

- a. Model POS PROVIDED BY OPERATIONS

**ITEM # CM7-39        MOP SINK CABINET**  
**Quantity:            One (1)**  
**Manufacturer:        Advance Tabco**

**Model: 9-OPC-84**

- a. Model 9-OPC-84 Cabinet with Mop Sink, 25-3/16"W x 22-3/4"D x 84"H, mop sink base with drain (bowl 16" x 20" x 12"), left hinged door, (2) mop holders, (1) fixed intermediate shelf, slotted side panels for ventilation, 16/304 series stainless steel sink bowl, 18/304 series stainless steel sink bowl apron, 18/430 series stainless steel cabinet, NSF.
- b. Model CAB-R Change door to right-side hinge
- c. Model K-240 Service Sink Faucet, wall mount, heavy duty, 8" OC, 6-1/2" spout, with hose thread & pail hook, vacuum breaker spout, wall braced, chrome-plated brass
- d. Model K-610CF Perforated bottom strainer plate, stainless steel, removable, sits 1" above bottom of sink, fits Advance Tabco Fabricated 16" x 20" sink bowls only

**CSC – CONCOURSE LEVEL SIDELINE CLUB**

**ITEM # CSC-1                    1 COMPARTMENT SINK PREP TABLE**  
**Quantity:                        One (1)**  
**Manufacturer:                  Atlanta Custom Fabricators**  
**Model:                             1CSPT**

- a. Model 1CSPT Prep table with 1-Compartment Sink, 7'-0" long X 2'-6" wide X 36" high, all 14 gauge type 304 stainless steel construction. Table to be fully welded construction with all welds ground and polished to a uniform finish. Top to be provided with 8" high back splash, 2" return on 45 degree angle and 1" turned down, attach to wall with stainless steel Z-clips, marine edges, stainless steel cross bracing, stainless steel legs and stainless steel adjustable flanged feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Sink to be 20" long X 20" wide X 12" deep, provided with T&S Brass #B-3950 Waste Valve, twist handle assembly for 3-1/2" sink opening, 2" drain outlet with 1-1/2" adapter and stainless steel lever waste bracket. Crease bottom of sink bowl to pitch to the drain. Provide stainless steel skirt to cover sink bowl.
- c. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- d. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CSC-1.1                FAUCET**  
**Quantity:                        One (1)**  
**Manufacturer:                  T&S Brass**  
**Model:                             B-0231-CR**

- a. Model B-0231-CR Faucet, 12" swing nozzle, 8" wall mount base, 1/2" NPT female Inlets, quarter-turn Cerama cartridges, low lead, ADA Compliant

**ITEM # CSC-2                    WALL MOUNTED OVER SHELF**  
**Quantity:                        One (1)**  
**Manufacturer:                  Atlanta Custom Fabricators**  
**Model:                             WMO**

- a. Model WMO Wall mounted over shelf, 7'-0" long X 12" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2",

supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.

- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CSC-2.1**            **WALL MOUNTED OVER SHELF**  
**Quantity:**                **One (1)**  
**Manufacturer:**        **Atlanta Custom Fabricators**  
**Model:**                    **WMO**

- a. Model WMO Wall mounted over shelf, 7'-0" long X 14" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CSC-3**            **HAND SINK**  
**Quantity:**                **One (1)**  
**Manufacturer:**        **Advance Tabco**  
**Model:**                    **7-PS-66**

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus

**ITEM # CSC-4**            **WORK TABLE**  
**Quantity:**                **One (1)**  
**Manufacturer:**        **Atlanta Custom Fabricators**  
**Model:**                    **WT**

- a. Model WT Work table, all stainless steel construction, 5'-0" long X 2'-6" wide X 36" high. Table to be fully welded construction with all welds fully ground and polished to a uniform finish. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges, 8" back splash with 2" return on 45 degree angle and 1" turned down, attach with stainless steel Z clips, stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.
- c. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CSC-5**            **WALL MOUNTED OVER SHELF**  
**Quantity:**                **One (1)**  
**Manufacturer:**        **Atlanta Custom Fabricators**  
**Model:**                    **WMO**

- a. Model WMO Wall mounted over shelf, 5'-0" long X 12" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2",

supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.

- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CSC-5.1**            **WALL MOUNTED OVER SHELF**  
**Quantity:**                **One (1)**  
**Manufacturer:**        **Atlanta Custom Fabricators**  
**Model:**                    **WMO**

- a. Model WMO Wall mounted over shelf, 5'-0" long X 14" deep. Shelf to be constructed of 16 gauge type 304 stainless steel with back and ends turned up 2" and front rolled 1-1/2", supported by 14 gauge stainless steel cantilever brackets secured to wall with stainless steel fasteners.
- b. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CSC-6**            **ICE MACHINE**  
**Quantity:**                **One (1)**  
**Manufacturer:**        **Hoshizaki**  
**Model:**                    **KM-660MWJ**

- a. Model KM-660MWJ Ice Maker, Cube-Style, 22"W, water-cooled, self-contained condenser, production capacity up to 647 lb/24 hours at 70°/50° (630 lb AHRI certified at 90°/70°), stainless steel finish, crescent cube style, R-404A refrigerant, 115v/60/1-ph, 12.35 amps, NSF, UL

**ITEM # CSC-6.1**        **ICE BIN**  
**Quantity:**                **One (1)**  
**Manufacturer:**        **Hoshizaki**  
**Model:**                    **B-500SF**

- a. Model B-500SF Ice Bin, 30"W, top-hinged front-opening door, 500-lb ice storage capacity, for top-mounted ice maker, stainless steel exterior, painted legs included, protected with H-GUARD Plus Antimicrobial Agent, ETL, ETL-Sanitation
- b. Model HS-2033 Top Kit, 8", ABS
- c. Model LP-6 LEG Leg Package, (4) x 6" stainless steel legs
- d. Model HS-5607 Scoop Holder Kit

**ITEM # CSC-6.2**        **WATER FILTER**  
**Quantity:**                **One (1)**  
**Manufacturer:**        **Hoshizaki**  
**Model:**                    **H9320-51**

- a. Model H9320-51 Water Filtration System, single configuration.

**ITEM # CSC-7**            **FLOOR TROUGH**  
**Quantity:**                **One (1)**  
**Manufacturer:**        **Atlanta Custom Fabricators**  
**Model:**                    **FT**

- a. Model FT Stainless steel floor trough, 2'-6" long X 1'-0" wide, 2" deep, constructed of 14 gauge type 304 stainless steel with perimeter stainless steel anchor tabs welded approximately 12" O.C., removable washable 1" X 1/4" fiber grate. Grating flat bars to be

parallel to pour pattern to minimize splash. Provide with 4" O.D. tailpiece drain connection and removable stainless steel scrap basket.

- b. Unit to be further constructed in accordance with shop drawings.

APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CSC-8**                      **3 COMPARTMENT SINK**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **Advance Tabco**  
**Model:**                         **K7-CS-29**

- a. Model K7-CS-29 Convenience Store Sink, 3-compartment, with left & right-hand drainboards, 16" front-to-back x 14" W compartment, 12" deep with 8"H backsplash, stainless steel open frame base, side crossrails, adjustable metal bullet feet, 18 gauge 304 stainless steel, 11-5/8" drainboards, overall 21-1/2" F/B x 70" L/R  
 OMIT FAUCET
- b. (2) Model K-472 Faucet hole revision
- c. (3) Model K-4 Support Bracket, for lever waste drain handle, (1) support required for each lever drain
- d. Model K-454 Side splash, integral (welded), for NSF sinks & dish tables, height matches backsplash height.  
 RIGHT SIDE

**ITEM # CSC-8.1**                **FAUCET**  
**Quantity:**                      **Two (2)**  
**Manufacturer:**                **T&S Brass**  
**Model:**                         **5F-8WLX10**

- a. Model 5F-8WLX10 Equip Faucet, 8" centers, wall mount, 10" swivel nozzle, lever handles, 2" flange, ceramic cartridges, low lead, ADA Compliant

**ITEM # CSC-9**                    **WALL SHELF W/ POT RACK**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **Advance Tabco**  
**Model:**                         **PS-12-72**

- a. Model PS-12-72 Shelf with Pot Rack, wall-mounted, 72"W x 12"D, 18/430 stainless steel shelf, 2" x 1/4" stainless steel pot rack, includes: (9) plated double pot hooks, NSF

**ITEM # CSC-10**                **BAG-IN-BOX RACK**  
**Quantity:**                      **Two (2)**  
**Manufacturer:**                **By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # CSC-10.1**              **CARBONATOR**  
**Quantity:**                      **Two (2)**  
**Manufacturer:**                **By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER  
 CARBONATOR IS LOCATED IN (CSC) CONCOURSE LEVEL - SIDLE LINE CLUB BAR

**ITEM # CSC-10.2**              **CARBONATOR**  
**Quantity:**                      **Two (2)**  
**Manufacturer:**                **By Product Supplier**



- a. PROVIDED BY PRODUCT SUPPLIER  
CARBONATOR IS LOCATED IN (CB2) CONCOURSE LEVEL - BAR 2

**ITEM # CSC-11**                    **STORAGE SHELVING**  
**Quantity:**                    **Four (4) – (1 COMPLETE UNIT 4 SHELVES)**  
**Manufacturer:**              **Metro**  
**Model:**                        **1830NK3**

- a. Model 1830NK3 Quick Ship - Super Erecta® Shelf, wire, 30"W x 18"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. Model 74UPK3 Quick Ship - Super Erecta® SiteSelect™ Post, 73-7/8"H, for use with stem casters, Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
- c. (2) Model 5PC Quick Ship - Super Erecta® Stem Caster, swivel, 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper
- d. (2) Model 5PCB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper

**ITEM # CSC-12**                    **MOP SINK CABINET**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Advance Tabco**  
**Model:**                        **9-OPC-84**

- a. Model 9-OPC-84 Cabinet with Mop Sink, 25-3/16"W x 22-3/4"D x 84"H, mop sink base with drain (bowl 16" x 20" x 12"), left hinged door, (2) mop holders, (1) fixed intermediate shelf, slotted side panels for ventilation, 16/304 series stainless steel sink bowl, 18/304 series stainless steel sink bowl apron, 18/430 series stainless steel cabinet, NSF (right hinged door available on request)
- b. Model CAB-R Change door to right-side hinge
- c. Model K-240 Service Sink Faucet, wall mount, heavy duty, 8" OC, 6-1/2" spout, with hose thread & pail hook, vacuum breaker spout, wall braced, chrome-plated brass
- d. Model K-610CF Perforated bottom strainer plate, stainless steel, removable, sits 1" above bottom of sink, fits Advance Tabco Fabricated 16" x 20" sink bowls only

**ITEM # CSC-13**                    **SPARE NO.**

**ITEM # CSC-14**                    **SPARE NO.**

**ITEM # CSC-15**                    **REACH-IN REFRIGERATOR**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Delfield**  
**Model:**                        **GAR2P-S**

- a. Model GAR2P-S Specification Line® Refrigerator, Reach-In, two-section, 46.0 cubic feet capacity, top-mounted self-contained refrigeration system, (2) full-height hinged solid doors (locking), (6) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, stainless steel exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.35 HP, 115v/60/1-ph, 6.0 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®

- b. Left door hinged on left, right door hinged on right, standard
- c. Set of (4) 5" locking casters, standard

**ITEM # CSC-16**                    **ROLL-IN REFRIGERATOR**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Delfield**  
**Model:**                        **GARRI1P-S**

- a. Model GARRI1P-S Specification Line® Refrigerator, Roll-In, one-section, 37.0 cubic feet capacity, top-mounted self-contained refrigeration system, (1) full-height hinged solid door (locking), 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, 1" tall stainless steel ramp, stainless steel exterior front, sides & interior, GreenGenius™ R290 Hydrocarbon refrigerant, 0.35 HP, 115v/60/1-ph, 6.0 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®
- b. Full height solid door, standard
- c. Door hinged on right standard

**ITEM # CSC-17**                    **UNIVERSAL ROLL-IN RACK**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**                **Cres Cor**  
**Model:**                        **207UA12AC**

- a. Model 207UA12AC Rack, Roll-In Refrigerator, open frame design, (12) universal slides for 12" x 20" thru 18" x 26" pans on 4-1/2" centers, adjustable at 1-1/2" intervals, welded extruded aluminum frame, NSF
- b. Model 1032 001 Pan Stop, mounted to rear, prevents accidental push through of pans
- c. Model 1056 002 Corner Bumpers, add 2" to OA dimensions, non-marking, gray

**ITEM # CSC-18**                    **HAND SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Advance Tabco**  
**Model:**                        **7-PS-95**

- a. Model 7-PS-95 Hand Sink, pedestal mounted base, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, splash mounted faucet, soap & paper towel dispenser, pedal valves with easy access design, basket drain, wall bracket, NSF, cCSAus
- b. Model 7-PS-17 Welded Side Splash, 7-3/4"H (installed height), both sides, for hand sinks with 14" wide x 10" front-to-back bowl, splash mounted faucets

**ITEM # CSC-19**                    **REACH-IN FREEZER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Delfield**  
**Model:**                        **GAF1P-SH**

- a. Model GAF1P-SH Specification Line® Freezer, Reach-In, one-section, 21.0 cubic feet capacity, top-mounted self-contained refrigeration system, (2) half-height hinged solid doors (locking), (3) adjustable chrome wire shelves, 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, pilaster with shelf clips, stainless steel exterior front, sides & interior, (4) 5" locking casters, GreenGenius™ R290 Hydrocarbon refrigerant, 0.55 HP, 115v/60/1-ph, 7.2 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®
- b. ODoor hinged on right standard
- c. Set of (4) 5" locking casters, standard

**ITEM # CSC-20**                      **EXHAUST HOOD W/ FIRE SYSTEM**  
**Quantity:**                        **One (1)**  
**Manufacturer:**                **Accurex**  
**Model:**                            **XBEW-108.00-S**

- a. Model XBEW-108.00-S
- A. Type I, exhaust only wall canopy suitable for all types of cooking applications. The hood(s) shall be U.L. 710 Listed without a fire damper (with optional) for medium, heavy, or extra-heavy duty rated cooking appliances. Make-up air shall be independently provided. The hood(s) exterior shall be constructed of a minimum of 18-gauge 300 series stainless steel. The hood(s) shall be constructed using the standing seam method for optimum strength and with a Performance Enhancing Lip (PEL) to improve capture efficiency by turning air back into the hood. Front panels shall be of single wall construction. An integral 3-inch air space is provided to meet NFPA® 96 clearance requirements against limited combustible walls. Integral 3-inch air space may be omitted for non-combustible construction. All seams, joints and penetrations of the hood enclosure shall be welded and/or liquid tight. Lighter material gauges, alternate material types and finishes are not acceptable. All unexposed interior surfaces shall be constructed of a minimum 18-gauge corrosion resistant stainless steel including, but not limited to ducts, plenum, and brackets.
- B. The hood(s) shall include a filter housing constructed of the same material as the hood. The filters shall be stainless steel baffle type (non-stick coating optional), U.L. 1046 Classified, and in sufficient number and size to ensure optimum performance. The filter housing shall terminate in a pitched, full length grease trough which shall drain into a removable grease container. These filters shall have a grease removal efficiency of 28% at 8 microns (16% from 3-10 microns) and static pressure drop of 0.5-0.6 in WC. Vapor proof, U.L.
- C. LED light fixtures shall be pre-wired to a junction box located at the top of the hood for field connection. The wiring shall conform to the requirements of the NFPA® 70.
- D. The canopy hood(s) shall be built in accordance with the NFPA® 96, IMC, UMC, and bear the NSF Seal of Approval. The hood manufacturer shall provide, on request, the necessary data that confirms compliance with the code authorities listed above.
- E. Continuous Capture - UL listed connection to join multiple sections.
- F. Provide Accurex Controls: XKC-CV-S Controls system shall be a UL listed outlet center which shall standardly consist of a NEMA-1 Stainless Steel Enclosure within a Stainless-Steel Enclosure Panel, Printed Circuit Board (PCB), with Full Color Touchscreen, audible alarm, sensor (s) and motor starters. The constant volume Accurex Controls shall utilize resistive type temperature sensors that are mounted in the capture tank of the hood to monitor exhaust air temperatures, and an optional room temperature sensor, shipped loose, to be installed to detect ambient air temperatures in the kitchen space. Temperature sensors shall be made of stainless steel and shall be installed in a UL approved coupling.
- G. Fire System – Provide factory pre-piped for Ansul R-102 fire protection system located in an integral utility cabinet on the right end of the hood. The system shall provide surface, duct, and plenum protection for items of cooking equipment located beneath the hood in accordance with all applicable codes and provisions of NFPA 17A and 96. All system piping shall be concealed where possible with exposed portions of either chrome fittings or stainless-steel sleeving. The system shall be wired with shunt trip breaker and electric/gas shut-off valve serving items of cooking equipment beneath the hood to provide power and fuel shut-off in the event of system actuation.
- H. Exhaust fan(s) and supply fan(s) to be supplied by Mechanical Contractor
- I. 304 Stainless Steel inside and out. No galvanized metal.
- J. Provide fire cabinet on right end of hood.

K. Provide stainless steel backsplash for entire length of hood with 18" to extend right and 18" to extend left of the hood we applicable.

L. Provide stainless steel hood enclosure panel. Top of hood to have a minimum of 3" above the ceiling.

**ITEM # CSC-21**                    **FRYER**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**            **Henny Penny**  
**Model:**                        **OFE321.0**

- a. Model OFE321.0 OFE-321 Open Fryer, floor model, electric, 1 well, stainless steel construction, rectangular fry pot, includes filter drain pan, stainless steel Max oil filtration system, 2 PHT filter envelopes, 4" swiveling casters (2 locking), basket support included in each vat, BUILT-TO-ORDER CONFIGURATION, ENERGY STAR®
- b. F Full well configuration, standard
- c. 480v/60/3-ph, 14.4 kW, 17.0 amps, 3+G wires
- d. C1 Computron® 1000 control with melt mode, idle mode, two 4-character LED displays per control
- e. Without direct connect shortening disposal system plumbing
- f. Full Size Basket
- g. Model 180156 Crumb Catcher, for single well drain pans
- h. Model 03629 Fryer Pot Cover, 32x full pot

**ITEM # CSC-22**                    **REFRIGERATED EQUIPMENT STAND**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Delfield**  
**Model:**                        **F2952CP**

- a. Model F2952CP Refrigerated Low-Profile Equipment Stand, 52-1/4"W x 31-47/50"D x 24"H, single-section, (2) drawers (pans not included), stainless steel top & drawer fronts, front non-spill edge, ABS interior sides, 4" casters, side-mounted refrigeration system with electric condensate evaporator, R290 Hydrocarbon refrigerant, 1/5 hp, cUL, UL, NSF
- b. 115v/60/1-ph, 2.9 amps, NEMA 5-15P, standard
- c. Full perimeter marine edge, standard
- d. Compressor on right, standard

**ITEM # CSC-23**                    **GRIDDLE, HEAVY DUTY**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Southbend**  
**Model:**                        **HDG-48**

- a. Model HDG-48 Griddle, countertop, gas, 48" W x 24" D cooking surface, 1" thick polished steel plate, thermostatic controls, battery spark ignition, flame failure safety device, stainless steel front, sides & 4" adjustable legs, 120,000 BTU, CSA, NSF
- b. Natural Gas
- c. 4" legs, standard
- d. T&S Brass Model HG-2D-48SK-PS Safe-T-Link Gas Connector Kit, 3/4" connection, 48" hose, stainless steel braiding with extruded coating, (2) SwiveLink fittings, 360° rotatable hex nut, with 90° elbow & installation kit (includes restraining cable & ball valve), Posi-Set, 215,000 BTU/ hr minium flow capacity

**ITEM # CSC-24**                    **UNDERCOUNTER REFRIGERATED WORK TOP**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Delfield**

**Model: 4448NP**

- a. Model 4448NP Refrigerated Worktop/Undercounter, two-section, 48"W, (2) doors
- b. 115v/60/1-ph, NEMA 5-15P, standard
- c. Self-contained refrigeration, standard
- d. NN: 32" work height
- e. Door(s) standard

**ITEM # CSC-25 HOT FOOD HOLDING CABINET**

**Quantity: Two (2)**  
**Manufacturer: Alto-Shaam**  
**Model: 750-CTUS**

- a. Model 750-CTUS Halo Heat® Hot Food Storage Unit, 1-compartment, capacity (6) 12" x 20" full-size pans, French doors with (2) positive latch door handles, ON/OFF adjustable thermostat, indicator light, exterior temperature gauge, thermostat for 60° F - 200° F, stainless steel exterior & interior, EcoSmart®, cULus, NSF
- b. 120v/50/60/1-ph, 18.8 amps, 2.25kW, NEMA L5-30P
- c. Model 14227 Casters, 3" (76mm), set of (4).

**ITEM # CSC-26 REFRIGERATED PREP TABLE**

**Quantity: One (1)**  
**Manufacturer: Delfield**  
**Model: 4448NP-18M**

- a. Model 4448NP-18M Mega Top Sandwich/Salad Top Refrigerator, two-section, 48" W, 16.0 cubic feet, (2) doors, (2) 1/1 GN shelves, stainless steel top with polyethylene cutting board & (18) 1/6 size plastic pans, ABS interior sides, stainless steel front & sides, 5" casters, front-breathing rear-mounted refrigeration system, R290 Hydrocarbon refrigerant, 0.3 hp, cUL, UL, NSF
- b. 115v/60/1-ph, NEMA 5-15P, standard
- c. Self-Contained refrigeration, standard
- d. Door(s) standard
- e. Model 44CLEARLID Clear plexi lid (per opening)
- f. MUST confirm the quantity of lids required per cutout

**ITEM # CSC-27 WORK TABLE**  
**Quantity: One (1)**  
**Manufacturer: Atlanta Custom Fabricators**  
**Model: WT**

- a. Model WT Work table, all stainless steel construction, 6'-0" long X 2'-6" wide X 36" high. Table to be fully welded construction with all welds fully ground and polished to a uniform finish. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges, 8" back splash and left end splash, with 2" return on 45 degree angle and 1" turned down, attach with stainless steel Z clips, stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet. All exposed back and end splashes to be enclosed, fully welded, ground and polished.
- b. Model US Undershelf section constructed of 16 gauge type 304 stainless steel with rear and ends turned-up 2", front edge turned down 1-1/2" with 3/4" return on 45 degree angle, closed ends, reinforced with stainless steel hat channel on underside of shelf, size and shape per plan, notched and fully welded to legs, ground and polished to a uniform finish.

- c. Unit to be further constructed in accordance with shop drawings.  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # CSC-28**                    **PANINI GRILL**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Equipex LLC**  
**Model:**                        **DIABLO PREMIUM**

- a. Model DIABLO PREMIUM Roller Grill Panini Grill, cast iron grooved top & grooved bottom griddle plates, (2) 14"W x 9-1/2"D grill areas, (2) self- balancing adjustable top plates with heavy duty handles, front grease drawers & selector switches for panini press or bottom plate only operation, electronic timer, grills with stainless steel construction, 570°F thermostatic controls, 208/240v/60/1-ph, 24.0/27.0 amps, 6.5kW, NEMA 6-50P, cULus, cULus Classified
- b. Grooved top & grooved bottom plates, standard

**ITEM # CSC-29**                    **CONVEYOR TOASTER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Hatco**  
**Model:**                        **TQ3-400**

- a. Model TQ3-400 Toast-Qwik® Conveyor Toaster, countertop design, horizontal conveyor, touchscreen controls, (12) programmable recipes, all bread types toaster, approximately 6-7 slices/min capacity, USB, power save mode, 2" opening height, includes stainless steel toast tray insert, cULus, UL EPH Classified, CE
- b. 120v/50/60/1-ph, 1780 watts, 14.8 amps, NEMA 5-15P, standard
- c. Model STANDARD Black side panels, standard

**ITEM # CSC-30**                    **COLD SHELF, UNDERMOUNT**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Hatco**  
**Model:**                        **CSU-48-S**

- a. Model CSU-48-S Cold Shelf, undermount, 48"W x 24"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 5/8 HP, cULus, Made in USA
- b. 120v/60/1-ph, 800 watts, 5/8 HP, NEMA 5-15P (domestic voltage), standard

**ITEM # CSC-31**                    **SLIM DROP-IN HEATED WELL**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**                **Hatco**  
**Model:**                        **HWBI-S2**

- a. Model HWBI-S2 Drop-In Modular Slim Heated Well, (2) full size pan capacity, insulated, top mounted, remote thermostat with separate power switch, stainless steel & Aluminized construction (standard watt), CE, cULus, UL EPH Classified, Made in USA
- b. 208v/60/1, 2415w, 11.6 amps
- c. Single remote control configuration
- d. 15-5/8" bezel depth, standard

**ITEM # CSC-32**                    **UNDER-COUNTER BUFFET WARMER**  
**Quantity:**                    **Five (5)**  
**Manufacturer:**                **CookTek**  
**Model:**                        **660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # CSC-33**                    **FOOD SHIELD**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Spring USA**  
**Model:**                        **VG3-SK**

- a. Model VG3-SK Versa-Gard, adjustable, (7) position self-service/ operator service food protector, glass top/shelf & end panels, 1/4" or 3/8" clear tempered glass, surface mount, NSF/ANSI.
- b. LED LIGHTING

**ITEM # CSC33.1**                **FOOD SHIELD**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Spring USA**  
**Model:**                        **VG3-SK**

- a. Model VG3-SK Versa-Gard, adjustable, (7) position self-service/ operator service food protector, glass top/shelf & end panels, 1/4" or 3/8" clear tempered glass, surface mount, NSF/ANSI.
- b. LED LIGHTING

**ITEM # CSC-33.2**                **FOOD SHIELD**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Spring USA**  
**Model:**                        **VG3-DS**

- a. Model VG3-DS Versa-Gard, double-sided, adjustable (7) position self-service food protector, top panel/ shelf & end panels, 1/4" or 3/8" clear tempered glass, surface mount, NSF/ANSI.
- b. LED LIGHTING

**ITEM # CSC-33.3**                **FOOD SHIELD**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Spring USA**  
**Model:**                        **VG3-DS**

- a. Model VG3-DS Versa-Gard, double-sided, adjustable (7) position self-service food protector, top panel/ shelf & end panels, 1/4" or 3/8" clear tempered glass, surface mount, NSF/ANSI
- b. LED LIGHTING

**ITEM # CSC-34**                    **UNDERBAR HANDSINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12HS**

- a. Model TSF12HS TSF Series Underbar Hand Sink Unit, 12"W x 24"D, 10" wide x 14" front-to-back x 9-1/4" deep 18 gauge stainless steel sink, backsplash, 4" OC splash

mount faucet holes, (16) oz. pump soap dispenser integrated into front apron, C-fold paper towel dispenser integrated into front apron, stainless steel hinged door with magnetic catches, 1-1/2" NPS male drain, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with 1" adjustable thermoplastic feet.

- b. 6" Backsplash standard
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # CSC-35**                    **BRIDGE TRASH MODULE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12BTB**

- a. Model TSF12BTB TSF Series Trash Receptacle Top Cover, 12"W x 24"D x 13-9/16"H, stainless steel construction (wastebasket is not included), 6"H backsplash, 8-3/8" x 6-3/8" opening for trash (requires support by adjacent underbar equipment or accessory end panel & leg kit)
- b. 6" Backsplash standard

**ITEM # CSC-36**                    **UNDERBAR DRAINBOARD**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12DB**

- a. Model TSF12DB TSF Series Underbar Drainboard, 12"W x 24"D, pitched drainboard top, all stainless steel construction, backsplash, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet (replaces TSF12 TSD12)
- b. 6" backsplash
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 1032968-12 TSF Series 12"W Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed

**ITEM # CSC-37**                    **UNDERBAR DRAINBOARD**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TS90D-FI**

- a. Model TS90D-FI TS Series Underbar Corner Drainboard, 18-9/16"W x 18-9/16"D, drainboard top, glass rack inserts, 90° full inside front corner, clipped rear corner, backsplash, 1-1/2" drain, all stainless-steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.

**ITEM # CSC-38**                    **UNDERBAR BLENDER STATION W/SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12BS**



- a. Model TSF12BS TSF Series Underbar Blender Station with 18 gauge stainless steel dump sink, 12"W, backsplash, 9-5/8" wide x 10-5/8" front-to-back x 6" deep sink, 4" OC splash mount faucet holes, recessed blender shelf with access hole & installed junction box, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # CSC-39**                    **BRIDGE TRASH MODULE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Perlick Corporation**  
**Model:**                      **TSF12BTB**

- a. Model TSF12BTB TSF Series Trash Receptacle Top Cover, 12"W x 24"D x 13-9/16"H, stainless steel construction (wastebasket is not included), 6"H backsplash, 8-3/8" x 6-3/8" opening for trash (requires support by adjacent underbar equipment or accessory end panel & leg kit)
- b. 6" Backsplash standard

**ITEM # CSC-40**                    **UNDERBAR ICE WELL**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Perlick Corporation**  
**Model:**                      **TS36IC10**

- a. Model TS36IC10 TS Series Underbar Ice Bin/Cocktail Unit, modular with cold plate, 36"W x 18-9/16"D, approximately 85-lb. ice capacity, 10-circuit aluminum cold plate concealed under bin liner, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF
- b. 6" Backsplash standard
- c. Model ICC36 Ice Chest Covers, 2-piece sliding assembly, 36"W, front & back, stainless steel.

**ITEM # CSC-40.1**                **SPEED RAIL**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Perlick Corporation**  
**Model:**                      **SR-D36A**

- a. Model SR-D36A Speed Rail, double, 36" W, stainless steel construction, factory installed

**ITEM # CSC-40.2**                **SODA GUN STATION**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Perlick Corporation**  
**Model:**                      **TSF4SGB**

- a. Model TSF4SGB TSF Series Soda Gun Filler Section, 4"W x 24"D x 22"H, all stainless steel construction, universal design accepts either Wunder-Bar® & Schroeder America™

8-14 product soda manifolds & drip cups (accepts only NON-FLOW CONTROL manifolds that don't exceed 3" in overall thickness), interior mounted manifold conceals soda lines, tool-less removal of top cover provides easy access, integrated drip cup mounting allows concealed routing of drip tube to waste drain, accessory speed rails can bypass or terminate on Soda Gun Filler, soda manifold, hose gun & drip cup NOT included, NSF

**ITEM # CSC-41**                    **UNDERBAR DRAINBOARD**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12DB**

- a. Model TSF12DB TSF Series Underbar Drainboard, 12"W x 24"D, pitched drainboard top, all stainless steel construction, backsplash, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" backsplash
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 1032968-12 TSF Series 12"W Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed

**ITEM # CSC-42**                    **UNDERCOUNTER DISH MACHINE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **MEIKO**  
**Model:**                        **UM**

- a. Model UM M-iClean Series Glasswasher, undercounter, 23-5/8"W x 23-5/8"D x 28-3/4"H, high temperature with built-in booster, fully automatic operation, (37) racks/hour capacity, 0.61 gallons/rack, illuminated door handle, glass touch-screen display, M-iClean active wash water filtration, Blue Touch component color coding for intuitive manual cleaning, Auto-Safe temperature control for guaranteed sanitization, Soft Start fine china & glassware protection, leak detection, pumped drain & rinse, standard liquid detergent & rinse aid pumps, double-wall stainless steel construction, (1) coated wire glass rack included, 3/4 HP wash pump, NSF, cETLus, ENERGY STAR®
- b. 208-230v/60/3-ph, 31.1/33.9 amps, standard
- c. NEMA 15-50P, installed by others, includes plug, receptacle & plate
- d. Drain water tempering kit, reduces drain water temperature to below 140°F, installed by others
- e. Standard adjustable hex feet
- f. Drain board top

**ITEM # CSC-43**                    **BOTTLE COOLER**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **BC36RT-3**

- a. Model BC36RT-3 Bottle Cooler, flat top, 36" W, self-contained refrigeration, (8.6) cu. ft. interior capacity, digital temperature control & display, 38°F factory temperature setting, (1) dent-resist and stainless steel door with lock & die-cast handles, automatic condensate evaporator, stainless steel top & interior, R290 Hydrocarbon refrigerant, 1/6 HP, 120v/60/1-ph, 1.9 amps, NEMA 5-15P, NSF, cULus
- b. Black cabinet finish
- c. (2) bin dividers with supporting brackets
- d. Model 67061 Casters, 2-7/8", set of (4)

**ITEM # CSC-44**                    **UNDERBAR HANDSINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12HS**

- a. Model TSF12HS TSF Series Underbar Hand Sink Unit, 12"W x 24"D, 10" wide x 14" front-to-back x 9-1/4" deep 18 gauge stainless steel sink, backsplash, 4" OC splash mount faucet holes, (16) oz. pump soap dispenser integrated into front apron, C-fold paper towel dispenser integrated into front apron, stainless steel hinged door with magnetic catches, 1-1/2" NPS male drain, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with 1" adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # CSC-45**                    **BRIDGE TRASH MODULE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12BTB**

- a. Model TSF12BTB TSF Series Trash Receptacle Top Cover, 12"W x 24"D x 13-9/16"H, stainless steel construction (wastebasket is not included), 6"H backsplash, 8-3/8" x 6-3/8" opening for trash (requires support by adjacent underbar equipment or accessory end panel & leg kit)
- b. 6" Backsplash standard
- c. Model BTB-PL Leg Panel Kit, left
- d. Model BTB-PL Leg Panel Kit, right

**ITEM # CSC-46**                    **UNDERBAR BLENDER STATION W/SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Perlick Corporation**  
**Model:**                        **TSF12BS**

- a. Model TSF12BS TSF Series Underbar Blender Station with 18 gauge stainless steel dump sink, 12"W, backsplash, 9-5/8" wide x 10-5/8" front-to-back x 6" deep sink, 4" OC splash mount faucet holes, recessed blender shelf with access hole & installed junction box, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # CSC-47**                    **UNDERBAR ICE WELL**  
**Quantity:**                    **One (1)**

**Manufacturer:** Perlick Corporation  
**Model:** TS36IC10

- a. Model TS36IC10 TS Series Underbar Ice Bin/Cocktail Unit, modular with cold plate, 36"W x 18-9/16"D, approximately 85-lb. ice capacity, 10-circuit aluminum cold plate concealed under bin liner, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF
- b. 6" Backsplash standard
- c. Model ICC36 Ice Chest Covers, 2-piece sliding assembly, 36"W, front & back, stainless steel.

**ITEM # CSC-47.1**      **SPEED RAIL**  
**Quantity:** One (1)  
**Manufacturer:** Perlick Corporation  
**Model:** SR-D36A

- a. Model SR-D36A Speed Rail, double, 36" W, stainless steel construction, factory installed

**ITEM # CSC-47.2**      **SODA GUN STATION**  
**Quantity:** One (1)  
**Manufacturer:** Perlick Corporation  
**Model:** TSF4SGB

- a. Model TSF4SGB TSF Series Soda Gun Filler Section, 4"W x 24"D x 22"H, all stainless steel construction, universal design accepts either Wunder-Bar® & Schroeder America™ 8-14 product soda manifolds & drip cups (accepts only NON-FLOW CONTROL manifolds that don't exceed 3" in overall thickness), interior mounted manifold conceals soda lines, tool-less removal of top cover provides easy access, integrated drip cup mounting allows concealed routing of drip tube to waste drain, accessory speed rails can bypass or terminate on Soda Gun Filler, soda manifold, hose gun & drip cup NOT included, NSF

**ITEM # CSC-48**      **UNDERBAR BLENDER STATION W/SINK**  
**Quantity:** One (1)  
**Manufacturer:** Perlick Corporation  
**Model:** TSF12BS

- a. Model TSF12BS TSF Series Underbar Blender Station with 18 gauge stainless steel dump sink, 12"W, backsplash, 9-5/8" wide x 10-5/8" front-to-back x 6" deep sink, 4" OC splash mount faucet holes, recessed blender shelf with access hole & installed junction box, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # CSC-49**      **BRIDGE TRASH MODULE**  
**Quantity:** One (1)

**Manufacturer:** Perlick Corporation  
**Model:** TSF12BTB

- a. Model TSF12BTB TSF Series Trash Receptacle Top Cover, 12"W x 24"D x 13-9/16"H, stainless steel construction (wastebasket is not included), 6"H backsplash, 8-3/8" x 6-3/8" opening for trash (requires support by adjacent underbar equipment or accessory end panel & leg kit)
- b. 6" Backsplash standard

**ITEM # CSC-50**                    **UNDERBAR ICE WELL**  
**Quantity:**                    **One (1)**  
**Manufacturer:**               **Perlick Corporation**  
**Model:**                        **TS36IC10**

- a. Model TS36IC10 TS Series Underbar Ice Bin/Cocktail Unit, modular with cold plate, 36"W x 18-9/16"D, approximately 85-lb. ice capacity, 10-circuit aluminum cold plate concealed under bin liner, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF
- b. 6" Backsplash standard
- c. Model ICC36 Ice Chest Covers, 2-piece sliding assembly, 36"W, front & back, stainless steel.

**ITEM # CSC-50.1**               **SPEED RAIL**  
**Quantity:**                    **One (1)**  
**Manufacturer:**               **Perlick Corporation**  
**Model:**                        **SR-D36A**

- a. Model SR-D36A Speed Rail, double, 36" W, stainless steel construction, factory installed

**ITEM # CSC-50.2**               **SODA GUN STATION**  
**Quantity:**                    **One (1)**  
**Manufacturer:**               **Perlick Corporation**  
**Model:**                        **TSF4SGB**

- a. Model TSF4SGB TSF Series Soda Gun Filler Section, 4"W x 24"D x 22"H, all stainless steel construction, universal design accepts either Wunder-Bar® & Schroeder America™ 8-14 product soda manifolds & drip cups (accepts only NON-FLOW CONTROL manifolds that don't exceed 3" in overall thickness), interior mounted manifold conceals soda lines, tool-less removal of top cover provides easy access, integrated drip cup mounting allows concealed routing of drip tube to waste drain, accessory speed rails can bypass or terminate on Soda Gun Filler, soda manifold, hose gun & drip cup NOT included, NSF

**ITEM # CSC-51**                    **UNDERBAR DRAINBOARD**  
**Quantity:**                    **One (1)**  
**Manufacturer:**               **Perlick Corporation**  
**Model:**                        **TSF18DB**

- a. Model TSF18DB TSF Series Underbar Drainboard, 18"W x 24"D, pitched drainboard top, all stainless steel construction, backsplash, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" backsplash

- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 1032968-18 TSF Series 18"W Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed

**ITEM # CSC-52                      UNDERBAR DRAINBOARD**  
**Quantity:                              One (1)**  
**Manufacturer:                        Perlick Corporation**  
**Model:                                    TS90D-FI**

- a. Model TS90D-FI TS Series Underbar Corner Drainboard, 18-9/16"W x 18-9/16"D, drainboard top, glass rack inserts, 90° full inside front corner, clipped rear corner, backsplash, 1-1/2" drain, all stainless-steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.

**ITEM # CSC-53                      BOTTLE COOLER**  
**Quantity:                              One (1)**  
**Manufacturer:                        Perlick Corporation**  
**Model:                                    BC36RT-3**

- a. Model BC36RT-3 Bottle Cooler, flat top, 36" W, self-contained refrigeration, (8.6) cu. ft. interior capacity, digital temperature control & display, 38°F factory temperature setting, (1) dent-resist and stainless steel door with lock & die-cast handles, automatic condensate evaporator, stainless steel top & interior, R290 Hydrocarbon refrigerant, 1/6 HP, 120v/60/1-ph, 1.9 amps, NEMA 5-15P, NSF, cULus
- b. Black cabinet finish
- c. (2) bin dividers with supporting brackets
- d. Model 67061 Casters, 2-7/8", set of (4)

**ITEM # CSC-54                      BACK BAR REFRIGERATOR, PASS THRU**  
**Quantity:                              One (1)**  
**Manufacturer:                        Perlick Corporation**  
**Model:                                    SDPS60**

- a. Model SDPS60 Pass-Thru Sliding Door Refrigerated Back Bar Cabinet, two-section, 60"W, self-contained side mount refrigeration, 14.8 cu.ft. internal volume, (4) sliding glass doors with locks, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/5 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 2.5 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top
- e. Condensing unit cover finish, front: Black vinyl coated
- f. Condensing unit cover finish, rear: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Shelving style, first: (3) flat shelves
- i. Shelving style, second: (3) flat shelves
- j. Crisp White LED
- k. Black baseplates (all sides) & 4" legs (set of 4), for 60" back bar cabinets

### **SBB1 – CONCOURSE LEVEL SERVICE BAR / BUFFET 1**

**ITEM # SBB1-1                      UNDERBAR HAND SINK**  
**Quantity:                              One (1)**

**Manufacturer:** Perlick Corporation  
**Model:** TSF12HS

- a. Model TSF12HS TSF Series Underbar Hand Sink Unit, 12"W x 24"D, 10" wide x 14" front-to-back x 9-1/4" deep 18 gauge stainless steel sink, backsplash, 4" OC splash mount faucet holes, (16) oz. pump soap dispenser integrated into front apron, C-fold paper towel dispenser integrated into front apron, stainless steel hinged door with magnetic catches, 1-1/2" NPS male drain, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with 1" adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # SBB1-2**            **UNDERBAR ICE WELL**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Perlick Corporation**  
**Model:**                **TS36IC**

- a. Model TS36IC TS Series Underbar Ice Bin/Cocktail Unit, modular, 36"W x 18-9/16"D, approximately 85-lb. ice capacity, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF
- b. 6" Backsplash standard
- c. Model ICC36 Ice Chest Covers, 2-piece sliding assembly, 36"W, front & back, stainless steel.

**ITEM # SBB1-2.1**        **SPEED RAIL**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Perlick Corporation**  
**Model:**                **SR-D36A**

- a. Model SR-D36A Speed Rail, double, 36" W, stainless steel construction, factory installed

**ITEM # SBB1-3**            **UNDERBAR BLENDER STATION W/SINK**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Perlick Corporation**  
**Model:**                **TSF12BS**

- a. Model TSF12BS TSF Series Underbar Blender Station with 18 gauge stainless steel dump sink, 12"W, backsplash, 9-5/8" wide x 10-5/8" front-to-back x 6" deep sink, 4" OC splash mount faucet holes, recessed blender shelf with access hole & installed junction box, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (2) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs

- d. One (1) Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # SBB1-4**                    **BACK BAR COOLER, 4 DOOR**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Perlick Corporation**  
**Model:**                        **BBS108**

- a. Model BBS108 Refrigerated Back Bar Cabinet, four-section, 108"W, self-contained refrigeration, 33.5 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 4.2 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Left
- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Left
- n. Door handle, second: full length stainless steel handle, 24"
- o. Shelving style, second: (3) flat shelves
- p. Door type, third: solid, black vinyl/field laminated
- q. Door hinge location, third: Right
- r. Door handle, third: full length stainless steel handle, 24"
- s. Shelving style, third: (3) flat shelves
- t. Door type, fourth: solid, black vinyl/field laminated
- u. Door hinge location, fourth: Right
- v. Door handle, fourth: full length stainless steel handle, 24"
- w. Shelving style, fourth: (3) flat shelves
- x. Crisp White LED
- y. Model 57787 Casters (3-3/4"), set of (6)

**ITEM # SBB1-5**                    **COLD SHELF, UNDERMOUNT**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**            **Hatco**  
**Model:**                        **CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA
- b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P, standard

**ITEM # SBB1-6**                    **ELECTRIC GRIDDLE**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Evo America, LLC**  
**Model:**                        **10-0148-EVT**



- a. Model 10-0148-EVT Evo® EVent® 48E Full Metal Surround Cooking Station, electric, 48"W x 24"D rectangular steel cooktop surrounded with black granite, self-contained ventilation, multi-stage filtration system, integrated fire suppression system, 100° F to 550° F (38° C to 288° C) temperature range, touch panel display, includes: cleaning kit, (2) stainless steel spatulas, (1) stainless steel scraper, UL, UL EPH Classified, Made in USA
- b. 208v/60/1-ph, 32.0 amps, 6.7 kW, 8-foot cord, NEMA 6-50P
- c. Model 10-0150-EVT-FMS Customization for 10-0148-EVT: Metal surround, stainless steel enclosure
- d. Model 10-0150-EVT-36 Caster Kit, for 36" working height, standard

**ITEM # SBB1-7**                    **DECORATIVE HEAT LAMP**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**            **Hatco**  
**Model:**                      **DLH-725**

- a. Model DLH-725 Decorative Heat Lamp, High Wattage, (1) bulb type (not included), 8-1/2"H x 9-1/2" diameter shade, 375 watt max, CE, cULus, UL EPH Classified, Made in USA
- b. 120v/60/1-ph, 375 watt, standard
- c. Model WHITE-CTD-120H Lamp Bulb, 375 Watt clear, coated
- d. Model BCOPPER Bright Copper plated finish
- e. Model BCOPPER Bright Copper plated finish
- f. Model RCT Mounting Style - Retractable mount to track adapter (specify cord & track color) - retractable Straight cord mount, 8-1/2" Shade adjusts from 27" to 77" & 10-1/2" Shade adjusts from 29" to 77"
- g. Model R Switch Location - Remote
- h. Model DL-CORD-BK Black Cord, standard
- i. (2) Model DL-TRACK-4B Track Mount Bar, 4', black
- j. Model DL-ADAPT-BK Black Track Adapter

**ITEM # SBB1-8**                    **UNDER-COUNTER BUFFET WARMER**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**            **CookTek**  
**Model:**                      **660801**

- a. Four (4) Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE, Made in China

**ITEM # SBB1-9**                    **REFRIGERATED UNDERCOUNTER WORK TOP**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Delfield**  
**Model:**                      **4448NP**

- a. Model 4448NP Refrigerated Worktop/Undercounter, two-section, 48"W, (2) doors
- b. 115v/60/1-ph, NEMA 5-15P, standard
- c. Self-contained refrigeration, standard
- d. NN: 32" work height
- e. Door(s) standard

**ITEM # SBB1-10            HOT FOOD HOLDING CABINET**

**Quantity:**            **One (1)**  
**Manufacturer:**    **Alto-Shaam**  
**Model:**              **750-CTUS**

- a. Model 750-CTUS Halo Heat® Hot Food Storage Unit, 1-compartment, capacity (6) 12" x 20" full-size pans, French doors with (2) positive latch door handles, ON/OFF adjustable thermostat, indicator light, exterior temperature gauge, thermostat for 60° F - 200° F, stainless steel exterior & interior, EcoSmart®, cULus, NSF
- b. 120v/50/60/1-ph, 18.8 amps, 2.25kW, NEMA L5-30P
- c. Model 14227 Casters, 3" (76mm), set of (4)

**ITEM # SBB1-11            REFRIGERATED PREP TABLE**

**Quantity:**            **One (1)**  
**Manufacturer:**    **Delfield**  
**Model:**              **4448NP-18M**

- a. Model 4448NP-18M Mega Top Sandwich/Salad Top Refrigerator, two-section, 48" W, 16.0 cubic feet, (2) doors, (2) 1/1 GN shelves, stainless steel top with polyethylene cutting board & (18) 1/6 size plastic pans, ABS interior sides, stainless steel front & sides, 5" casters, front-breathing rear-mounted refrigeration system, R290 Hydrocarbon refrigerant, 0.3 hp, cUL, UL, NSF
- b. 115v/60/1-ph, NEMA 5-15P, standard
- c. Self-Contained refrigeration, standard Door(s) standard

**ITEM # SBB1-12            DROP-IN SINK W/ FAUCET**

**Quantity:**            **One (1)**  
**Manufacturer:**    **Advance Tabco**  
**Model:**              **DI-1-10**

- a. Model DI-1-10 Drop-In Sink, 1-compartment, 10" wide x 14" front-to-back x 10" deep bowl, 20 gauge 304 stainless steel, with deck mounted gooseneck faucet, basket drain, NSF

**ITEM # SBB1-13            FOOD SHIELD**

**Quantity:**            **One (1)**  
**Manufacturer:**    **Spring USA**  
**Model:**              **VG3-SK**

- a. Model VG3-SK Versa-Gard, adjustable, (7) position self-service/ operator service food protector, glass top/shelf & end panels, 1/4" or 3/8" clear tempered glass, surface mount, NSF/ANSI.

**ITEM # SBB1-13.1        FOOD SHIELD**

**Quantity:**            **One (1)**  
**Manufacturer:**    **Spring USA**  
**Model:**              **VG3-SK**

- a. Model VG3-SK Versa-Gard, adjustable, (7) position self-service/ operator service food protector, glass top/shelf & end panels, 1/4" or 3/8" clear tempered glass, surface mount, NSF/ANSI.

**ITEM # SBB1-14**      **FOOD SHIELD**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Spring USA**  
**Model:**                **VG3-SK**

- a. Model VG3-SK Versa-Gard, adjustable, (7) position self-service/ operator service food protector, glass top/shelf & end panels, 1/4" or 3/8" clear tempered glass, surface mount, NSF/ANSI.

**ITEM # SBB1-15**      **MOP SINK CABINET**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Advance Tabco**  
**Model:**                **9-OPC-84**

- a. Model 9-OPC-84 Cabinet with Mop Sink, 25-3/16"W x 22-3/4"D x 84"H, mop sink base with drain (bowl 16" x 20" x 12"), left hinged door, (2) mop holders, (1) fixed intermediate shelf, slotted side panels for ventilation, 16/304 series stainless steel sink bowl, 18/304 series stainless steel sink bowl apron, 18/430 series stainless steel cabinet, NSF (right hinged door available on request)
- b. Model K-240 Service Sink Faucet, wall mount, heavy duty, 8" OC, 6-1/2" spout, with hose thread & pail hook, vacuum breaker spout, wall braced, chrome-plated brass
- c. Model K-610CF Perforated bottom strainer plate, stainless steel, removable, sits 1" above bottom of sink, fits Advance Tabco Fabricated 16" x 20" sink bowls only

#### **SBP – CONCOURSE LEVEL BUFFET PANTRY**

**ITEM # SBP-1**            **HAND SINK**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Advance Tabco**  
**Model:**                **7-PS-66**

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus
- b. Model 7-PS-31 Skirt for 17-1/4" wide hand sink with splash mounted faucet (10" x 14" bowl), stainless steel

**ITEM # SBP-2**            **3 COMPARTMENT SINK**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Advance Tabco**  
**Model:**                **K7-CS-29**

- a. Model K7-CS-29 Convenience Store Sink, 3-compartment, with left & right-hand drainboards, 16" front-to-back x 14" W compartment, 12" deep with 8"H backsplash, stainless steel open frame base, side crossrails, adjustable metal bullet feet, 18 gauge 304 stainless steel, 11-5/8" drainboards, overall 21-1/2" F/B x 70" L/R  
 OMIT FAUCET
- b. (2) Model K-472 Faucet hole revision
- c. (3) Model K-4 Support Bracket, for lever waste drain handle, (1) support required for each lever drain

**ITEM # SBP-2.1**        **FAUCET**  
**Quantity:**            **Two (2)**  
**Manufacturer:**      **T&S Brass**

**Model: 5F-8WLX10**

- a. Model 5F-8WLX10 Equip Faucet, 8" centers, wall mount, 10" swivel nozzle, lever handles, 2" flange, ceramic cartridges, low lead, ADA Compliant

**ITEM # SBP-3 WALL SHELF W/ POT RACK**

**Quantity: One (1)**  
**Manufacturer: Advance Tabco**  
**Model: PS-12-72**

- a. Model PS-12-72 Shelf with Pot Rack, wall-mounted, 72"W x 12"D, 18/430 stainless steel shelf, 2" x 1/4" stainless steel pot rack, includes: (9) plated double pot hooks, NSF

**ITEM # SBP-4 ROLL-IN REFRIGERATOR**

**Quantity: One (1)**  
**Manufacturer: Delfield**  
**Model: GARRI2P-S**

- a. Model GARRI2P-S Specification Line® Refrigerator, Roll-In, two-section, 76.5 cubic feet capacity, top-mounted self-contained refrigeration system, (2) full-height hinged solid doors (locking), 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, 1" tall stainless steel ramp, stainless steel exterior front, sides & interior, GreenGenius™ R290 Hydrocarbon refrigerant, 0.38 HP, 115v/60/1-ph, 6.5 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®
- b. Full height solid doors, standard
- c. Door hinged on left standard
- d. Door hinged on right standard

**ITEM # SBP-5 UNIVERSAL ROLL-IN RACK**

**Quantity: Four (4)**  
**Manufacturer: Cres Cor**  
**Model: 207UA12AC**

- a. Model 207UA12AC Rack, Roll-In Refrigerator, open frame design, (12) universal slides for 12" x 20" thru 18" x 26" pans on 4-1/2" centers, adjustable at 1-1/2" intervals, welded extruded aluminum frame, NSF
- b. Model 1032 001 Pan Stop, mounted to rear, prevents accidental push through of pans
- c. Model 1056 002 Corner Bumpers, add 2" to OA dimensions, non-marking, gray

**ITEM # SBP-6 ROLL-IN HEATED CABINET**

**Quantity: One (1)**  
**Manufacturer: Delfield**  
**Model: GAHRI2-S**

- a. Model GAHRI2-S Specification Line® Heated Cabinet, Roll-In, two-section, 76.5 cubic feet capacity, (2) full-height hinged solid doors (locking), 4.3" easyTouch® screen temperature display/control with remote monitoring, incandescent interior lighting, 1" tall stainless steel ramp, stainless steel exterior front, sides & interior, 208-240v/60/1-ph, 10.5 amps, NEMA 6-20P, NSF, cULus, ENERGY STAR®
- b. Left door hinged on left, right door hinged on right, standard
- c. Full height solid doors, standard
- d. Model AS269-AFJ-0043 Raised Ramp, for roll in/roll thru, standard

**ITEM # SBP-7 REACH-IN ICE FREEZER**

**Quantity:** One (1)  
**Manufacturer:** Beverage Air  
**Model:** MMF49HC-1-B

- a. Model MMF49HC-1-B MarketMax™ Freezer Merchandiser, reach-in, two-section, (2) triple pane hinged glass doors, 46.2 cu. ft. capacity, electronic control, digital display, (10) epoxy coated steel shelves, LED interior lighting, lighted sign panel, self closing door with automatic hold-open feature, bottom-mounted refrigeration, black exterior, R290 Hydrocarbon refrigerant, 3/4 HP, cULus, UL EPH Classified, UL-Sanitation, Made in USA
- b. 115v/60/1-ph, 11.0 amps, cord with NEMA 5-15P
- c. door hinged left, right door hinged right, standard
- d. Model 61C01-017D-01 Casters, 6" HB, MM & Slate Series models (set of 4)

**ITEM # SBP-8** MOBILE SECURITY UNIT  
**Quantity:** One (1)  
**Manufacturer:** Eagle Group  
**Model:** CSC2448

- a. Model CSC2448 Security Unit, mobile, 51-1/4"W x 27-1/4"D x 69"H, open wire construction with 2" x 2" mesh panels, (2) doors with hasps for padlock, chrome-plated finish, (2) swivel & (2) swivel/brake 5" stem casters with poly tread, KD, NSF
- b. Model 2448C-X Shelf, wire, 48"W x 24"D, patented QuadTruss® design, includes (4) pairs of split sleeves per shelf, 800 lbs. capacity, chrome-plated finish, NSF

**ITEM # SBP-9** DISH DOLLY  
**Quantity:** Two (2)  
**Manufacturer:** Metro  
**Model:** PCD11A

- a. Model PCD11A Quick Ship - Poker Chip Dish Dolly, 26-5/8"W x 26-5/8"D x 31-15/16"H, adjustable, dish size 4-1/4" to 11-3/4", removable dividers & towers, two-handed access, recessed handles, 5"Dia. swivel casters with neoprene wheels (2 with brakes), chip-resistant polymer shell with Microban® antimicrobial protection, aesthetic blue, vinyl dust/water splash cover, NSF

**ITEM # SBP-10** BAG-N-BOX RACK  
**Quantity:** One (1)  
**Manufacturer:** By Product Supplier

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # SBP-10.1** CARBONATOR  
**Quantity:** One (1)  
**Manufacturer:** By Product Supplier

- a. PROVIDED BY PRODUCT SUPPLIER  
 LOCATED IN (SLBE) SUITE LEVEL-LOGE BAR EAST

**ITEM # SBP-11** MOP SINK CABINET  
**Quantity:** One (1)  
**Manufacturer:** Advance Tabco  
**Model:** 9-OPC-84

- a. Model 9-OPC-84 Cabinet with Mop Sink, 25-3/16"W x 22-3/4"D x 84"H, mop sink base with drain (bowl 16" x 20" x 12"), left hinged door, (2) mop holders, (1) fixed intermediate shelf, slotted side panels for ventilation, 16/304 series stainless steel sink bowl, 18/304 series stainless steel sink bowl apron, 18/430 series stainless steel cabinet, NSF
- b. Model CAB-R Change door to right-side hinge
- c. Model K-240 Service Sink Faucet, wall mount, heavy duty, 8" OC, 6-1/2" spout, with hose thread & pail hook, vacuum breaker spout, wall braced, chrome-plated brass
- d. Model K-610CF Perforated bottom strainer plate, stainless steel, removable, sits 1" above bottom of sink, fits Advance Tabco Fabricated 16" x 20" sink bowls only

**SL01 – SUITE LEVEL SUITE 01**

**ITEM # SL01-1                    UNDER-COUNTER BUFFET WARMER**  
**Quantity:                        Three (3)**  
**Manufacturer:                   CookTek**  
**Model:                            660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SL01-2                    COLD SHELF, UNDERMOUNT**  
**Quantity:                        One (1)**  
**Manufacturer:                   Hatco**  
**Model:                            CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA
- b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

**SL02 – SUITE LEVEL SUITE 00**

**ITEM # SL02-1                    UNDER-COUNTER BUFFET WARMER**  
**Quantity:                        Three (3)**  
**Manufacturer:                   CookTek**  
**Model:                            660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SL02-2                    COLD SHELF, UNDERMOUNT**  
**Quantity:                        One (1)**  
**Manufacturer:                   Hatco**  
**Model:                            CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA

- b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

### **SL03 – SUITE LEVEL SUITE 03**

**ITEM # SL03-1                    UNDER-COUNTER BUFFET WARMER**  
**Quantity:                        Three (3)**  
**Manufacturer:                   CookTek**  
**Model:                             660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SL03-2                    COLD SHELF, UNDERMOUNT**  
**Quantity:                        One (1)**  
**Manufacturer:                   Hatco**  
**Model:                             CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA  
b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

### **SL04 – SUITE LEVEL LARGE SUITE 04**

**ITEM # SL04-1                    UNDER-COUNTER BUFFET WARMER**  
**Quantity:                        Three (3)**  
**Manufacturer:                   CookTek**  
**Model:                             660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SL04-2                    COLD SHELF, UNDERMOUNT**  
**Quantity:                        One (1)**  
**Manufacturer:                   Hatco**  
**Model:                             CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA  
b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

### **SL06 – SUITE LEVEL SUITE 06**

**ITEM # SL06-1                    UNDER-COUNTER BUFFET WARMER**  
**Quantity:                        Three (3)**  
**Manufacturer:                   CookTek**

**Model: 660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SL06-2 COLD SHELF, UNDERMOUNT**  
**Quantity: One (1)**  
**Manufacturer: Hatco**  
**Model: CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA  
 b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

### SL07 – SUITE LEVEL SUITE 07

**ITEM # SL07-1 UNDER-COUNTER BUFFET WARMER**  
**Quantity: Three (3)**  
**Manufacturer: CookTek**  
**Model: 660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SL07-2 COLD SHELF, UNDERMOUNT**  
**Quantity: One (1)**  
**Manufacturer: Hatco**  
**Model: CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA  
 b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

### SL08 – SUITE LEVEL SUITE 08

**ITEM # SL08-1 UNDER-COUNTER BUFFET WARMER**  
**Quantity: Three (3)**  
**Manufacturer: CookTek**  
**Model: 660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.



**ITEM # SL08-2**                    **COLD SHELF, UNDERMOUNT**  
**Quantity:**                    **One (1)**  
**Manufacturer:**               **Hatco**  
**Model:**                        **CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA
- b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

### **SL09 – SUITE LEVEL SUITE 09**

**ITEM # SL09-1**                    **UNDER-COUNTER BUFFET WARMER**  
**Quantity:**                    **Three (3)**  
**Manufacturer:**               **CookTek**  
**Model:**                        **660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SL09-2**                    **COLD SHELF, UNDERMOUNT**  
**Quantity:**                    **One (1)**  
**Manufacturer:**               **Hatco**  
**Model:**                        **CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA
- b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

### **SL10 – SUITE LEVEL SUITE 10**

**ITEM # SL10-1**                    **UNDER-COUNTER BUFFET WARMER**  
**Quantity:**                    **Three (3)**  
**Manufacturer:**               **CookTek**  
**Model:**                        **660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SL10-2**                    **COLD SHELF, UNDERMOUNT**  
**Quantity:**                    **One (1)**  
**Manufacturer:**               **Hatco**  
**Model:**                        **CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA

- b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

### **SL11 – SUITE LEVEL SUITE 11**

**ITEM # SL11-1                    UNDER-COUNTER BUFFET WARMER**  
**Quantity:                        Three (3)**  
**Manufacturer:                   CookTek**  
**Model:                             660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SL11-2                    COLD SHELF, UNDERMOUNT**  
**Quantity:                        One (1)**  
**Manufacturer:                   Hatco**  
**Model:                             CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA  
b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

### **SL12 – SUITE LEVEL SUITE 12**

**ITEM # SL12-1                    UNDER-COUNTER BUFFET WARMER**  
**Quantity:                        Three (3)**  
**Manufacturer:                   CookTek**  
**Model:                             660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SL12-2                    COLD SHELF, UNDERMOUNT**  
**Quantity:                        One (1)**  
**Manufacturer:                   Hatco**  
**Model:                             CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA  
b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

### **SL13 – SUITE LEVEL SUITE 13**

**ITEM # SL13-1                    UNDER-COUNTER BUFFET WARMER**  
**Quantity:                        Three (3)**  
**Manufacturer:                   CookTek**

**Model: 660801**

- a. Three (3) Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SL13-2 COLD SHELF, UNDERMOUNT**  
**Quantity: One (1)**  
**Manufacturer: Hatco**  
**Model: CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA
- b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

#### **SL14 – SUITE LEVEL LARGE SUITE 14**

**ITEM # SL14-1 UNDER-COUNTER BUFFET WARMER**  
**Quantity: Three (3)**  
**Manufacturer: CookTek**  
**Model: 660801**

- a. Three (3) Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SL14-2 COLD SHELF, UNDERMOUNT**  
**Quantity: One (1)**  
**Manufacturer: Hatco**  
**Model: CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA
- b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

#### **SL16 – SUITE LEVEL SUITE 16**

**ITEM # SL16-1 UNDER-COUNTER BUFFET WARMER**  
**Quantity: Three (3)**  
**Manufacturer: CookTek**  
**Model: 660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SL16-2**                    **COLD SHELF, UNDERMOUNT**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Hatco**  
**Model:**                        **CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA
- b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

### **SL17 – SUITE LEVEL SUITE 17**

**ITEM # SL17-1**                    **UNDER-COUNTER BUFFET WARMER**  
**Quantity:**                    **Three (3)**  
**Manufacturer:**                **CookTek**  
**Model:**                        **660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SL17-2**                    **COLD SHELF, UNDERMOUNT**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Hatco**  
**Model:**                        **CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA
- b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

### **SL18 – SUITE LEVEL SUITE 18**

**ITEM # SL18-1**                    **UNDER-COUNTER BUFFET WARMER**  
**Quantity:**                    **Three (3)**  
**Manufacturer:**                **CookTek**  
**Model:**                        **660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SL18-2**                    **COLD SHELF, UNDERMOUNT**  
**Quantity:**                    **One (1)**  
**Manufacturer:**                **Hatco**  
**Model:**                        **CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA

- b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

**SLB2 – SUITE LEVEL BUFFET 2**

**ITEM # SLB2-1                    COLD SHELF, UNDERMOUNT**  
**Quantity:                        Four (4)**  
**Manufacturer:                    Hatco**  
**Model:                             CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA  
 b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

**ITEM # SLB2-2                    DECORATIVE HEAT LAMP**  
**Quantity:                        Four (4)**  
**Manufacturer:                    Hatco**  
**Model:                             DLH-725**

- a. Model DLH-725 Decorative Heat Lamp, High Wattage, (1) bulb type (not included), 8-1/2"H x 9-1/2" diameter shade, 375 watt max, CE, cULus, UL EPH Classified, Made in USA  
 b. 120v/60/1-ph, 375 watt, standard  
 c. Model WHITE-CTD-120H Lamp Bulb, 375 Watt clear, coated  
 d. Model BCOPPER Bright Copper plated finish  
 e. Model BCOPPER Bright Copper plated finish  
 f. Model RCT Mounting Style - Retractable mount to track adapter (specify cord & track color) - retractable Straight cord mount, 8-1/2" Shade adjusts from 27" to 77" & 10-1/2" Shade adjusts from 29" to 77"  
 g. Model R Switch Location - Remote  
 h. Model DL-CORD-BK Black Cord, standard  
 i. Model DL-TRACK-4B Track Mount Bar, 4', black  
 j. Model DL-ADAPT-BK Black Track Adapter

**ITEM # SLB2-3                    UNDER-COUNTER BUFFET WARMER**  
**Quantity:                        Four (4)**  
**Manufacturer:                    CookTek**  
**Model:                             660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SLB2-4                    HOT/COLD/FREEZE WELL, DROP-IN**  
**Quantity:                        One (1)**  
**Manufacturer:                    Low Temp Industries**  
**Model:                             DI-QSP-DW-20-04**

- a. Model DI-QSP-DW-20-04 QuickSwitch™ Hot/Cold/Freeze Food Well, drop-in, 64-3/4"W x 26-3/4"D x 21-16/25"H, 14ga stainless steel top, accommodates (4) 12" x 20" pan size, wired remote, individual wired remote digital controls for hot or cold operation, manifold

drain, stainless steel top & wells, galvanized exterior, cUL, UL, UL EPH Classified  
(ANSI/NSF 4, ANSI/NSF 7)

- b. 120/208v/60/1-ph, 14.4 amps, NEMA 14-20P

**ITEM # SLB2-5                      REFRIGERATED UNDERCOUNTER WORK TOP**  
**Quantity:                              One (1)**  
**Manufacturer:                         Delfield**  
**Model:                                    4448NP**

- a. Model 4448NP Refrigerated Worktop/Undercounter, two-section, 48"W, (2) doors  
 b. 115v/60/1-ph, NEMA 5-15P, standard  
 c. Self-contained refrigeration, standard  
 d. NN: 32" work height  
 e. Door(s) standard

**ITEM # SLB2-6                      PANINI GRILL**  
**Quantity:                              One (1)**  
**Manufacturer:                         Equipex LLC**  
**Model:                                    DIABLO**

- a. Model DIABLO Roller Grill Panini Grill, cast iron grooved top & grooved bottom griddle plates, (2) 14"W x 9-1/2"D grill areas, (2) independent adjustable spring counterbalanced tops, front drip tray & scraper, grills with stainless steel construction, 570°F thermostatic controls, 208/240v/60/1-ph, 24.0/27.0 amps, 6.5kW, NEMA 6-50P, cULus, cULus Classified  
 b. Grooved top & grooved bottom plates, standard

**ITEM # SLB2-7                      HOT FOOD HOLDING CABINET**  
**Quantity:                              One (1)**  
**Manufacturer:                         Alto-Shaam**  
**Model:                                    750-CTUS**

- a. Model 750-CTUS Halo Heat® Hot Food Storage Unit, 1-compartment, capacity (6) 12" x 20" full-size pans, French doors with (2) positive latch door handles, ON/OFF adjustable thermostat, indicator light, exterior temperature gauge, thermostat for 60° F - 200° F, stainless steel exterior & interior, EcoSmart®, cULus, NSF  
 b. 120v/50/60/1-ph, 18.8 amps, 2.25kW, NEMA L5-30P  
 c. Model 14227 Casters, 3" (76mm), set of (4)

**ITEM # SLB2-8                      REFRIGERATED PREP TABLE**  
**Quantity:                              One (1)**  
**Manufacturer:                         Delfield**  
**Model:                                    4448NP-18M**

- a. Model 4448NP-18M Mega Top Sandwich/Salad Top Refrigerator, two-section, 48" W, 16.0 cubic feet, (2) doors, (2) 1/1 GN shelves, stainless steel top with polyethylene cutting board & (18) 1/6 size plastic pans, ABS interior sides, stainless steel front & sides, 5" casters, front-breathing rear-mounted refrigeration system, R290 Hydrocarbon refrigerant, 0.3 hp, cUL, UL, NSF  
 b. 115v/60/1-ph, NEMA 5-15P, standard  
 c. Self-Contained refrigeration, standard  
 d. Door(s) standard

**ITEM # SLB2-9                      DROP-IN SINK W/ FAUCET**

**Quantity:** One (1)  
**Manufacturer:** Advance Tabco  
**Model:** DI-1-10

- a. Model DI-1-10 Drop-In Sink, 1-compartment, 10" wide x 14" front-to-back x 10" deep bowl, 20 gauge 304 stainless steel, with deck mounted gooseneck faucet, basket drain, NSF

**ITEM # SLB2-10**      **FOOD SHIELD**  
**Quantity:** One (1)  
**Manufacturer:** Spring USA  
**Model:** VG3-SK

- a. Model VG3-SK Versa-Gard, adjustable, (7) position self-service/ operator service food protector, glass top/shelf & end panels, 1/4" or 3/8" clear tempered glass, surface mount, NSF/ANSI.

**ITEM # SLB2-11**      **FOOD SHIELD**  
**Quantity:** One (1)  
**Manufacturer:** Spring USA  
**Model:** VG3-SK

- a. Model VG3-SK Versa-Gard, adjustable, (7) position self-service/ operator service food protector, glass top/shelf & end panels, 1/4" or 3/8" clear tempered glass, surface mount, NSF/ANSI.

**ITEM # SLB2-11.1**      **FOOD SHIELD**  
**Quantity:** One (1)  
**Manufacturer:** Spring USA  
**Model:** VG3-SK

- a. Model VG3-SK Versa-Gard, adjustable, (7) position self-service/ operator service food protector, glass top/shelf & end panels, 1/4" or 3/8" clear tempered glass, surface mount, NSF/ANSI.

**ITEM # SLB2-12**      **FOOD SHIELD**  
**Quantity:** One (1)  
**Manufacturer:** Spring USA  
**Model:** VG3-SK

- a. Model VG3-SK Versa-Gard, adjustable, (7) position self-service/ operator service food protector, glass top/shelf & end panels, 1/4" or 3/8" clear tempered glass, surface mount, NSF/ANSI.

#### **SLBA – SUITE LEVEL LOGE BAR A**

**ITEM # SLBA-1**      **UNDERBAR HAND SINK**  
**Quantity:** Three (3)  
**Manufacturer:** Perlick Corporation  
**Model:** TSF12HS

- a. Model TSF12HS TSF Series Underbar Hand Sink Unit, 12"W x 24"D, 10" wide x 14" front-to-back x 9-1/4" deep 18 gauge stainless steel sink, backsplash, 4" OC splash mount faucet holes, (16) oz. pump soap dispenser integrated into front apron, C-fold

paper towel dispenser integrated into front apron, stainless steel hinged door with magnetic catches, 1-1/2" NPS male drain, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with 1" adjustable thermoplastic feet.

- b. 6" Backsplash standard
- c. (6) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # SLBA-2                      UNDERBAR STORAGE CABINET**  
**Quantity:                            Three (3)**  
**Manufacturer:                      Perlick Corporation**  
**Model:                                TSF24SC**

- a. Model TSF24SC Underbar Storage Cabinet 24"W x 24"D, 4" or 6"H backsplash with 1" return at top, pitched drainboard top with 1-1/2" NPS drain socket with 1/2" OD barb & 1/2" ID anti-microbial tubing, 1-1/2" NPS male drain center back of cabinet bottom, (1) adjustable intermediate shelf, stainless steel construction, Perlick Quick Clamp stainless steel legs & adjustable feet, NSF.
- b. 6" backsplash
- c. (6) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 1032968-24 TSF Series 24"W Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- e. Model DR24SC Field reversable door and lock set for 24"W storage cabinets
- f. Model SC-ES-L End Splash, left, for storage cabinets
- g. Model SC-ES-R End Splash, right, for storage cabinets

**ITEM # SLBA-3                      POS**  
**Quantity:                            Three (3)**  
**Manufacturer:                      By Operations**  
**Model:                                POS**

- a. PROVIDED BY OPERATIONS

**ITEM # SLBA-4                      UNDERBAR ICE WELL**  
**Quantity:                            Three (3)**  
**Manufacturer:                      Perlick Corporation**  
**Model:                                TS30IC10**

- a. Model TS30IC10 TS Series Underbar Ice Bin/Cocktail Unit, modular with cold plate, 30"W x 18-9/16"D, approximately 70-lb. ice capacity, 10-circuit aluminum cold plate concealed under bin liner, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF
- b. 6" Backsplash standard
- c. Model ICC30 Ice Chest Covers, 2-piece sliding assembly, 30"W, front & back, stainless steel.

**ITEM # SLBA-4.1                  SPEED RAIL**



**Quantity:** Three (3)  
**Manufacturer:** Perlick Corporation  
**Model:** SR-D30A

- a. Model SR-D30A Speed Rail, double, 30" W, stainless steel construction, factory installed

**ITEM # SLBA-5**            **SODA GUN STATION**  
**Quantity:** Three (3)  
**Manufacturer:** Perlick Corporation  
**Model:** TSF4SGB

- a. Model TSF4SGB TSF Series Soda Gun Filler Section, 4"W x 24"D x 22"H, all stainless steel construction, universal design accepts either Wunder-Bar® & Schroeder America™ 8-14 product soda manifolds & drip cups (accepts only NON-FLOW CONTROL manifolds that don't exceed 3" in overall thickness), interior mounted manifold conceals soda lines, tool-less removal of top cover provides easy access, integrated drip cup mounting allows concealed routing of drip tube to waste drain, accessory speed rails can bypass or terminate on Soda Gun Filler, soda manifold, hose gun & drip cup NOT included, NSF

**ITEM # SLBA-6**            **UNDERBAR BLENDER STATION W/ SINK**  
**Quantity:** Three (3)  
**Manufacturer:** Perlick Corporation  
**Model:** TSF12BS

- a. Model TSF12BS TSF Series Underbar Blender Station with 18 gauge stainless steel dump sink, 12"W, backsplash, 9-5/8" wide x 10-5/8" front-to-back x 6" deep sink, 4" OC splash mount faucet holes, recessed blender shelf with access hole & installed junction box, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (6) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6", for TS or TSF series
- f. Model 7054L End Splash, left, 6", for TS or TSF series

**ITEM # SLBA-7**            **BRIDGE TRASH MODULE**  
**Quantity:** Three (3)  
**Manufacturer:** Perlick Corporation  
**Model:** TSF12BTB

- a. Model TSF12BTB TSF Series Trash Receptacle Top Cover, 12"W x 24"D x 13-9/16"H, stainless steel construction (wastebasket is not included), 6"H backsplash, 8-3/8" x 6-3/8" opening for trash (requires support by adjacent underbar equipment or accessory end panel & leg kit)
- b. 6" Backsplash standard

**ITEM # SLBA-8**            **BACK BAR COOLER, 4 DOOR**  
**Quantity:** One (1)  
**Manufacturer:** Perlick Corporation  
**Model:** BBS108

- a. Model BBS108 Refrigerated Back Bar Cabinet, four-section, 108"W, self-contained refrigeration, 33.5 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 4.2 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Left
- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Left
- n. Door handle, second: full length stainless steel handle, 24"
- o. Shelving style, second: (3) flat shelves
- p. Door type, third: solid, black vinyl/field laminated
- q. Door hinge location, third: Right
- r. Door handle, third: full length stainless steel handle, 24"
- s. Shelving style, third: (3) flat shelves
- t. Door type, fourth: solid, black vinyl/field laminated
- u. Door hinge location, fourth: Right
- v. Door handle, fourth: full length stainless steel handle, 24"
- w. Shelving style, fourth: (3) flat shelves
- x. Crisp White LED
- y. Model 57787 Casters (3-3/4"), set of (6)

**ITEM # SLBA-9**                      **BACK BAR COOLER, 2 DOOR**  
**Quantity:**                        **Four (4)**  
**Manufacturer:**                **Perlick Corporation**  
**Model:**                            **BBS60**

- a. Model BBS60 Refrigerated Back Bar Cabinet, two-section, 60"W, self-contained refrigeration, 16 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/5 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 2.5 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Right
- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Right
- n. Door handle, second: full length stainless steel handle, 24"
- o. Shelving style, second: (3) flat shelves
- p. Crisp White LED

- q. Model 57786 Casters, 3-3/4", set of (4)

**ITEM # SLBA-10                    UNDERBAR 3 COMPARTMENT SINK**  
**Quantity:                            One (1)**  
**Manufacturer:                      Perlick Corporation**  
**Model:                                TS60M3-DB**

- a. Model TS60M3-DB TS Series Underbar Multi-tank Sink Unit, three 18 gauge stainless steel compartment, 60"W x 18-9/16"D, backsplash, 10" wide x 14" front-to-back x 9-1/4" deep compartments, 12" pitched drainboard top on left & right, 4" OC (TS) splash or (TSF) deck mount faucet holes, seamless 18 gauge stainless steel front apron, includes 1-1/2" drains & 8-1/2" removable overflow standpipes, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet.
- b. 6" backsplash
- c. Model ZZPERL1040635 TS Series, Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- d. Model 934-10LF Front Loading Faucet, wall/splash mount, lead free, 10" swing spout, faucet valves include built-in check valves to prevent back flow or cross flow, (2) 3/8" O.D. x 3/8" O.D. x 18" braided stainless steel supply lines included
- e. (3) Model 54965-1 Drain Screen, for 1-1/2" drain socket

**ITEM # SLBA-11                    BAG-N-BOX RACK**  
**Quantity:                            One (1)**  
**Manufacturer:                      By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

**ITEM # SLBA-11.1                CARBONATOR**  
**Quantity:                            One (1)**  
**Manufacturer:                      By Product Supplier**

- a. PROVIDED BY PRODUCT SUPPLIER

### **SLBE – SUITE LEVEL LOGE BAR EAST**

**ITEM # SLBE-1                    UNDERBAR HAND SINK**  
**Quantity:                            Two (2)**  
**Manufacturer:                      Perlick Corporation**  
**Model:                                TSF12HS**

- a. Model TSF12HS TSF Series Underbar Hand Sink Unit, 12"W x 24"D, 10" wide x 14" front-to-back x 9-1/4" deep 18 gauge stainless steel sink, backsplash, 4" OC splash mount faucet holes, (16) oz. pump soap dispenser integrated into front apron, C-fold paper towel dispenser integrated into front apron, stainless steel hinged door with magnetic catches, 1-1/2" NPS male drain, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with 1" adjustable thermoplastic feet.
- b. 6" Backsplash standard
- c. (4) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"

- f. Model 7054L End Splash, left, 6"

**ITEM # SLBE-2                    UNDERBAR STORAGE CABINET**  
**Quantity:                        Three (3)**  
**Manufacturer:                  Perlick Corporation**  
**Model:                            TSF24SC**

- a. Model TSF24SC Underbar Storage Cabinet 24"W x 24"D, 4" or 6"H backsplash with 1" return at top, pitched drainboard top with 1-1/2" NPS drain socket with 1/2" OD barb & 1/2" ID anti-microbial tubing, 1-1/2" NPS male drain center back of cabinet bottom, (1) adjustable intermediate shelf, stainless steel construction, Perlick Quick Clamp stainless steel legs & adjustable feet, NSF.
- b. 6" backsplash
- c. (6) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 1032968-24 TSF Series 24"W Perforated Drainboard Insert, 'Stadium' shaped perforations, stainless steel construction, factory installed
- e. Model DR24SC Field reversable door and lock set for 24"W storage cabinets, Factory Installed
- f. Model SC-ES-L End Splash, left, for storage cabinets
- g. Model SC-ES-R End Splash, right, for storage cabinets

**ITEM # SLBE-3                    POS**  
**Quantity:                        Three (3)**  
**Manufacturer:                  BY OPERATIONS**  
**Model:                            POS**

- a. POS PROVIDED BY OPERATIONS

**ITEM # SLBE-4                    SODA GUN STATION**  
**Quantity:                        Three (3)**  
**Manufacturer:                  Perlick Corporation**  
**Model:                            TS4SGB**

- a. Model TS4SGB TS Series Soda Gun Filler Section, 4"W x 18-9/16"D x 22"H, all stainless steel construction, universal design accepts either Wunder-Bar® & Schroeder America™ 8-14 product soda manifolds & drip cups (accepts only NON-FLOW CONTROL manifolds that don't exceed 3" in overall thickness), interior mounted manifold conceals soda lines, tool-less removal of top cover provides easy access, integrated drip cup mounting allows concealed routing of drip tube to waste drain, accessory speed rails can bypass or terminate on Soda Gun Filler, soda manifold, hose gun & drip cup NOT included, NSF

**ITEM # SLBE-5                    UNDERBAR ICE WELL**  
**Quantity:                        One (1)**  
**Manufacturer:                  Perlick Corporation**  
**Model:                            TS24IC10**

- a. Model TS24IC10 TS Series Underbar Ice Bin/Cocktail Unit, modular with cold plate, 24"W x 18-9/16"D, approximately 50-lb. ice capacity, 10-circuit aluminum cold plate concealed under bin liner, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF
- b. 6" Backsplash standard

- c. Model ICC24 Ice Chest Covers, 2-piece sliding assembly, 24"W, front & back, stainless steel.

**ITEM # SLBE-5.1      SPEED RAIL**  
**Quantity:              One (1)**  
**Manufacturer:        Perlick Corporation**  
**Model:                  SR-D24A**

- a. Model SR-D24A Speed Rail, double, 24" W, stainless steel construction, factory installed

**ITEM # SLBE-6        UNDERBAR BLENDER STATION W/ SINK**  
**Quantity:              Three (3)**  
**Manufacturer:        Perlick Corporation**  
**Model:                  TSF12BS**

- a. Model TSF12BS TSF Series Underbar Blender Station with 18 gauge stainless steel dump sink, 12"W, backsplash, 9-5/8" wide x 10-5/8" front-to-back x 6" deep sink, 4" OC splash mount faucet holes, recessed blender shelf with access hole & installed junction box, stainless steel construction, Perlick Quick Clamp tool less leg attachment, stainless steel legs with adjustable thermoplastic feet (replaces TS12BLW)
- b. 6" Backsplash standard
- c. (6) Model 1039805 Perlick Flex Mount Leg Relocation Kit, Includes: (1) Rails, (1) Bolts, and (1) Tightening Knobs
- d. Model 934GN-LF Front Loading Faucet, wall/splash mount, lead free, gooseneck spout, faucet valves includes: built-in check valves to prevent back flow or across flow, (2) 3/8" O.D. x 3/8" O.D. x 18", braided stainless steel supply lines included
- e. Model 7054R End Splash, right, 6"
- f. Model 7054L End Splash, left, 6"

**ITEM # SLBE-7        BRIDGE TRASH MODULE**  
**Quantity:              Three (3)**  
**Manufacturer:        Perlick Corporation**  
**Model:                  TSF12BTB**

- a. Model TSF12BTB TSF Series Trash Receptacle Top Cover, 12"W x 24"D x 13-9/16"H, stainless steel construction (wastebasket is not included), 6"H backsplash, 8-3/8" x 6-3/8" opening for trash (requires support by adjacent underbar equipment or accessory end panel & leg kit)
- b. 6" Backsplash standard

**ITEM # SLBE-8        UNDERBAR ICE WELL**  
**Quantity:              Two (2)**  
**Manufacturer:        Perlick Corporation**  
**Model:                  TS30IC10**

- a. Model TS30IC10 TS Series Underbar Ice Bin/Cocktail Unit, modular with cold plate, 30"W x 18-9/16"D, approximately 70-lb. ice capacity, 10-circuit aluminum cold plate concealed under bin liner, 6"H backsplash with 1" return at top, ABS plastic top ledge, 10-3/4" deep stainless steel ice bin, stainless steel front & sides, galvanized steel back & bottom, 1/2" NPS male drain, 1-5/8" tubular stainless steel legs with 1" adjustable thermoplastic feet, NSF
- b. 6" Backsplash standard
- c. Model ICC30 Ice Chest Covers, 2-piece sliding assembly, 30"W, front & back, stainless steel.

**ITEM # SLBE-8.1**      **SPEED RAIL**  
**Quantity:**            **Two (2)**  
**Manufacturer:**      **Perlick Corporation**  
**Model:**                **SR-D30A**

- a. Model SR-D30A Speed Rail, double, 30" W, stainless steel construction, factory installed

**ITEM # SLBE-9**        **UNDERCOUNTER DISH MACHINE**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **MEIKO**  
**Model:**                **UM**

- a. Model UM M-iClean Series Glasswasher, undercounter, 23-5/8"W x 23-5/8"D x 28-3/4"H, high temperature with built-in booster, fully automatic operation, (37) racks/hour capacity, 0.61 gallons/rack, illuminated door handle, glass touch-screen display, M-iClean active wash water filtration, Blue Touch component color coding for intuitive manual cleaning, Auto-Safe temperature control for guaranteed sanitization, Soft Start fine china & glassware protection, leak detection, pumped drain & rinse, standard liquid detergent & rinse aid pumps, double-wall stainless steel construction, (1) coated wire glass rack included, 3/4 HP wash pump, NSF, cETLus, ENERGY STAR®
- b. 208-230v/60/3-ph, 31.1/33.9 amps, standard
- c. NEMA 15-50P, installed by others, includes plug, receptacle & plate
- d. Drain water tempering kit, reduces drain water temperature to below 140°F, installed by others
- e. Standard adjustable hex feet
- f. Drain board top

**ITEM # SLBE-10**      **BACK BAR COOLER, 4 DOOR**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Perlick Corporation**  
**Model:**                **BBS108**

- a. Model BBS108 Refrigerated Back Bar Cabinet, four-section, 108"W, self-contained refrigeration, 33.5 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/4 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 4.2 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Right
- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Left
- n. Door handle, second: full length stainless steel handle, 24"
- o. Shelving style, second: (3) flat shelves
- p. Door type, third: solid, black vinyl/field laminated
- q. Door hinge location, third: Right
- r. Door handle, third: full length stainless steel handle, 24"

- s. Shelving style, third: (3) flat shelves
- t. Door type, fourth: solid, black vinyl/field laminated
- u. Door hinge location, fourth: Right
- v. Door handle, fourth: full length stainless steel handle, 24"
- w. Shelving style, fourth: (3) flat shelves
- x. Crisp White LED
- y. Model 57787 Casters (3-3/4"), set of (6)

**ITEM # SLBE-11                      BACK BAR COOLER, 2 DOOR**  
**Quantity:                              Four (4)**  
**Manufacturer:                        Perlick Corporation**  
**Model:                                    BBS60**

- a. Model BBS60 Refrigerated Back Bar Cabinet, two-section, 60"W, self-contained refrigeration, 16 cu.ft. internal volume, digital thermostat, LED interior lighting, front vented, automatic defrost & condensate evaporator, includes floor drain, stainless steel interior, side mount compressor, 1/5 HP, R290 Hydrocarbon refrigerant, NSF, cULus
- b. 120v/60/1-ph, 2.5 amps, NEMA 5-15P
- c. Standard refrigerator
- d. Stainless steel top - no tapping holes
- e. Condensing unit location: Left
- f. Condensing unit cover finish: Black vinyl coated
- g. End finish: Stainless steel, unfinished, both sides, standard
- h. Door type, first: solid, black vinyl/field laminated
- i. Door hinge location, first: Left
- j. Door handle, first: full length stainless steel handle, 24"
- k. Shelving style, first: (3) flat shelves
- l. Door type, second: solid, black vinyl/field laminated
- m. Door hinge location, second: Right
- n. Door handle, second: full length stainless steel handle, 24"
- o. Shelving style, second: (3) flat shelves
- p. Crisp White LED
- q. Model 57786 Casters, 3-3/4", set of (4)

### **SLC – SUITE LEVEL LOUNGE C**

**ITEM # SLC-1                        UNDER-COUNTER BUFFET WARMER**  
**Quantity:                              Three (3)**  
**Manufacturer:                        CookTek**  
**Model:                                    660801**

- a. Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SLC-2                        COLD SHELF, UNDERMOUNT**  
**Quantity:                              One (1)**  
**Manufacturer:                        Hatco**  
**Model:                                    CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA
- b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

**SLD – SUITE LEVEL LOUNGE D**

**ITEM # SLD-1                      UNDER-COUNTER BUFFET WARMER**  
**Quantity:                        Three (3)**  
**Manufacturer:                  CookTek**  
**Model:                             660801**

Three (3) Model 660801 (B651-U2) Incogneeto™ Induction Buffet, under-countertop design, mounts to underside of countertop, includes control panel & (1) Magneeto™ trivet (locator/controller disc), automatic pan detection, lock feature, red LED display, polycarbonate top, aluminum housing, 100-120v/50/60/1-ph, 650 watts, 6.0 amps, 6 ft. cord, NEMA 5-15P, cETLus, NSF, CE.

**ITEM # SLD-2                      COLD SHELF, UNDERMOUNT**  
**Quantity:                        One (1)**  
**Manufacturer:                  Hatco**  
**Model:                             CSU-24-I**

- a. Model CSU-24-I Cold Shelf, undermount, 24"W x 19-1/2"D, electronic temperature control, attached control box, self-contained refrigeration, R-513A refrigerant, aluminum hardcoat, 1/5 HP, cULus, Made in USA
- b. 120v/60/1-ph, 300 watts, 1/5 HP, NEMA 5-15P standard

**SP1 – SUITE LEVEL SERVICE PANTRY ONE**

**ITEM # SP1-1                      REACH-IN ICE FREEZER**  
**Quantity:                        Two (2)**  
**Manufacturer:                  Beverage Air**  
**Model:                             MMF49HC-1-B**

- a. Model MMF49HC-1-B MarketMax™ Freezer Merchandiser, reach-in, two-section, (2) triple pane hinged glass doors, 46.2 cu. ft. capacity, electronic control, digital display, (10) epoxy coated steel shelves, LED interior lighting, lighted sign panel, self closing door with automatic hold-open feature, bottom-mounted refrigeration, black exterior, R290 Hydrocarbon refrigerant, 3/4 HP, cULus, UL EPH Classified, UL-Sanitation, Made in USA
- b. 115v/60/1-ph, 11.0 amps, cord with NEMA 5-15P
- c. Left door hinged left, right door hinged right, standard
- d. Model 61C01-017D-01 Casters, 6" HB, MM & Slate Series models (set of 4)

**ITEM # SP1-2                      ROLL-IN REFRIGERATOR**  
**Quantity:                        Three (3)**  
**Manufacturer:                  Delfield**  
**Model:                             GARRI2P-S**

- a. Model GARRI2P-S Specification Line® Refrigerator, Roll-In, two-section, 76.5 cubic feet capacity, top-mounted self-contained refrigeration system, (2) full-height hinged solid doors (locking), 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, 1" tall stainless steel ramp, stainless steel exterior front,



sides & interior, GreenGenius™ R290 Hydrocarbon refrigerant, 0.38 HP, 115v/60/1-ph, 6.5 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®

- b. Full height solid door, standard
- c. Door hinged on left standard
- d. Full height solid door, standard
- e. Door hinged on right standard

**ITEM # SP1-3**                      **UNIVERSAL ROLL-IN RACK**  
**Quantity:**                      **Twelve (12)**  
**Manufacturer:**                **Cres Cor**  
**Model:**                         **207UA12AC**

- a. Model 207UA12AC Rack, Roll-In Refrigerator, open frame design, (12) universal slides for 12" x 20" thru 18" x 26" pans on 4-1/2" centers, adjustable at 1-1/2" intervals, welded extruded aluminum frame, NSF
- b. Model 1032 001 Pan Stop, mounted to rear, prevents accidental push through of pans
- c. Model 1056 002 Corner Bumpers, add 2" to OA dimensions, non-marking, gray

**ITEM # SP1-4**                      **HAND SINK**  
**Quantity:**                      **Two (2)**  
**Manufacturer:**                **Advance Tabco**  
**Model:**                         **7-PS-66**

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus

**ITEM # SP1-5**                      **POS**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **BY OPERATIONS**  
**Model:**                         **POS**

- a. PROVIDED BY OPERATIONS

**ITEM # SP1-5.1**                    **POS PRINTER**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **BY OPERATIONS**  
**Model:**                         **POS**

- a. PROVIDED BY OPERATIONS

**ITEM # SP1-6**                      **ISLAND WORK TABLE**  
**Quantity:**                      **Two (2)**  
**Manufacturer:**                **Atlanta Custom Fabricators**  
**Model:**                         **IWT**

- a. Model IWT Island work table, all stainless steel construction, 8'-0" long X 3'-0" wide X 36" high. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges. Table to be fully welded construction with all welds ground and polished to a uniform finish. Table to be provided with stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet.
- b. Unit to be further constructed in accordance with shop drawings  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # SP1-7**                    **DISH DOLLY**  
**Quantity:**                    **Four (4)**  
**Manufacturer:**              **Metro**  
**Model:**                        **PCD11A**

- a. Model PCD11A Quick Ship - Poker Chip Dish Dolly, 26-5/8"W x 26-5/8"D x 31-15/16"H, adjustable, dish size 4-1/4" to 11-3/4", removable dividers & towers, two-handed access, recessed handles, 5"Dia. swivel casters with neoprene wheels (2 with brakes), chip-resistant polymer shell with Microban® antimicrobial protection, aesthetic blue, vinyl dust/water splash cover, NSF

**ITEM # SP1-8**                    **ROLL-IN HEATED CABINET**  
**Quantity:**                    **Three (3)**  
**Manufacturer:**              **Delfield**  
**Model:**                        **GAHRI2-S**

- a. Model GAHRI2-S Specification Line® Heated Cabinet, Roll-In, two-section, 76.5 cubic feet capacity, (2) full-height hinged solid doors (locking), 4.3" easyTouch® screen temperature display/control with remote monitoring, incandescent interior lighting, 1" tall stainless steel ramp, stainless steel exterior front, sides & interior, 208-240v/60/1-ph, 10.5 amps, NEMA 6-20P, NSF, cULus, ENERGY STAR®
- b. Left door hinged on left, right door hinged on right, standard
- c. Full height solid doors, standard
- d. Model AS269-AFJ-0043 Raised Ramp, for roll in/roll thru, standard

**ITEM # SP1-9**                    **STORAGE SHELVING**  
**Quantity:**                    **Eight (8) – (3 COMPLETE UNITS 4 SHELVES EACH)**  
**Manufacturer:**              **Metro**  
**Model:**                        **2142NK3**

- a. Model 2142NK3 Quick Ship - Super Erecta® Shelf, wire, 42"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. Model 74UPK3 Quick Ship - Super Erecta® SiteSelect™ Post, 73-7/8"H, for use with stem casters, Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
- c. (4) Model 5PC Quick Ship - Super Erecta® Stem Caster, swivel, 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper
- d. (4) Model 5PCB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper

**ITEM # SP1-10**                **3 COMPARTMENT SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Advance Tabco**  
**Model:**                        **K7-CS-29**

- a. Model K7-CS-29 Convenience Store Sink, 3-compartment, with left & right-hand drainboards, 16" front-to-back x 14" W compartment, 12" deep with 8"H backsplash, stainless steel open frame base, side crossrails, adjustable metal bullet feet, 18 gauge 304 stainless steel, 11-5/8" drainboards, overall 21-1/2" F/B x 70" L/R  
 OMIT FAUCET
- b. (2) Model K-472 Faucet hole revision

- c. (3) Model K-4 Support Bracket, for lever waste drain handle, (1) support required for each lever drain

**ITEM # SP1-10.1**      **FAUCET**  
**Quantity:**            **Two (2)**  
**Manufacturer:**      **T&S Brass**  
**Model:**                **5F-8WLX10**

- a. Model 5F-8WLX10 Equip Faucet, 8" centers, wall mount, 10" swivel nozzle, lever handles, 2" flange, ceramic cartridges, low lead, ADA Compliant

**ITEM # SP1-11**      **WALL SHELF W/ POT RACK**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Advance Tabco**  
**Model:**                **PS-12-72**

- a. Model PS-12-72 Shelf with Pot Rack, wall-mounted, 72"W x 12"D, 18/430 stainless steel shelf, 2" x 1/4" stainless steel pot rack, includes: (9) plated double pot hooks, NSF

**ITEM # SP1-12**      **MOP SINK CABINET**  
**Quantity:**            **One (1)**  
**Manufacturer:**      **Advance Tabco**  
**Model:**                **9-OPC-84DL**

- a. Model 9-OPC-84DL Cabinet with Mop Sink, 50-3/8"W x 22-3/4"D x 84"H O.A., double hinged doors, left side mop sink 20"W x 16"D front to back x 12" deep (drain included), storage for mop bucket to roll in on right, (2) mop holders, (4) fixed intermediate shelves (3 on right, 1 on left above sink), slotted side panels for ventilation, 16/304 series stainless steel sink bowl, 18/304 series sink bowl apron, 18/430 series stainless steel cabinet, NSF
- b. Model K-240 Service Sink Faucet, wall mount, heavy duty, 8" OC, 6-1/2" spout, with hose thread & pail hook, vacuum breaker spout, wall braced, chrome-plated brass
- c. Model K-610CF Perforated bottom strainer plate, stainless steel, removable, sits 1" above bottom of sink, fits Advance Tabco Fabricated 16" x 20" sink bowls only

**ITEM # SP1-13**      **SPARE NO.**

**ITEM # SP1-14**      **SPARE NO.**

**ITEM # SP1-15**      **DUNNAGE RACK**  
**Quantity:**            **Five (5)**  
**Manufacturer:**      **Channel Manufacturing**  
**Model:**                **ES2048**

- a. Model ES2048 Dunnage Rack, Tubular Dunnage Rack, Stainless Series, 48"W x 20"D x 12"H, Stainless Steel Construction, (4,000) lb. distributed weight capacity per shelf, Made in USA, NSF, 20lbs. (ITEM WEIGHT ONLY), add /8 after model number for (8") height

**ITEM # SP1-16**      **DRY STORAGE SHELVING**  
**Quantity:**            **Ten (10) – (2 COMPLETE UNIT 5 SHELVES EACH)**  
**Manufacturer:**      **Metro**  
**Model:**                **2160NK3**

- a. Model 2160NK3 Quick Ship - Super Erecta® Shelf, wire, 60"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. (8) Model 86PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 86-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

**ITEM # SP1-16.1            DRY STORAGE SHELVING**  
**Quantity:                Ten (10) – (2 COMPLETE UNIT 5 SHELVES EACH)**  
**Manufacturer:           Metro**  
**Model:                    2148NK3**

- a. Model 2148NK3 Quick Ship - Super Erecta® Shelf, wire, 48"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. (8) Model 86PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 86-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

**ITEM # SP1-16.2            DRY STORAGE SHELVING**  
**Quantity:                Ten (10) – (2 COMPLETE UNIT 5 SHELVES EACH)**  
**Manufacturer:           Metro**  
**Model:                    2142NK3**

- a. Model 2142NK3 Quick Ship - Super Erecta® Shelf, wire, 42"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. (8) Model 86PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 86-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection

**ITEM # SP1-17              MOBILE SECURITY UNIT**  
**Quantity:                One (1)**  
**Manufacturer:           Eagle Group**  
**Model:                    CSC2448**

- a. Model CSC2448 Security Unit, mobile, 51-1/4"W x 27-1/4"D x 69"H, open wire construction with 2" x 2" mesh panels, (2) doors with hasps for padlock, chrome-plated finish, (2) swivel & (2) swivel/brake 5" stem casters with poly tread, KD, NSF
- b. (2) Model 2448C-X Shelf, wire, 48"W x 24"D, patented QuadTruss® design, includes (4) pairs of split sleeves per shelf, 800 lbs. capacity, chrome-plated finish, NSF

## **SP2 – SUITE LEVEL SERVICE PANTRY TWO**

**ITEM # SP2-1              HAND SINK**  
**Quantity:                Two (2)**  
**Manufacturer:           Advance Tabco**  
**Model:                    7-PS-66**

- a. Model 7-PS-66 Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, 7-3/4" high side splashes, with heavy duty splash mounted faucet, wall bracket, NSF, cCSAus

**ITEM # SP2-2**                      **ROLL-IN REFRIGERATOR**  
**Quantity:**                      **Two (2)**  
**Manufacturer:**                **Delfield**  
**Model:**                         **GARRI2P-S**

- a. Model GARRI2P-S Specification Line® Refrigerator, Roll-In, two-section, 76.5 cubic feet capacity, top-mounted self-contained refrigeration system, (2) full-height hinged solid doors (locking), 4.3" easyTouch® screen temperature display/control with remote monitoring, LED interior lighting, 1" tall stainless steel ramp, stainless steel exterior front, sides & interior, GreenGenius™ R290 Hydrocarbon refrigerant, 0.38 HP, 115v/60/1-ph, 6.5 amps, NEMA 5-15P, NSF, cULus, ENERGY STAR®
- b. Full height solid doors, standard
- c. Door hinged on left standard
- d. Door hinged on right standard

**ITEM # SP2-3**                      **ROLL-IN HEATED CABINET**  
**Quantity:**                      **Two (2)**  
**Manufacturer:**                **Delfield**  
**Model:**                         **GAHRI2-S**

- a. Model GAHRI2-S Specification Line® Heated Cabinet, Roll-In, two-section, 76.5 cubic feet capacity, (2) full-height hinged solid doors (locking), 4.3" easyTouch® screen temperature display/control with remote monitoring, incandescent interior lighting, 1" tall stainless steel ramp, stainless steel exterior front, sides & interior, 208-240v/60/1-ph, 10.5 amps, NEMA 6-20P, NSF, cULus, ENERGY STAR®
- b. Left door hinged on left, right door hinged on right, standard
- c. Full height solid doors, standard
- d. Model AS269-AFJ-0043 Raised Ramp, for roll in/roll thru, standard

**ITEM # SP2-4**                      **UNIVERSAL ROLL-IN RACK**  
**Quantity:**                      **Eight (8)**  
**Manufacturer:**                **Cres Cor**  
**Model:**                         **207UA12AC**

- a. Model 207UA12AC Rack, Roll-In Refrigerator, open frame design, (12) universal slides for 12" x 20" thru 18" x 26" pans on 4-1/2" centers, adjustable at 1-1/2" intervals, welded extruded aluminum frame, NSF
- b. Model 1032 001 Pan Stop, mounted to rear, prevents accidental push through of pans
- c. Model 1056 002 Corner Bumpers, add 2" to OA dimensions, non-marking, gray

**ITEM # SP2-5**                      **ISLAND WORK TABLE**  
**Quantity:**                      **One (1)**  
**Manufacturer:**                **Atlanta Custom Fabricators**  
**Model:**                         **IWT**

- a. Model IWT Island work table, all stainless steel construction, 8'-0" long X 3'-0" wide X 36" high. Top to be 14 gauge type 304 stainless steel with 1-3/4" rolled edges. Table to be fully welded construction with all welds ground and polished to a uniform finish. Table to be provided with stainless steel cross bracing, stainless steel legs and stainless steel adjustable bullet feet.

- b. Unit to be further constructed in accordance with shop drawings  
APPROVED SHOP DRAWINGS REQUIRED PRIOR TO CONSTRUCTION.

**ITEM # SP2-6**                    **DISH DOLLY**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**            **Metro**  
**Model:**                      **PCD11A**

- a. Model PCD11A Quick Ship - Poker Chip Dish Dolly, 26-5/8"W x 26-5/8"D x 31-15/16"H, adjustable, dish size 4-1/4" to 11-3/4", removable dividers & towers, two-handed access, recessed handles, 5"Dia. swivel casters with neoprene wheels (2 with brakes), chip-resistant polymer shell with Microban® antimicrobial protection, aesthetic blue, vinyl dust/water splash cover, NSF

**ITEM # SP2-7**                    **SPARE NO.**

**ITEM # SP2-8**                    **SPARE NO.**

**ITEM # SP2-9**                    **SPARE NO.**

**ITEM # SP2-10**                **REACH-IN ICE FREEZER**  
**Quantity:**                    **Two (2)**  
**Manufacturer:**            **Beverage Air**  
**Model:**                      **MMF49HC-1-B**

- a. Model MMF49HC-1-B MarketMax™ Freezer Merchandiser, reach-in, two-section, (2) triple pane hinged glass doors, 46.2 cu. ft. capacity, electronic control, digital display, (10) epoxy coated steel shelves, LED interior lighting, lighted sign panel, self closing door with automatic hold-open feature, bottom-mounted refrigeration, black exterior, R290 Hydrocarbon refrigerant, 3/4 HP, cULus, UL EPH Classified, UL-Sanitation, Made in USA  
b. 115v/60/1-ph, 11.0 amps, cord with NEMA 5-15P  
c. Left door hinged left, right door hinged right, standard  
d. Model 61C01-017D-01 Casters, 6" HB, MM & Slate Series models (set of 4)

**ITEM # SP2-11**                **MOBILE SECURITY UNIT**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Eagle Group**  
**Model:**                      **CSC2448**

- a. Model CSC2448 Security Unit, mobile, 51-1/4"W x 27-1/4"D x 69"H, open wire construction with 2" x 2" mesh panels, (2) doors with hasps for padlock, chrome-plated finish, (2) swivel & (2) swivel/brake 5" stem casters with poly tread, KD, NSF  
b. (2) Model 2448C-X Shelf, wire, 48"W x 24"D, patented QuadTruss® design, includes (4) pairs of split sleeves per shelf, 800 lbs. capacity, chrome-plated finish, NSF

**ITEM # SP2-12**                **3 COMPARTMENT SINK**  
**Quantity:**                    **One (1)**  
**Manufacturer:**            **Advance Tabco**  
**Model:**                      **K7-CS-29**

- a. Model K7-CS-29 Convenience Store Sink, 3-compartment, with left & right-hand drainboards, 16" front-to-back x 14" W compartment, 12" deep with 8"H backsplash, stainless steel open frame base, side crossrails, adjustable metal bullet feet, 18 gauge

304 stainless steel, 11-5/8" drainboards, overall 21-1/2" F/B x 70" L/R  
OMIT FAUCET

- b. (2) Model K-472 Faucet hole revision
- c. (3) Model K-4 Support Bracket, for lever waste drain handle, (1) support required for each lever drain

**ITEM # SP2-12.1      FAUCET**  
**Quantity:            Two (2)**  
**Manufacturer:       T&S Brass**  
**Model:                5F-8WLX10**

- a. Model 5F-8WLX10 Equip Faucet, 8" centers, wall mount, 10" swivel nozzle, lever handles, 2" flange, ceramic cartridges, low lead, ADA Compliant

**ITEM # SP2-13        WALL SHELF W/ POT RACK**  
**Quantity:            One (1)**  
**Manufacturer:       Advance Tabco**  
**Model:                PS-12-72**

- a. Model PS-12-72 Shelf with Pot Rack, wall-mounted, 72"W x 12"D, 18/430 stainless steel shelf, 2" x 1/4" stainless steel pot rack, includes: (9) plated double pot hooks, NSF

**ITEM # SP2-14        POS**  
**Quantity:            One (1)**  
**Manufacturer:       BY OPERATIONS**  
**Model:                POS**

- a. Model POS PROVIDED BY OPERATIONS

**ITEM # SP2-14.1     POS PRINTER**  
**Quantity:            One (1)**  
**Manufacturer:       BY OPERATIONS**  
**Model:                POS**

- a. Model POS PROVIDED BY OPERATIONS

**ITEM # SP2-15        STORAGE SHELVING**  
**Quantity:            Four (4) – (1 COMPLETE UNIT 4 SHELVES)**  
**Manufacturer:       Metro**  
**Model:                2142NK3**

- a. Model 2142NK3 Quick Ship - Super Erecta® Shelf, wire, 42"W x 21"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
- b. Model 74UPK3 Quick Ship - Super Erecta® SiteSelect™ Post, 73-7/8"H, for use with stem casters, Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
- c. (2) Model 5PC Quick Ship - Super Erecta® Stem Caster, swivel, 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper
- d. (2) Model 5PCB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, corrosion resistant, polyurethane flat wheel tread, polymer horn, includes bumper

**ITEM # SP2-16**                    **MOP SINK CABINET**  
**Quantity:**                    **One (1)**  
**Manufacturer:**              **Advance Tabco**  
**Model:**                        **9-OPC-84**

- a. Model 9-OPC-84 Cabinet with Mop Sink, 25-3/16"W x 22-3/4"D x 84"H, mop sink base with drain (bowl 16" x 20" x 12"), left hinged door, (2) mop holders, (1) fixed intermediate shelf, slotted side panels for ventilation, 16/304 series stainless steel sink bowl, 18/304 series stainless steel sink bowl apron, 18/430 series stainless steel cabinet, NSF (right hinged door available on request)
- b. Model K-240 Service Sink Faucet, wall mount, heavy duty, 8" OC, 6-1/2" spout, with hose thread & pail hook, vacuum breaker spout, wall braced, chrome-plated brass
- c. Model K-610CF Perforated bottom strainer plate, stainless steel, removable, sits 1" above bottom of sink, fits Advance Tabco Fabricated 16" x 20" sink bowls only

**END OF SECTION 11 40 00**



**PART 15 - THIS PAGE IS INTENTIONALLY LEFT BLANK**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 11 47 00 - ICE MACHINES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Ice-making machines and bins.

**1.2 COORDINATION**

- A. Coordinate equipment layout and installation with other work, including layout and installation of lighting fixtures, HVAC equipment, and fire-suppression system components.
- B. Coordinate locations and requirements of utility service connections.
- C. Coordinate sizes, locations, and requirements of the following:
  - 1. Floor areas with positive slopes to drains.
  - 2. Roof curbs, equipment supports, and penetrations.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include the following:
  - 1. Manufacturer's model number.
  - 2. Accessories and components that will be included for Project.
  - 3. Clearance requirements for access and maintenance.
  - 4. Utility service connections for water, drainage, power, and fuel; include roughing-in dimensions.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings:
  - 1. Indicate locations of equipment and connections to utilities.
  - 2. Key equipment using same designations as indicated on Drawings.
  - 3. Include plans and elevations; clearance requirements for equipment access and maintenance; details of equipment supports; and utility service characteristics.
- B. Sample Warranty: For special warranty.

**1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For equipment to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
    - a. Product Schedule: For each equipment item, include the following:
      - 1) Designation indicated on Drawings.
      - 2) Manufacturer's name and model number.
      - 3) List of factory-authorized service agencies including addresses and telephone numbers.

**1.7 FIELD CONDITIONS**

- A. Field Measurements: Verify actual dimensions of construction contiguous with equipment by field measurements before fabrication. Indicate measurements on Coordination Drawings.

**1.8 WARRANTY**

- A. Refrigeration Compressor Warranty: Manufacturer agrees to repair or replace compressors that fail in materials or workmanship within specified warranty period.
  1. Failure includes, but is not limited to, inability to maintain set temperature.
  2. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. NSF Standards: Provide equipment that bears NSF Certification Mark or UL Classification Mark certifying compliance with applicable NSF standards.
- B. UL Certification: Provide electric and fuel-burning equipment and components that are evaluated by UL for fire, electric shock, and casualty hazards according to applicable safety standards, and that are UL certified for compliance and labeled for intended use.
- C. Regulatory Requirements: Install equipment to comply with the following:
  1. ASHRAE 15, "Safety Code for Mechanical Refrigeration."
  2. NFPA 70, "National Electrical Code."

**2.2 ICE-MAKING MACHINES**

- A. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated in paragraphs below or comparable product by one of the following:
  1. Follett Corporation.
  2. Hoshizaki America, Inc.
  3. Ice-O-Matic
  4. Manitowoc Ice.
  5. Scotsman Ice Machines.
- B. Ice Machine:
  1. Basis of Design: Manitowoc; RNF-1100W.
  2. Description: Water-cooled, freestanding units.
    - a. Production: Small, chewable, pellet-type ice.
    - b. Capacity: 1158 lbs. per 24-hour period.
    - c. Dimensions: 30 inches wide by 23.62 inches deep by 27.40 inches high.
    - d. Accessories:
      - 1) Storage Bin: Manitowoc; D-570.
        - a) Storage Capacity: 430 lbs.
        - b) Dimensions: 30 inches wide by 34 inches deep by 44 inches high.
      - 2) Water filter.
    - e. Electrical Service: Equip unit for connection to 208-230/60/1.

**2.3 MISCELLANEOUS MATERIALS**

- A. Installation Accessories, General: NSF certified for end-use application indicated.

**2.4 FINISHES**

- A. Stainless-Steel Finishes:
  - 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
  - 2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
    - a. Run grain of directional finishes with long dimension of each piece.
    - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Install equipment level and plumb, according to manufacturer's written instructions.
  - 1. Connect equipment to utilities.
- B. Complete equipment assembly where field assembly is required.
- C. Install equipment with access and maintenance clearances that comply with manufacturer's written installation instructions and with requirements of authorities having jurisdiction.

**3.2 CLEANING AND PROTECTING**

- A. After completing installation of equipment, repair damaged finishes.
- B. Clean and adjust equipment as required to produce ready-for-use condition.
- C. Protect equipment from damage during remainder of the construction period.

**3.3 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain equipment.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 11 61 00 - THEATER AND STAGE EQUIPMENT****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
  - 1. Curtain tracks and carriers for vomitories.

**1.2 SUBMITTALS**

- A. Shop Drawings showing layout and types of cubicles, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.

**1.3 PROJECT CONDITIONS**

- A. Field Measurements: Verify dimensions by field measurements. Verify that tracks and curtains may be installed to comply with the original design and referenced standard.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide cubicles by one of the following:
  - 1. ADC Hospital Equipment.
  - 2. Creative Healthcare Products, Inc. (Clickeze).
  - 3. General Cubicle Co.
  - 4. Imperial Fastener Co.
  - 5. Kirsch Co.
  - 6. Nelson: A.R. Nelson Co., Inc.
  - 7. Pryor Products.
  - 8. Salisbury Industries.

**2.2 CUBICLE TRACK**

- A. Track: Anodized, extruded aluminum.
- B. Track Mounting: Ceiling mounted; mechanically fastened directly to finished ceiling.
  - 1. Exposed Fasteners: Stainless steel.
  - 2. Concealed Fasteners: Stainless steel.
- C. Track Accessories: Provide end caps, connectors, end stops, coupling sleeves, wall brackets, and other accessories as required for secure and operational installation. Provide a quantity of carriers for 6-inch spacing the full length of the curtain plus 1 additional carrier.
  - 1. Carriers: One-piece nylon glide with chrome-plated steel hook.
  - 2. Carriers: One-piece nylon glide with hook.
  - 3. Carriers: Nylon rollers and axle with chrome-plated steel hook.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine ceilings for suitable conditions where cubicle track is to be installed.

- B. Do not proceed until unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install cubicle curtain track level and plumb, according to manufacturer's written instructions and original design.
- B. Install ceiling-mounted tracks at intervals of not less than 24 inches.
- C. Center fastener in track to insure unencumbered carrier operation.

END OF SECTION



**SECTION 11 61 43 - STAGE CURTAINS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Stage curtains, scrims, and drops.
  - 2. Draw-curtain tracks.
  - 3. Draw-curtain machines for motorized operation.
  - 4. Curtain rigging.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for steel framing and supports for stage-curtain systems.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product and the following:
  - 1. Draw-Curtain Machines: Include rated capacities, operating characteristics, and electrical characteristics.
  - 2. Tracks: Capability of each track to support the weight and operation of curtains that it supports.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
  - 1. Include plans, elevations, sections, and attachment details of curtains.
  - 2. Include fabric assembly and hanging details.
  - 3. Dimension operating clearances.
  - 4. Include documentation of capacity of each batten, track, attachment, and rigging component to support loads.
  - 5. Points of attachment for proscenium curtain and the corresponding static and dynamic loads imposed on structure.
  - 6. Locations of equipment components, switches, and controls. Differentiate between manufacturer-installed and field-installed wiring.
  - 7. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of stage curtain indicated. Include color charts showing full range of colors, textures, and patterns available, together with 12-inch-square Sample (any color) of each fabric type and seam.
- D. Samples for Verification: Full width by minimum 36-inch-long section of each fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric.
- E. Delegated-Design Submittal: For stage-curtain systems and attachments to structure, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Structural members to which tracks, battens, and other stage-curtain equipment will be attached.
  - 2. Locations of lighting fixtures and cabling, ductwork, piping, and sprinklers.
  - 3. Rigging equipment for stage equipment.
  - 4. Access panels.
- B. Qualification Data: For Installer and professional engineer.
- C. Product Certificates: For the following, from manufacturer:
  - 1. Fabric: Provide name of flame-retardant chemical used, identification of applicator, treatment method, application date, allowable life span for treatment, and details of any restrictions and limitations.
  - 2. Rigging: Compliance of suspended battens and tracks with requirements.
- D. Sample Warranty: For manufacturer's special warranty.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For stage curtains and rigging to include in operation and maintenance manuals.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: Manufacturer of stage curtains.

**1.7 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install stage curtains until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Verify locations of supporting structural elements and construction contiguous with stage curtains and rigging by field measurements before fabrication and indicate measurements on Shop Drawings.

**1.8 WARRANTY**

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of stage-curtain systems that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, faulty operation of rigging.
  - 2. Warranty Period: Two years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 STAGE-CURTAIN SYSTEMS**

- A. Description: Complete stage-curtain systems, including stage curtains, tracks, draw-curtain machines, and rigging; with necessary accessories for support and operation.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Black Sheep Enterprises.
    - b. Georgia Stage, Inc.
    - c. iWeiss Theatrical Solutions.
    - d. Janson Industries.
    - e. LimeLight Productions, Inc.
    - f. LuXout Stage Curtains.
    - g. Mainstage Theatrical Supply, Inc.
    - h. NorthEast Stage.
    - i. Rose Brand.
    - j. Sew What? Inc.
    - k. Show Works.
    - l. S&K Theatrical Draperies, Inc.
    - m. Stagecraft Industries, Inc.
    - n. Stage Decoration & Supplies, Inc.
    - o. Syracuse Scenery & Stage Lighting Co., Inc.
    - p. Texas Scenic Company, Inc.
    - q. Tru-Roll, Inc.; a division of Advanced Entertainment Technology.
- B. Source Limitations: Obtain stage-curtain systems from single manufacturer. Obtain each color, grade, finish, type, and variety of fabric from single source with resources to provide materials of consistent quality in appearance and physical properties.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design stage-curtain systems, including comprehensive engineering analysis and attachments to building structure, using performance requirements.
- B. Structural Performance: Stage-curtain systems and attachments to structure shall withstand the effects of gravity and operational loads and the following loads and stresses:
1. Design Loads: Weight of curtains.
- C. Fire-Test-Response Characteristics: Provide stage curtains meeting the following requirements as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
1. Flame-Propagation Resistance: Passes NFPA 701.
    - a. Permanently attach label to each fabric of curtain assembly indicating whether fabric is inherently and permanently flame resistant or is treated with flame-retardant chemicals and whether it requires retreatment after cleaning or after a designated time period of use.
    - b. Permanently attach 12-inch-square swatch of same fabric and dye lot for each fabric of a curtain assembly to the back of assembly for use as fire-resistance test strip.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

**2.3 CURTAIN FABRICS**

- A. General: Provide fabrics inherently and permanently flame resistant or chemically flame resistant by immersion treatment according to performance requirements indicated. Provide fabrics of each type and color from same dye lot.
- B. Heavyweight Woven Cotton Velour: Napped fabric of 100 percent cotton weighing not less than 25 oz./linear yd., with pile height not less than 79 mils; 54-inch minimum width.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dazian LLC; Symphony.
    - b. Frankel Associates/Fabric One; 950.
    - c. JB Martin Company; #2703 Overture.
    - d. KM Fabrics, Inc.; Memorable.
    - e. Valley Forge Fabrics, Inc.; 2525 Velour.
  2. Color/Texture/Pattern: As selected by Architect from manufacturer's full range.
- C. Medium-Weight Woven Cotton Velour: Napped fabric of 100 percent cotton weighing not less than 20 oz./linear yd., with pile height not less than 75 mils; 54-inch minimum width.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dazian LLC; Allure.
    - b. Frankel Associates/Fabric One; 650.
    - c. JB Martin Company; #2603 Concertino.
    - d. KM Fabrics, Inc.; Marvel.
    - e. Valley Forge Fabrics, Inc.; 2020 Velour.
  2. Color/Texture/Pattern: As selected by Architect from manufacturer's full range.
- D. Lightweight Woven Cotton Velour: Napped fabric of 100 percent cotton weighing not less than 15 oz./linear yd., with pile height not less than 59 mils; 54-inch minimum width.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. JB Martin Company; #2503 Melody.
    - b. KM Fabrics, Inc.; Princess.
    - c. Valley Forge Fabrics, Inc.; 16 oz. Velvet.
  2. Color/Texture/Pattern: As selected by Architect from manufacturer's full range.
- E. Polyester Velour: Napped fabric of 100 percent polyester weighing not less than 22 oz./linear yd., with pile height approximately 75 mils; inherently and permanently flame resistant; 54-inch minimum width.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dazian LLC; Angelo.
    - b. JB Martin Company; Dante.
    - c. KM Fabrics, Inc.; Prestige.
    - d. Milliken & Company; Encore.
  2. Color/Texture/Pattern: As selected by Architect from manufacturer's full range.
- F. Muslin: Sheer, plain-woven fabric.
1. Fabric: 100 percent cotton weighing not less than 16 oz./linear yd.; [100-inch] <Insert dimension> minimum width.
  2. Fabric: 100 percent polyester weighing not less than [11.75 oz./linear yd.] <Insert value>; inherently and permanently flame resistant; [106-inch] <Insert dimension> minimum width.
  3. Color: As selected by Architect from manufacturer's full range.

- G. Duvetyn: 100 percent cotton, short-napped fabric weighing not less than 8 oz./linear yd.; twill weave with soft uniform texture; 54-inch minimum width; black.
- H. Duvetyn: 100 percent cotton, short-napped fabric weighing not less than 8 oz./linear yd.; twill weave with soft uniform texture; 54-inch minimum width; black.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dazian LLC; Duvetyne.
    - b. Frankel/Fabric One; Duvetyne.
    - c. Fred Krieger & Co., Inc.; Duvetyne.
    - d. Rose Brand; Duvetyne.
- I. Duvetyn, Heavy Weight: 100 percent cotton, short-napped fabric weighing not less than 16 oz./linear yd.; twill weave with soft uniform texture; 54-inch minimum width; black.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dazian LLC; Supercote Heavyweight.
    - b. Fred Krieger & Co., Inc.; Super Commando.
    - c. Rose Brand; Black Commando.
    - d. Valley Forge Fabrics, Inc.; Commando.
- J. Repp, Atlas Oxford: 100 percent heavyweight cotton woven fabric; herringbone weave; 54-inch minimum width.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Fred Krieger & Co., Inc.; Atlas Oxford.
    - b. Rose Brand; Atlas Oxford.
  2. Color/Texture/Pattern: As selected by Architect from manufacturer's full range.
- K. Repp, Nassau Chevron: 100 percent heavyweight cotton woven fabric; chevron weave; 54-inch minimum width.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Frankel Associates/Fabric One; Nassau Chevron.
    - b. Fred Krieger & Co., Inc.; Nassau Chevron.
    - c. Rose Brand; Nassau Chevron.
    - d. Valley Forge Fabrics, Inc.; Nassau Chevron.
  2. Color/Texture/Pattern: As selected by Architect from manufacturer's full range.
- L. Synthetic Boucle: 100 percent synthetic blend with opaque vinyl backing; diagonal weave; inherently and permanently flame resistant; 48-inch minimum width.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Fred Krieger & Co., Inc.; Dural.
  2. Color/Texture/Pattern: As selected by Architect from manufacturer's full range.
- M. Polyester: 100 percent polyester yarn woven fabric weighing not less than 13 oz./linear yd.; inherently and permanently or durably flame resistant; 72-inch minimum width.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dazian LLC; PD Cloth.
    - b. Frankel Associates/Fabric One; Cyc-Clone.
    - c. Rose Brand; Poly Cyc.
    - d. Valley Forge Fabrics, Inc.; Wiz Key.

2. Color/Texture/Pattern: As selected by Architect from manufacturer's full range.
- N. Sharkstooth Scrim: Open-weave, seamless, lightweight gauze fabric.
1. Fabric: 100 percent cotton or 95 percent cotton/5 percent polyester weighing not less than 29 oz./linear yd.; 30-foot minimum width.
  2. Fabric: 100 percent cotton weighing not less than 32 oz./linear yd.; three-thread construction; 30-foot minimum width.
  3. Fabric: 100 percent polyester weighing not less than 37 oz./linear yd.; inherently and permanently flame resistant; 35-foot minimum width.
  4. Fabric: 100 percent polyester/modacrylic blend weighing not less than 40 oz./linear yd.; inherently and permanently flame resistant; three-thread construction; suitable for all weather applications; 36-foot minimum width.
  5. Color: As selected by Architect.

## 2.4 LINING

- A. Cotton Lining: Yarn-dyed denim cloth of 100 percent cotton; woven in a warp-faced twill; 54-inch minimum width; black.
- B. Ranger Lining: 100 percent cotton fabric weighing not less than 13 oz./linear yd.; 54-inch minimum width; black.
- C. Polyester Lining: 100 percent polyester fabric; inherently and permanently flame resistant; 54-inch minimum width; black.

## 2.5 CURTAIN-BOTTOM WEIGHTS

- A. Individual Weights: Curtain manufacturer's standard segmented weights to suit each curtain type and location.
- B. Proof Coil Chain: Grade 30, No. 8, zinc plated, 3/16 inch, ASTM A413/A413M.
- C. Weight Tape: Curtain manufacturer's standard, continuous weight tape to suit each curtain type and location.
- D. Pipe or Conduit Weight and Stiffener: Curtain manufacturer's standard or recommended stiffening pipe or conduit that slides into bottom hem, suitable for curtain type and location indicated.

## 2.6 CURTAIN FABRICATION

- A. General: Affix permanent label, stating compliance with requirements of authorities having jurisdiction, in accessible location on fabric not visible to audience. Provide vertical seams unless otherwise indicated. Arrange vertical seams so they do not fall on faces of pleats. Do not use fabric cuts less than one-half width. Orient velour fabric with the fabric nap down.
- B. Vertical and Top Hems: Machine sew hems as follows unless otherwise indicated:
  1. Vertical Hems: Minimum 2 inches wide, and not less than 4 inches wide at borders, valance, teasers, and tormentors, with not less than a 1-inch tuck and with no selvage material visible from front of curtain. Sew open ends of hems closed.
  2. Turn backs: Provide leading-edge turn backs for traveler curtains, formed by folding back not less than 12 inches of face fabric, with not less than a 1-inch tuck, and vertically secured by sewing.
  3. Top Hems: Reinforced by double-stitching 3-1/2-inch-wide, heavy, jute webbing to top edge on back side of curtain with not less than 2 inches of face fabric turned under.

- C. Fullness:
1. Flat: Provide zero percent fullness in curtains.
  2. 50 Percent Fullness: Provide fullness, exclusive of turnbacks and hems, by sewing additional material into 3-inch double-stitched, flat, box pleats spaced at 12 inches o.c. along top hem reinforcement.
  3. 100 Percent Fullness: Provide fullness, exclusive of turnbacks and hems, by sewing additional material into 6-inch double-stitched, flat, box pleats spaced at 12 inches o.c. along top hem reinforcement.
- D. Grommets: Brass, No. 3, or No. 4.
1. Black Curtains: Provide brass or aluminum grommets with black finish.
  2. Flat Curtains: Place 12 inches o.c. and 1 inch from corner of curtain; for ties, snap hooks, or S-hooks.
  3. Flat Curtains: Provide blind grommet top finish to mask battens using hidden pairs of grommets; place 12 inches o.c. and 1 inch from corner of curtain; for ties.
  4. Pleated Curtains: Center grommets on each box pleat and place 1 inch from corner of curtain; for snap hooks or S-hooks.
- E. Bottom Hems: Machine sew hems as follows unless otherwise indicated:
1. For Flat Curtains Without Fullness: 4-inch lined hem with pocket for sliding pipe or conduit weight and stiffener into bottom of curtain, and with a concealing flap of same fabric in front of pocket made 2 inches longer than bottom edge of pocket.
  2. For Curtains With Fullness:
    - a. Curtains That Do Not Hang to Floor: Hems not less than 3 inches deep, with 3/4-inch weight tape, and with open ends of hems sewn closed.
    - b. Floor-Length Curtains: Hems not less than 6 inches deep, with 1-inch weight tape sewn to top seam of the bottom hem, clear of the finished bottom edge, and with open ends of hems sewn closed.
    - c. Floor-Length Curtains: Hems not less than 6 inches deep, with individual weights in individual closed pockets sewn above finished bottom edge of curtain, and with open ends of hems sewn closed.
    - d. Floor-Length Curtains: Hems not less than 6 inches deep; with separate, interior, 100 percent cotton, heavy canvas chain pockets equipped with proof coil chain; with chain pockets sewn so that chain rides 2 inches above finished bottom edge of curtain; and with open ends of hems sewn closed.
  3. Lining: Where indicated, provide lining for curtain in same fullness as face fabric and finished 2 inches shorter than face fabric. Sew or otherwise securely attach lining to top hem of face fabric. Attach lining to face fabric along bottom and side seams with 4-inch-long strips of heavy woven cotton tape. Sew lining to bottom edge of curtain allowing sufficient lining fabric for tucking to prevent shrinkage.

## 2.7 SCRIMS AND DROPS

- A. General: Affix permanent label, stating compliance with requirements of authorities having jurisdiction, in accessible location on fabric not visible to audience. Provide vertical seams unless otherwise indicated. Do not use fabric cuts less than one-half width.
- B. Scrims: Scrim curtain fabric sewn flat. Provide with continuous 6-inch pipe pocket at bottom with 6-inch flap of same fabric in front of pocket. Double-stitch 3-1/2-inch jute webbing at top with not less than No. 2 brass grommets spaced at 12 inches o.c. and 1 inch from corner of curtain. Provide not less than 2-inch double-folded side hem and 4-inch bottom hem.

- C. Drops: Muslin fabric, sewn flat, with either horizontal or vertical seams and with selvage to the rear. Provide 6-inch pipe pocket at bottom with 6-inch flap of same fabric in front of pocket. Double-stitch 3-1/2-inch jute webbing at top with not less than No. 2 brass grommets spaced at 12 inches o.c. and 1 inch from corner of curtain. Provide not less than 2-inch double-folded side hem and 4-inch bottom hem.

## 2.8 **CURTAIN ACCESSORIES**

- A. S-Hooks: Manufacturer's standard heavy-duty plated-wire hooks, not less than 2 inches long.
- B. Tie Lines: No. 4 or No. 4-1/2 cord or braided soft cotton tape, black or white to best match curtain; not less than 5/8 inch wide by 36 inches long, threaded through grommets.
- C. Snap Hooks: Manufacturer's standard heavy-duty hooks, sewn to top edge of curtain.

## 2.9 **ALUMINUM CURTAIN TRACK**

- A. Aluminum Track: Extruded aluminum, ASTM B221; alloy and temper as recommended by manufacturer for strength and corrosion resistance; black paint finish; complete with necessary accessories for support and operation.
  - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Automatic Devices Company; 500 series, Patriarc.
    - b. H & H Specialties Inc.; 500 series.
    - c. Tru-Roll, Inc., a division of Advanced Entertainment Technology; No. 1200 Medium Duty Straight Track.
  - 2. Curved Track: Fabricate curved portions of track in shop.
  - 3. Cable Guides for Curved Track: Outside idlers, mule pulleys, spindles, and guides; quantity sufficient for configuration of curve(s) and length of track.
  - 4. Aluminum Thickness: As recommended by manufacturer for loads and operation.
- B. Curtain Rails: Single or double curtain capacity as indicated. Provide end stops for track rails.
- C. Curtain Carriers: Standard carriers with a pair of nylon-tired ball-bearing wheels riveted parallel to plated-steel body. Equip carriers with rubber or neoprene bumpers and nylon glide strips to reduce noise, and heavy-duty, plated-steel swivel eye for attaching curtain snap or S-hook. Provide quantity of curtain carriers sufficient for track length, to suit curtain fabrication.
  - 1. Master Curtain Carriers: One master carrier, for each leading curtain edge, with two pairs of nylon-tired ball-bearing wheels riveted parallel to plated-steel body.
- D. Curved-Suspended-Track Stiffener: NPS 1-1/2 steel pipe for supporting both sections of suspended curved tracks; curved to match track.
- E. Clamp and Bracket Hangers: Steel clamps and brackets of sufficient strength required to support loads for attaching track to overhead support.
- F. Track-Lap Clamp: Metal to match track channel for attaching two tracks at center overlap.
- G. Folding Guide: Where indicated, equip carriers with rear-fold or backpack guide and rubber spacers to fold curtain from the offstage end of the track; sized for use with operating line if any.
- H. Manual Walk-Along Operation: Fabricate curtain track without cord, cable, pulleys, or floor pulley.
- I. Manual Cord Operation: Fabricate curtain track with cord, pulleys, and floor pulley.
  - 1. Operating Line: 3/8-inch-diameter, stretch-resistant operating cord consisting of braided synthetic-fiber jacket over solid, synthetic-fiber, linear filaments.



2. End Pulleys: One single dead-end and one double live-end pulley. Provide sheave(s) with shielded ball bearing(s) housed in plated-steel body finished to match track. Provide with bracket for securing off-stage curtain end.
  3. Floor Pulley: Sheave with shielded ball bearing housed in plated-steel body, painted black. Adjustable type, with 3-inch wheel.
- J. Motorized Operation: Fabricate curtain track with cord and pulleys.
1. Operating Line: 1/4-inch-diameter, stretch-resistant operating cable consisting of braided synthetic-fiber jacket over galvanized wire cable.
  2. End Pulleys: One single dead-end and one double live-end pulley. Provide sheave(s) with shielded ball bearing(s), housed in plated-steel body finished to match track. Provide with bracket for securing off-stage curtain end.

## 2.10 STEEL CURTAIN TRACK

- A. Steel Track: Roll-formed, galvanized, commercial-quality, zinc-coated steel sheet, ASTM A653/A653M; G60 coating designation; with continuous bottom slot and with each half of track in one continuous piece; black paint finish; complete with necessary accessories for support and operation.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Automatic Devices Company; 280 series.
    - b. H & H Specialties Inc.; 200 series.
    - c. Tru-Roll, Inc., a division of Advanced Entertainment Technology; No. 2300 Medium Duty Cyclorama Track.
  2. Curved Track: Factory-fabricated sections.
  3. Cable Guides for Curved Track: Outside idlers, mule pulleys, spindles, and guides; quantity sufficient for configuration of curve(s) and length of track.
  4. Steel Thickness: As recommended by manufacturer for loads and operation.
    - a. Heavy Duty: Minimum 0.079 inch.
    - b. Medium Duty: Minimum 0.064 inch.
- B. Curved-Suspended-Track Stiffener: NPS 1-1/2 steel pipe for supporting both sections of suspended curved tracks; curved to match track.
- C. Clamp and Bracket Hangers: Steel clamps and brackets of sufficient strength required to support loads for attaching track to overhead support.
- D. Track-Lap Clamp: Metal to match track channel for attaching two tracks at center overlap.
- E. Folding Guide: Where indicated, equip carriers with rear-fold or backpack guide and rubber spacers to fold curtain from the offstage end of the track; sized for use with operating line if any.
- F. Heavy-Duty Track System: Equip track with heavy-duty components as recommended by manufacturer for loads and operation. Provide end stops for track.
1. Curtain Carriers: Standard carriers of plated steel with a pair of nylon -tired ball-bearing wheels riveted parallel to body. Equip carriers with rubber or neoprene bumpers to reduce noise, and heavy-duty, plated-steel swivel eye and trim chain for attaching curtain snap or S-hook. Provide quantity of curtain carriers sufficient for track length, to suit curtain fabrication.
    - a. Master Curtain Carriers: One master carrier, for each leading curtain edge, of plated steel with two pairs of nylon -tired ball-bearing wheels and with two line guides per carrier.
  2. Pulleys: One dead-end, single-wheel pulley; one live-end, double-wheel pulley; and one adjustable pulley to maintain proper tension on operating line; each with not less than 5-inch molded-nylon- or glass-filled-nylon-tired ball-bearing sheaves enclosed in steel housings. Provide pulleys with steel housing finished to match track and with bracket for securing off-stage curtain end.

- G. Medium-Duty Track System: Equip track with components as recommended by manufacturer for loads and operation. Provide end stops for track.
  - 1. Curtain Carriers: Standard carriers of plated steel with a pair of nylon wheels riveted parallel to body. Equip carriers with plated-steel swivel eye for attaching curtain snap or S-hook. Provide quantity of curtain carriers sufficient for track length, to suit curtain fabrication.
    - a. Master Curtain Carriers: One master carrier, for each leading curtain edge, of plated steel with two pairs of nylon wheels and with two line clamps per carrier.
  - 2. Pulleys: One dead-end, single-wheel pulley; one live-end, double-wheel pulley; and one adjustable pulley to maintain proper tension on operating line; each containing guarded ball-bearing sheaves enclosed in steel housings. Provide pulleys with steel housing finished to match track and with bracket for securing off-stage curtain end.
- H. Manual Cord Operation: Provide with cord operating line, 3/8-inch-diameter, stretch-resistant operating cord of braided synthetic-fiber jacket over solid, synthetic-fiber, linear filaments.
- I. Motorized Operation: Provide with cable operating line, 1/4-inch- diameter, stretch-resistant operating cable of braided synthetic-fiber jacket over galvanized wire cable.

## 2.11 DRAW-CURTAIN MACHINES

- A. General: Operating machine of size and capacity recommended and provided by track manufacturer for each motorized curtain specified; complete with electric motor and factory-prewired motor controls, starter, gear-reduction unit, brake, and control station.
  - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Automatic Devices Company; Autodrape Model No. 1454.
    - b. H & H Specialties Inc.; Atlas Silk Model No. 454.
    - c. Tru-Roll, Inc., a division of Advanced Entertainment Technology; Tru-Roll Traction Drive.
- B. Operator Type: Cable drum with grooved drum and cable tension device to automatically take up cable slack and retain cable in grooves.
- C. Operator Type: Traction drive.
- D. Motor Characteristics: Size sufficient to start, accelerate, and operate curtain in either direction from any position at indicated speeds without exceeding nameplate rating or service factor; complying with NEMA MG 1 and the following:
  - 1. Electrical Characteristics:
    - a. Phase: Single phase.
    - b. Volts: 115 V.
    - c. Hertz: 60.
    - d. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
- E. Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
- F. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- G. Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
  - 1. Switches: Key-operated, keyed alike, with one key per switch plus one extra key.
  - 2. Control-Station Enclosures: Key-accessed, keyed alike, with one key per enclosure plus one extra key.
- H. Limit Switches: Fully closed and fully opened preset stops.

**2.12 CURTAIN RIGGING**

- A. Battens: Fabricated from steel pipe with a minimum number of joints. Connect pipe at joints with a drive-fit pipe sleeve not less than 18 inches long, and secure with four flush rivets, plug welds, threaded couplings, or another equally strong method.
  - 1. Steel Pipe: ASTM A53/A53M, Grade A, standard weight (Schedule 40), black, NPS 1-1/2 nominal diameter unless otherwise indicated.
  - 2. Finish: Shop painted black, with a 1-inch-wide yellow stripe at center of each batten.
- B. Supports, Clamps, and Anchors: ASTM A153/A153M, Class B, galvanized sheet steel in manufacturer's standard thicknesses, galvanized after fabrication.
- C. Trim and Support Cable: 1/4-inch-diameter, 7x19 galvanized-steel cable with a breaking strength of 7000 lb. Provide fittings according to cable manufacturer's written instructions for size, number, and method of installation, including a drop-forged galvanized turnbuckle to allow for leveling.
- D. Trim and Support Chain: ASTM A391/A391M, Grade 80, hardened alloy steel chain rated for overhead lifting.
- E. Inserts, Bolts, Rivets, and Fasteners: Manufacturer's standard corrosion-resistant units.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for supporting members, blocking, installation tolerances, clearances, and other conditions affecting performance of stage-curtain work.
- B. Examine inserts, clips, blocking, or other supports required to be installed by others to support tracks and battens.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION, GENERAL**

- A. Install stage-curtain system according to curtain and track manufacturer's written instructions.

**3.3 BATTEN INSTALLATION**

- A. Install battens by suspending at heights indicated with trim and supports spaced to support load, except do not exceed 10 feet between supports.
  - 1. Cable Trim and Support: Secure cables either directly to structures or to inserts, eye screws, or other devices that are secure and appropriate to substrate and that are not subject to deterioration or failure with age or elevated temperatures. Attach other cable end to pipe clamps with turnbuckles, housed or fixed with nuts after adjustment, to prevent loosening.
  - 2. Chain Trim and Support: Secure chain with load-rated terminations.

**3.4 TRACK INSTALLATION**

- A. Ceiling-Mounted Track: Drill track at intervals not greater than manufacturer's written instructions for spacing, and fasten directly to structure.
- B. Beam-Mounted Track: Install track by suspending from beam clamps securely mounted to I-beam structure at track-support spacing, according to manufacturer's written instructions.

- C. Wall-Mounted Track: Install track by suspending from brackets securely mounted to wall construction at track-support spacing, according to manufacturer's written instructions.
- D. Batten-Hung Track: Install track by suspending from pipe batten with manufacturer's track clamp hangers attached to batten pipe clamps at track-support spacing, according to manufacturer's written instructions.
- E. Track-Support Spacing: According to manufacturer's recommendations for applied loads, but not exceeding the following dimensions between supports:
  - 1. Heavy-Duty Track: 72 inches.
  - 2. Medium-Duty Track: 48 inches.
  - 3. Curved Walk-Along Track: 48 inches, with additional supports at curves and splices.
- F. Install track for center-parting curtains with not less than 24-inch overlap of track sections at center, supported by track lap clamps.

### **3.5 CURTAIN INSTALLATION**

- A. Track Hung: Secure curtains to track carriers with S-hooks.
- B. Batten Hung: Secure curtains to pipe battens with S-hooks.

### **3.6 DRAW-CURTAIN-MACHINE INSTALLATION**

- A. Install each draw-curtain machine by securely mounting to the supporting construction, according to manufacturer's written instructions.
- B. Adjust each installation to function smoothly and lubricate as recommended by manufacturer.

### **3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain stage curtains, draw-curtain machines, and tracks.

### **3.8 CURTAIN SCHEDULE**

- A. Stage Curtain : As indicated on Drawings.

END OF SECTION

**SECTION 11 61 44 - HALF-HOUSE CURTAINS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Black-Out Curtains: Motor-operated Arena Reduction (Half-House) Curtains
  - 2. Rigging and Operating Equipment (except where indicated by others)
  - 3. System Design and Engineering
- B. Related Work: Electrical interface activities shall be coordinated with the Work of Division 26 Sections for motors, controls, conduit, wiring, and connections to permanent power supply.
- C. Related Sections include the following:
  - 1. Division 05 Section "Metal Fabrications" for supplementary metal members supporting curtain systems to structure.
  - 2. Division 11 Sections "Arena Curtains" and "Upper Bowl Masking System" for supply of other curtain systems.

**1.2 SYSTEM DESCRIPTION**

- A. Design of half-house arena reduction system shall conform to the best engineering practices and shall reflect a requirement for minimum ongoing institutional maintenance.
- B. Arena Reduction Curtain: Electric chain motor operated rigging system, truss-supported black-out drapery, trusses, curtain-to-truss attachment, controllers, accessories, and training. Curtain raised and lowered by operating system. Curtain and support truss designed for convenient dismantling and storage when not deployed.
  - 1. Design shall reflect a requirement for minimum ongoing institutional maintenance.
  - 2. Locations, Heights and Configurations: The general scope is indicated on the drawings. Design arena reduction curtain system to provide a continuous barrier as follows:
    - a. Locations: Primary and Secondary locations as indicated. Coordinate system, including curtain planes, curtain panel raising and lowering paths, operation, deployment and components with other building features including the scoreboard and structural, mechanical and electrical work.
    - b. Heights: Curtains shall extend from a line approximately five feet below the rigging steel level to the arena floor. Provide bottom overlap adequate to effectively close curtain to floor areas and other conditions without unreasonable excess material.
    - c. Configurations: Follow the profile of the floor surfaces, including seating tiers, below each hanging location, to provide full bottom closure.
      - 1) Provide pass-through for performance activities at center curtain panel edges.
- C. Fabric to be resistant to the following:
  - 1. Staining.
  - 2. Color fading.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: Provide fabrication and erection arrangement drawings for upper bowl masking system. Prior to beginning fabrication, submit complete shop drawings of the rigging components including, but not limited to, the following:
1. Mechanical Assembly Drawings: Show detailed sizes, rating, and weights of components, equipment, supports, and linkages. Show sufficient detail to serve as a basic record for maintenance. Provide a reference listing for all materials, components, equipment, and any special equipment furnished.
  2. Mechanical Detail Drawings: Show all details necessary for fabrication for all specially designed components, linkages, and supports.
  3. Mechanical General Layout: Show mechanical equipment locations, connections to building structure, linkages, calculated loads, travels and travel relationships between adjacent installations and between adjacent structure.
  4. Component Equipment Drawings: Provide manufacturer's approved drawings or catalog cuts showing weight, dimensions, and capacities of mechanical components.
  5. Erection Plans and Diagrams: Provide relative locations of various members and overall dimensions with reference to the preliminary drawings including auxiliary steel supplied by others.
  6. Miscellaneous Details and Assembly Drawings: Give lengths, widths, and sizes of members, connection details, locations, type and size of bolts, rivets, welds, and other connections together with material to be used.
  7. Provide complete wiring diagrams for field connections and showing all devices and circuits.
  8. Provide maintenance and replacement parts information.
- C. Approval of Shop Drawings shall not be considered as a guarantee of measurements of building conditions. Where drawings are approved, said approval does not mean that drawings have been checked in detail, and said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Specifications.
- D. Failure by the Contractor to submit shop drawings in ample time for review shall not entitle him to an extension of contract time, and no claim for extension by reason of such default will be allowed.
- E. Samples for Verification: For each type of fabric from dye lot to be used for the Work, with specified treatments applied, and showing complete pattern and texture repeat, if any. Mark top and face of fabric. Prepare Samples of size indicated below.
1. Size: Not less than 36 inches (900 mm) square.
- F. Product Certificates: For each type of fabric, signed by product manufacturer.
1. Fabric: Certification of flame resistance.
  2. Rigging: Suspended battens and tracks comply with requirements.
- G. Qualification Data: For Installer and Professional Engineer. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- H. Maintenance Data: For curtains and rigging to include in maintenance manuals.
1. Submit bound manual for rigging system, with operating and maintenance instructions, parts listing, recommended parts inventory listing, purchase source listing, emergency instructions and similar information.
- I. Warranties: Special warranties specified in this Section.

#### 1.4 SUBSTITUTIONS

- A. Bidders wishing to obtain approval of brand items in lieu of those listed herein by name shall submit such request in writing to the Owner not less than ten (10) days prior to the date for receipt of bids. The Owner assumes no responsibility for the delivery or the delivery on time for such requests. No oral approval for substitute brand items shall be sought by bidders.
- B. Each request shall include the brand name of the material or item for which substitution approval is being sought together with a complete description of the proposed brand name substitute including drawings, cuts, specifications, performance and test data, and any other detailed information necessary for a complete evaluation being made. Approval request based on pictorial illustrations or general statements such as "manufacturer's standard", "standard of the industry" "generally used", and the like will not be considered as fulfilling the requirement for complete description and performance and test data as listed above and as such those request will not be considered.
- C. Any approval granted for a substitute brand name item will be by addendum issued by the Owner and sent prior to the bidding date by first class mail to all bidders of record. The Owner assumes no responsibility for the delivery or the delivery on time of such addendum other than mailing in reasonable time during the ten (10) day period as allowed.
- D. If bidders do not elect to obtain prior approval for a substitute brand named item during the pre-bid time so specified above, the Owner has no obligation to review or consider such item subsequent to the contract award.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual experienced in installing arena curtains and rigging similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Codes: System and installation shall comply with all applicable codes and ordinances.
- C. Single Source: Half-house curtains shall be the work of a single manufacturer as his direct and undivided responsibility through the design, engineering, fabrication, installation, guarantee, and maintenance phase. Such manufacturer shall operate its own machining and fabricating facilities.
  - 1. Curtain fabrics for each of the three curtain systems shall be from the same manufacturer.
- D. Fire-Test-Response Characteristics: Provide arena curtains with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or a testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Flame-Resistance Ratings: ASTM E84 and NFPA 701, Small Scale.
  - 2. Permanently attach label to each fabric of curtain assembly indicating whether fabric is inherently and permanently flame resistant or treated with flame-retardant chemicals, and whether it will require retreatment after designated time period or cleaning.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of operable drapery systems that are similar to those indicated for this Project in material, design, and extent.
- F. Workmanship: The fabrication of equipment, rigging, and drapery, shall incorporate only new and unused materials. Equipment and rigging includes, but is not limited to, the following metal components: plate, bar, rod, castings, structural members, stampings, forgings, clamps, bolts, bearings, chain, pipe, sleeves, clips, cable, and all other accessories not mentioned. Drapery includes, but is not limited to, fabric, and accessory items such as chain pocketing and webbing.

- G. Fabrication: Incorporate neat and mechanically acceptable practices such as clean drilled and punched holes without flash, hand smooth finish for sheared, machined and cut edges, and proper fit of component and contiguous parts without irregularity where matching is intended. Moving parts shall have specified tolerances, shaft sizes, bearings, mountings, connections, and accessories coordinated into the work in a manner acceptable to the Owner. No wood construction or equipment shall be incorporated into the work.
- H. Installation: Provide straight, plumb, true, and aligned components throughout. Connections shall be tight fitting with a minimum safety factor of eight and arranged in an orderly manner. Mechanical fabrication shall possess the necessary properties to withstand stresses of tension, compression, flexure, shear and torsion which may apply on one or more of the components and shall be related to safety, ease of operation, quietness of operation, and service life. Service life for mechanical equipment (excluding cable) is to be coincident with the building life and the standards of quality and design covering the equipment fabrication in this category, plus the installation workmanship techniques required are both established on this basis.
1. The decision of the Owner in determining the acceptability of equipment items and installation technique and workmanship shall be final.
- I. Any workmanship or materials found to be defective, improperly placed, not in strict conformity with the specifications, or defaced or injured through action of fire or the elements, through usage by the Contractor or his employees, or from any other cause shall be removed immediately from the premises when directed by the Owner and satisfactory materials or work substituted therefore without delay. This shall include making good the work of other contractors destroyed or damaged by delivery or installation, or by such removal or replacement. The cost of the above replacements shall be borne by the Contractor responsible for the defective work or materials.
- J. In the event that rejected materials cannot be replaced before occupancy and use of the building, the rejected items shall be allowed to remain in use until replaced at no expense to the Owner.
- K. Preinstallation Conference: Conduct conference at Project site to comply with the following requirements:
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Construction Manager of scheduled meeting dates.
  2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related Change Orders.
    - d. Purchases.
    - e. Deliveries.
    - f. Submittals.
    - g. Review of mockups.
    - h. Possible conflicts.
    - i. Compatibility problems.
    - j. Time schedules.
    - k. Weather limitations.
    - l. Manufacturer's written recommendations.
    - m. Warranty requirements.
    - n. Compatibility of materials.
    - o. Acceptability of substrates.
    - p. Temporary facilities and controls.
    - q. Space and access limitations.
    - r. Regulations of authorities having jurisdiction.
    - s. Testing and inspecting requirements.
    - t. Required performance results.



- u. Protection of construction and personnel.
- 3. Record significant conference discussions, agreements, and disagreements.
- 4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify half-house-curtain openings and the dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings.

## 1.7 WARRANTY

- A. Special Warranty for Rigging Equipment: Manufacturer's standard form in which manufacturer agrees to repair or replace components of rigging equipment that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to faulty operation of rigging equipment.
- B. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Athletic & Performance Rigging (Tiffin Scenic Studios, Inc.).
  - 2. Atlanta Rigging Systems, Inc.
  - 3. Chicago Spotlight.
  - 4. Nickerson Arena Curtains

### 2.2 CURTAIN FABRICS

- A. General: Provide fabrics inherently and permanently flame resistant to comply with requirements indicated. Provide fabrics from the same dye lot.
- B. Polyester Fabric: Inherently fire-resistant, heavy PD Cloth, in a dense file weave construction; 72 inches (1800 mm) wide.
  - 1. Basis of Design Product: Dazian IFR Avora® Polyester

### 2.3 CURTAIN FABRICATION

- A. Sewing and Fabrication:
  - 1. Table drapery, as removed from bolts, across an inspection window to detecting defects. Cut defects out and do not incorporate in finished work.
  - 2. Fabric panels shall run full height of various sections without horizontal seams and be box pleated at top in 30 percent fullness exclusive of turnback facings. Pleats shall be on face side of drapery and reinforced across top with 3-1/2 inches BFM jute webbing. Sew webbing drapery top with four runs of stitching with dual runs 1-1/2 inches apart, using industrial style sewing machine and at least H30 heavy industrial thread. Locate grommets so that no horizontal stitching is cut or severed and on each plait approximately one foot center to center.
  - 3. Face fabric bottom edge to be within ¼ inch parallel with drapery top edge for true hanging across full width.

- B. Half-House Curtains: Multiple panels to achieve design intent.
1. With 30 percent fullness
  2. Bottom Hem: 5 inches deep with No. 8 zinc plated jack chain weighting in separate pockets inside hem.
  3. Top and Side Hems: 3-1/2 inches reinforced with jute webbing.
  4. Brass grommets located on top to correspond with positions carrier chains.
  5. Drapery Self-Storage: Provide drapery storage bags to attach to trussing with velcro-style dome straps on one foot centers that enable all drapery to self-store.
  6. Finished drapery panel sizes and quantities shall be determined by manufacturer. Provide storage panels as required to protect each separate panel.

## 2.4 EQUIPMENT

- A. Quantities: Provide equipment in quantities as required to achieve the design requirements but at least in the quantities specified.
1. Chain Motors: C/M Model F Lodestar Half ton chain hoists.
  2. Quantity: As determined by manufacturer for a complete installation.
  3. Travel: 100'-0"
  4. Power: 280 V, 3 phase
  5. Traveling Speed: 16 fpm.
  6. Hook: To allow 360 degree rotation latch hook with upper and lower hooks.
  7. Power cords.
  8. Control cords.
  9. Chains:
    - a. Typical: 1/4 inch "Star Grade" by Lodestar.
    - b. Bridling: Special alloy (Stac) design.
  10. Chain Capture System (Chain catching bags):
    - a. Quantity: As determined by manufacturer for a complete installation.
    - b. Constructed of 1,000 Denier Nylon Codura; abrasion, water, and tear resistant. Steel frame and Masonite bottom combined to accept 270 inch-pounds with a 5:1 safety ratio.
  11. Cables:
    - a. Fly cables: As recommended by manufacturer.
    - b. Quantities: As determined by manufacturer for a complete installation.
      - 1) Wire Rope Bridles: 3/8 inch 7x19 Galvanized aircraft quality cable.
  12. Connections:
    - a. Construct wire rope bridles using Perma lock oval sleeve (flemish eye) to accept 3/8 inch cable as recommended by manufacturer. Terminate bridle ends with heavy pattern 3/8 inch thimbles.
    - b. Span Sets: 3 foot span sets, Tuflex, endless round sling.
      - 1) Quantity: As determined by manufacturer for a complete installation.
    - c. Shackles: 5/8 inch screw pin style, marked with size and working load limit.
      - 1) Quantity: As determined by manufacturer for a complete installation.
    - d. Provide additional bridling points for optional half house proscenium location.
    - e. Trusses: Aluminum; triangle design, 18 inches by 18 inches by 18 inches by 10 feet long; weld end plates for easy assembly. No splicing accepted.
      - 1) Quantity: As determined by manufacturer for a complete installation. Include truss hinges as needed
  13. Controllers: Eight (8) way controller with hand held remote by Motion Laboratories.
    - a. Controller: Provide two (2) minimum
      - 1) Remote Feeder Cable: One hundred (100), minimum
  14. Remote Station: Heavy duty, injection-molded, plastic hand held device.
    - a. Tail: Minimum one hundred (100) feet
    - b. Power Present: 12 V DC nominal maximum
      - 1) Capable of operating four through eight individual hoists separately, all, or any simultaneously.

- 2) Hoist Control Functions: Up, down, stationary, system go, and system kill
15. Motor Control Distro:
- a. Construct of 1/8 inch thick aluminum "U" channel with 1 inch flanges.
  - b. Panels shall bolt together to allow modular assembly.
  - c. Fit standard 19 inch rack rail.
  - d. Contractor Enable function allowing individual local (pickle) control.
  - e. Phase OK light (3 phase systems) to verify all 3 phases present and in correct sequence.
  - f. Phase Reverse function
  - g. Dual (redundant) contactors for Phase Reverse and System Kill.
  - h. Constructed with Twist-Lock, P-14 (canon), Socapex, Sine, or VSC connectors.
  - i. Input connectors by Twist-Lock, Camlok, or equal
  - j. Parallel flanged outlet for daisy-chaining units.
  - k. UL Listed Breakers: Provide at least one breaker per pair of hoists per NEC 96.
  - l. Cannon Tail / Hubbel breakout: 26 pin cannon connector allowing connection to remote station.
  - m. Black anodized finish with computer engraved labels and digitized customer logo.
  - n. Accessories: Provide auxiliary steel and miscellaneous metal framing as required for a complete installation

## 2.5 METAL FINISHES

- A. General: Shop finish the exposed metal components and supports for the half house curtains. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating metal finishes.
- B. Baked-Enamel/Powder-Coated Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on finish. Comply with coating manufacturer's written instructions for applying and baking.
  1. Color and Gloss: Matte black.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates for required substrates and conditions which would impair or be detrimental to the performance of the system. Notify the Contractor in writing of any such condition for correction. Begin work only after corrections have been made.
- B. Examine areas and conditions, with Installer present, for compliance with requirements for supporting members, blocking, installation tolerances, clearances, and other conditions affecting performance of curtain and rigging work. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Examine inserts, clips, blocking, or other supports required to be installed by others to support tracks and battens. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Installation system in accordance with manufacturer's written instructions and approved shop drawings.
- B. Secure system to structural steel frame. Provide auxiliary steel as required for proper installation.
- C. Install curtain system according to manufacturer's and fabricator's written instructions.

- D. Adjust movable units for smooth and free operation without binding or rough spots. Replace units that cannot be adjusted or that will not function properly.

### **3.3 DEMONSTRATION**

- A. Instruction: Provide at least one (1) hour instruction of Owner's designated personnel in proper use, operations, safety features and maintenance. Include truss assembly and disassembly, curtain deployment, attachment to trusses and equipment storage. Train Owners' personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

END OF SECTION

**SECTION 11 61 53 - ARENA CURTAINS****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes:
  - 1. Manually operated black-out arena curtains and rigging for vomitory entrances and concourse closures.
- B. Related Sections include the following:
  - 1. Division 05 Section "Metal Fabrications" for supplementary metal members supporting curtain systems to structure.
  - 2. Division 11 Sections "Half-House Curtains" and "Upper Bowl Masking System" for supply of other curtain systems.

**1.2 DEFINITIONS**

- A. Batten: Steel pipe supporting curtain or suspended track by means of chains from overhead structural support.
- B. Overlap: Track that extends beyond curtain centerline to ensure closure of biparting curtain.
- C. Rigging: General term for hardware used to move curtains.
- D. Trim: Adjustment of height or level of curtain or equipment.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide rigging capable of withstanding the effects of the following design loads and the weight of arena curtains.
  - 1. Design Loads: five (5) times the safety factor plus dead load.
  - 2. Hoisting time for retractable window coverings: 16 feet/minute minimum hoisting rate.
  - 3. Curtain sag: None
  - 4. Deflection: None
- B. Design Criteria
  - 1. Window coverings to provide light blocking at each specified window.
  - 2. Window covering shall be retracted on radio controlled motor operated rollers.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for arena curtains. Include plans, elevations, sections, details, attachments to other work, and the following:
  - 1. Operating clearances.
  - 2. Requirements for supporting curtains, track, and equipment. Verify capacity of each track and rigging component to support loads.
  - 3. Locations of equipment components, switches, and controls. Differentiate between manufacturer-installed and field-installed wiring.
  - 4. Include structural analysis data for rigging signed and sealed by the qualified professional engineer responsible for their preparation.
  - 5. Include curtain openings at the top of each aisle.

- C. Samples for Initial Selection: For each type of arena curtain indicated; include color charts showing the full range of colors, textures, and patterns available, together with a 24-inch- (600-mm-) square sample (any color) of each type fabric.
- D. Samples for Verification: For each type of fabric from dye lot to be used for the Work, with specified treatments applied, and showing complete pattern and texture repeat, if any. Mark top and face of fabric. Prepare Samples of size indicated below.
  - 1. Size: Not less than 36 inches (900 mm) x full width.
- E. Product Certificates: For each type of product including fabric, signed by product manufacturer.
  - 1. Fabric: Give name of flame-retardant chemical used, identification of applicator, treatment method, application date, allowable life span for treatment, and details of any restrictions and limitations.
  - 2. Rigging: Suspended battens and tracks comply with requirements.
- F. Qualification Data: For Installer. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- G. Maintenance Data: For arena curtains and rigging to include in maintenance manuals.
- H. Warranties: Special warranties specified in this Section.

### **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: A firm or individual experienced in installing arena curtains and rigging similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
  - 1. Welders, tackers, and welding operators: Qualified in compliance with requirements of AWS D1.1 and D1.3.
- B. Single Source: Arena curtains shall be the work of a single manufacturer as his direct and undivided responsibility through the design, engineering, fabrication, installation, guarantee, and maintenance phase. Such manufacturer shall operate its own machining and fabricating facilities.
  - 1. Curtain fabrics for each of the three curtain systems shall be from the same manufacturer.
- C. Fire-Test-Response Characteristics: Provide arena curtains with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or a testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Flame-Resistance Ratings: NFPA 701.
  - 2. Permanently attach label to each fabric of curtain assembly indicating whether fabric is inherently and permanently flame resistant or treated with flame-retardant chemicals, and whether it will require retreatment after designated time period or cleaning.
- D. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

### **1.6 PROJECT CONDITIONS**

- A. Field Measurements: Verify arena-curtain openings and the dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings.

### **1.7 WARRANTY**

- A. Special Warranty for Rigging Equipment: Manufacturer's standard form in which manufacturer agrees to repair or replace components of rigging equipment that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to faulty operation of rigging equipment.

- B. Warranty Period: Two years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Nickerson Arena Curtains
  2. Athletic & Performance Rigging (Tiffin Scenic Studios, Inc.).
  3. Chicago Spotlight.
  4. Atlanta Rigging Systems, Inc.

### **2.2 ARENA CURTAIN FABRICS**

- A. General: Provide fabrics inherently and permanently flame resistant to comply with requirements indicated. Provide fabrics from the same dye lot.
- B. Polyester Velour: Napped fabric of 100 percent polyester weighing not less than 15 oz./linear yard (425 g/linear meter); inherently and permanently flame resistant; 54-inch (1372-mm) minimum width.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dazian LLC; Milano Velvet.
    - b. Rose Brand; Encore.
  2. Colors: As selected by Architect from manufacturer's full range.
- C. Lining: Woven fabric of 100 percent polyester yarn, inherently and permanently flame resistant; 54-inch (1372-mm) minimum width, of weight recommended by curtain fabricator, but not less than 8 oz./linear yard (250 g/linear meter).
1. Colors: Match face fabric.

### **2.3 CURTAIN FABRICATION**

- A. General: Affix permanent label, stating compliance with requirements of authorities having jurisdiction, in accessible location on curtain not visible to audience. Provide vertical seams, unless otherwise indicated. Arrange vertical seams so they do not fall on faces of pleats. Do not use fabric cuts less than one-half width.
1. Vertical Hems: Provide vertical hems not less than 2 inches (50 mm) wide, with not less than a 1-inch (25-mm) tuck, and machine-sewn with no selvage material visible from front of curtain. Sew open ends of hems closed.
    - a. Overlaps: For center opening curtain, provide not less than 4 inches (100 mm) wide overlap.
    - b. Curtains: Provide 1/2-inch wide reflective tape permanently affixed vertically to the leading edge hems, visible to the audience in a blackout condition at the top of every aisle.
  2. Leading Edge Turnbacks: Provide turnbacks formed by folding not less than 12 inches (300 mm) of face fabric back, with not less than a 1-inch (25-mm) tuck, and secured by sewing turnbacks vertically.
    - a. Vomitory Curtains: Provide 1/2-inch wide reflective tape permanently affixed vertically to the leading edge hems, visible to the audience in a blackout condition.
  3. Top Hems: Reinforce top hems by double-stitching 3-1/2-inch- (89-mm-) wide, heavy jute webbing to top edge with not less than 2 inches (50 mm) of face fabric turned under.

4. Pleats: Provide 50 percent fullness in curtains, exclusive of turnbacks and hems, by sewing additional material into 3-inch (75-mm) double-stitched box pleats spaced at 12 inches (300 mm) o.c. along top hem reinforcement.
5. Grommets: Brass, No. 3, centered on each box pleat and 1 inch (25 mm) from corner of curtain, for snaps or S-hooks.
  - a. For black curtains, provide brass or aluminum grommets with black finish.
6. Bottom Hems:
  - a. For curtains that do not hang to the floor, provide hems not less than 3 inches (75 mm) deep with 3/4-inch (19-mm) weight tape.
7. Velour Curtains: Fabricate with the fabric nap down.
8. Lining: Provide lining for each curtain in same fullness as face fabric, and finished 2 inches (50 mm) shorter than face fabric. Attach lining to face fabric along bottom and side seams with 4-inch- (100-mm-) long strips of heavy woven cotton tape.

## 2.4 RIGGING

- A. Battens: Fabricate battens from steel pipe with a minimum number of joints. As necessary for required lengths, connect pipe with a drive-fit pipe sleeve not less than 18 inches (450 mm) long, and secure with four flush rivets, plug welds, threaded couplings, or another equally secure method.
  1. Steel Pipe: ASTM A 53/ A 53M, Grade A, standard weight (Schedule 40), black, 1-1/2-inch (40-mm) nominal diameter, unless otherwise indicated.
- B. S-Hooks: Track manufacturer's heavy-duty plated-wire hooks.
- C. Snap Hooks: Track manufacturer's heavy-duty hooks.
- D. Supports, Clamps, and Anchors: Sheet steel in manufacturer's standard thicknesses, galvanized after fabrication according to ASTM A 153/A 153M, Class B.
- E. Trim and Support Chain: Grade 80 hardened alloy steel chain rated for overhead lifting, ASTM A 391/A 391M.
- F. Inserts, Bolts, Rivets, and Fasteners: Manufacturer's standard corrosion-resistant units.
- G. Aluminum Curved Track: Fabricate of extruded aluminum, ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for strength and corrosion resistance, mill finish, not less than 0.08-inch (2.03-mm) nominal thickness.
  1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Automatic Devices Company; Rig-I-Flex 140 (240) series.
    - b. H & H Specialties, Inc.; 300 (300B) series.
    - c. Tiffin Scenic Studio Inc.'s Continental track systems, Continental No. 62 Track.

## 2.5 ALUMINUM-CURTAIN-TRACK FABRICATION

- A. General: Fabricate straight and curved aluminum curtain tracks for walk-along operation, without cord, cable, pulleys, or floor block, designed for rigid attachment to ceiling or hanging clamps.
  1. Shop-fabricate curved portions of track.
- B. Aluminum Track System: Fabricate track of 0.125-inch- (3.1-mm-) thick extruded aluminum consisting of an I-beam with intermediate flange or of parallel aluminum channels with steel tubing strongback. Provide single curtain carriers of two nylon-tired ball-bearing wheels riveted parallel to plated-steel body. Provide one master carrier, for each leading curtain edge, of plated steel with two pairs of nylon-tired ball-bearing wheels riveted parallel to plated-steel body. Equip carriers with rubber or neoprene bumpers and nylon glide strips to reduce noise, and



heavy-duty, plated-steel swivel eye for attaching curtain snap or S-hook. Provide end stops for track.

1. Suspended Track: 1-1/2-inch (40-mm) steel pipe stiffener for supporting both straight and curved sections of suspended curved tracks.
2. Operating Line: Manufacturer's standard 3/8-inch (9-mm) stretch-resistant operating cord consisting of braided synthetic-fiber jacket over solid, synthetic-fiber, linear, center filaments.
3. Track Lap Clamp: Metal to match track channel for attaching double-sectioned track at center overlap.
4. Curtain Carriers: For track spaced at 12 inches (300 mm) o.c.
5. Fold Guide: Equip carriers with rear-fold or backpack guide and rubber spacers to permit curtain folding for storage when curtain is open, sized for use with operating line if any.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for supporting members, blocking, installation tolerances, clearances, and other conditions affecting performance of stage-curtain work. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine inserts, clips, blocking, or other supports required to be installed by others to support tracks and battens. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Surface Preparation:
  1. Inspection: Inspect all materials prior to installation. Be responsible for all materials and expenses incurred to replace the Work installed with manufacturing defects or defects caused by installation.

#### **3.3 INSTALLATION, GENERAL**

- A. Install curtain system according to track manufacturer's and curtain fabricator's written instructions.
- B. Motors and controls shall be delivered to the job site complete with all required rigging hardware and accessories. Make all adjustments and modifications necessary or required for approval and leave ready for satisfactory operation.
- C. Safety Warnings: Assembly components shall clearly indicate weight, storage, and erection restrictions, and recognized product safety procedures.

#### **3.4 TRACK INSTALLATION**

- A. Ceiling-Mounted Tracks: Drill track at intervals not greater than manufacturer's written instructions for spacing, and fasten directly to structure.
- B. Beam-Mounted Tracks: Install tracks by suspending from manufacturer's special beam clamps securely mounted to I-beam structure at spacing, according to manufacturer's written instructions.

- C. Wall-Mounted Tracks: Install tracks by suspending from manufacturer's special bracket clamps securely mounted to wall construction at spacing, according to manufacturer's written instructions.
- D. Batten-Hung Tracks: Install track by suspending from pipe batten with manufacturer's track clamp hangers attached to batten pipe clamps at spacing, according to manufacturer's written instructions.
- E. Spacing: Do not exceed the following dimensions between supports:
  - 1. Heavy-Duty Track: 72 inches (1829 mm).
  - 2. Medium-Duty Track: 48 inches (1219 mm).
  - 3. Curved Walk-Along Track: 48 inches (1219 mm). Provide additional supports at curves and splices.
- F. Install track for center-parting curtains with not less than 24-inch (600-mm) overlap of track sections at center, supported by special lap clamps.

### **3.5 ARENA CURTAIN INSTALLATION**

- A. Track Hung: Secure curtains to track carriers with track manufacturer's special heavy-duty S-hooks.

### **3.6 DEMONSTRATION**

- A. Engage a factory-authorized service representative to test system and to train Owner's personnel to rig, adjust, operate, and maintain curtains, tracks, and draw-curtain machines.

END OF SECTION

**SECTION 11 82 26 - FACILITY WASTE COMPACTORS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes facility waste compactors.
- B. Related Requirements:
  - 1. Section 11 30 13 "Residential Appliances" for residential trash compactors.
  - 2. Section 11 40 00 "Foodservice Equipment" for food-waste shredding, pulping, grinding, and compacting machines in foodservice facilities.
  - 3. Section 21 13 13 "Wet-Pipe Sprinkler System" for building fire sprinklers and piping connections to automatic sprinkler in hopper of each chute-fed compactor.

**1.2 DEFINITIONS**

- A. See the "WASTEC 2013 Listing of Rated Stationary Compactors" for detailed definitions of waste-compactor terminology.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Inspect and discuss electrical, plumbing, and sprinkler roughing-in; equipment bases; and other preparatory work specified elsewhere.
  - 2. Review coordination of chute and diverter locations with waste compactors.
  - 3. Review sanitary requirements for water bibs, floor drains, and grease traps if required for Project to reduce decomposition and odors.
  - 4. Review haul routes of waste to the compactor, route of hauler's equipment, and protections along these routes that are specified elsewhere.
  - 5. Review required testing, inspection, and certification procedures.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, furnished specialties and accessories, and finishes.
- B. Shop Drawings: For each waste compactor and for special components not dimensioned or detailed in manufacturer's product data.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Dimension chute and diverter locations that interface with waste compactors.
  - 4. Include location and installation details of automatic sprinkler in hopper of each chute-fed compactor.
  - 5. Indicate equipment access points and required space for equipment service and operation.
  - 6. Include setting drawings, templates, and instructions for installing anchor bolts and other anchorages.
  - 7. Include diagrams for power, signal, and control wiring.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of waste compactor.
- C. Field quality-control reports.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For waste compactors to include in operation and maintenance manuals.
- B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard five-year maintenance agreement, starting on date maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
  - 1. Maintenance Proximity: Not more than two hour(s') normal travel time from Installer's place of business to Project site.

## PART 2 - PRODUCTS

### 2.1 FACILITY WASTE COMPACTORS

- A. Waste Compactor: Manufacturer's standard-type stationary compactor, complying with requirements; liquidtight; and with components, options, and accessories needed to provide a complete, functional system.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Compactors, Inc.
  - b. Harmony Enterprises, Inc.
  - c. J. V. Manufacturing, Inc.
  - d. Marathon Equipment Company; a Dover company.
  - e. Precision Machinery Systems, Inc.
  - f. PTR Baler & Compactor Company.
  - g. Rudco Products, Inc.
  - h. Sebright Products Inc.
  - i. SP Industries, Inc.
  - j. Wastequip, Inc.
  - k. Western Chutes; a division of Buchanan Company, Inc.
  - l. Wilkinson Hi-Rise, LLC.
  - 2. Source Limitations: Obtain from single source from single manufacturer.
  - 3. Waste-Compactor Standards: ANSI Z245.21 including appendices and NFPA 82.
  - 4. Waste-Container Standards: ANSI Z245.30 and ANSI Z245.60.
  - 5. WASTEC-Rated Size (Volume): Minimum Refer to Drawings.
  - 6. Clear Top Opening (Length by Width): Refer to Drawings .
  - 7. Cycle Time: Maximum Refer to Drawings.
  - 8. Discharge Opening (Width by Height): Maximum Refer to Drawings .
  - 9. Ground Height: Minimum Refer to Drawings .
  - 10. Ram Face: Minimum Refer to Drawings .
  - 11. Ram Penetration: Minimum Refer to Drawings.
  - 12. Normal/Maximum Resultant Ram Forces: Refer to Drawings.

13. Normal/Maximum System Pressures: Refer to Drawings.
  14. Scale Weight: Maximum Refer to Drawings.
  15. Electrical Characteristics: Refer to Drawings
  16. Controls: Refer to Drawings .
  17. Finish: Refer to Drawings .
    - a. Color: As selected by Architect from manufacturer's full range.
  18. Deodorizing Device:[Manufacturer's standard.
- C. Number of Extra Storage Containers: Two.

## **2.2 FABRICATION**

- A. Fabricate waste compactors with smooth, eased, exposed edges to prevent injury to persons in vicinity of the equipment.
- B. Fabricate containers, hoppers, compaction chambers, unit bodies, and similar components of steel with welded joints. Reinforce with steel members sized and spaced to withstand impacts and pressures of normal operations and to prevent deformation.
- C. Fabricate equipment with replaceable parts at points of normal wear.
- D. Fabricate liquidtight compactor baffles to stop liquid from leaking out.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, clearances, service rough-ins, and other conditions affecting performance of the Work.
- B. Examine walls, floors, and chutes for suitable conditions where each waste compactor will be installed.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION OF FACILITY WASTE COMPACTORS**

- A. Install each waste compactor according to manufacturer's written instructions, ANSI Z245.2, and ANSI Z245.21, including appendices.
- B. Install automatic sprinkler in hopper of each chute-fed compactor according to NFPA 82.
- C. Set waste compactors level, plumb, properly aligned, and securely in place. Anchor as required for secure operation.

### **3.3 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  1. Perform installation and startup checks according to ANSI Z245.21, Appendix D, "Tests for Evaluation of Equipment and Performance," and manufacturer's written instructions.
  2. Test and adjust controls, alarms, and safeties. Replace damaged and malfunctioning controls and equipment.
  3. Verify unrestricted access to each firefighting access door or hose connection required by ANSI Z245.21 and NFPA 82 for compactor container(s).

4. Verify correct locations, color coding, and legibility of caution, warning, and danger markings.
  5. Certify compliance with test parameters.
- B. A waste compactor will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.4 MAINTENANCE SERVICE**

- A. Maintenance Service: Beginning at Substantial Completion, initial maintenance service shall include 12 months' full maintenance by skilled employees of waste-compactor Installer. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper waste-compactor operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain waste compactors according to manufacturer's written instructions and ANSI Z245.2.

END OF SECTION

**SECTION 12 22 00 - CURTAINS AND DRAPES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Drapes.
  - 2. Drapery tracks.
- B. Related Requirements:
  - 1. Section 05 75 00 "Decorative Formed Metal" for drapery pockets.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Drapery Tracks: Include maximum weights of drapes that can be supported.
    - a. Motorized Tracks: Indicate motor weights, motor-mounting requirements, and electrical requirements.
  - 2. Fabrics.
  - 3. Textile treatments.
- B. Shop Drawings:
  - 1. Drapery Tracks: Show installation and anchorage details and locations of controls.
    - a. Motorized Tracks: Indicate dimensions, weights, and required clearances for track and motor and differentiate between manufacturer-installed and field-installed wiring.
  - 2. Drapes: Show sizes, locations, and details of installation.
- C. Samples: As follows:
  - 1. Drapery Tracks: 18 inches long, with carriers, controls, and accessories.
  - 2. Drapery Fabrics: For each color and pattern indicated, full width by 36 inches long, from dye lot to be used for the Work and with specified textile treatments applied. Show complete pattern repeat if any. Mark top and face of fabric.
  - 3. Textile Trims: For each color and pattern indicated, 18 inches long.
  - 4. Drape Fabrication: For each heading, fabric, color, and pattern indicated, a complete full-size panel to verify details of fabrication and thread colors.
- D. Samples for Initial Selection: For each type of product indicated.
- E. Samples for Verification: As follows:
  - 1. Drapery Tracks: 18 inches long, with carriers, controls, and accessories.
  - 2. Drapery Fabrics: For each color and pattern indicated, full width by 36 inches long, from dye lot to be used for the Work and with specified textile treatments applied. Show complete pattern repeat if any. Mark top and face of fabric.
  - 3. Textile Trims: For each color and pattern indicated, 18 inches long.
  - 4. Drape Fabrication: For each heading, fabric, color, and pattern indicated, a complete full-size panel to verify details of fabrication and thread colors.
- F. Product Schedule: For drapes. Use same designations indicated on Drawings.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: For drapery track installation; reflected ceiling plans drawn to scale and coordinating track installation with openings and ceiling-mounted items, on which the following items are shown:
  - 1. Suspended ceiling components.
  - 2. Structural members to which motors are attached.
  - 3. Size and location of motor access panel.
- B. Product Certificates: For each drapery fabric treated with flame retardant, signed by fabric supplier and indicating treatment durability and cleaning procedures required to maintain treatment effectiveness.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For products installed to include in maintenance manuals.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Drapery Track Carriers: For each size indicated, equal to 5 percent of amount installed, but no fewer than 10 of each size.
  - 2. Drapery Track Controls: For each type indicated, equal to 5 percent of amount installed, but no fewer than 10 of each type.
  - 3. Drapery Fabrics: For each fabric, color, and pattern indicated, from the same product run, full-width lengths equal to 5 percent of amount installed, but no fewer than 10 yards of each fabric, color, and pattern.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: For drapes and drapery tracks, fabricator of drapes.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockup at location and in size shown on Drawings.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.7 FIELD CONDITIONS**

- A. Field Measurements: Verify dimensions by field measurements before drape fabrication, and indicate measurements on Shop Drawings.
- B. Scheduling: Do not deliver or install drapes until after other finish work, including painting, is complete and spaces are otherwise ready for occupancy.

**PART 2 - PRODUCTS****2.1 DRAPERY TRACKS**

- A. Motorized Track:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Lutron Traditional Draper Track System or comparable product by one of the following:
    - a. BTX Window Automation Inc.
    - b. Forest Group USA, Inc.
    - c. Lutron Electronics Co., Inc.



- d. MechoShade Systems, Inc.
- e. Silent Gliss.
- f. SM Automatic, Inc.
2. Operation: Motorized.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Construction: Extruded aluminum, slotted for mounting at interval of not more than 24 inches o.c.
  - a. Lengths and Configurations: As indicated on Drawings.
  - b. Track Type: Dual tandem.
  - c. Support Capability: Weight of drape indicated mounted on track length indicated.
  - d. Finish: Match adjacent ceiling finish.
5. Mounting Brackets: Suitable for fastening track to surface indicated and designed to support weight of track assembly and drape plus force applied to operate track.
  - a. Mounting Surface: Drapery pocket.
6. Installation Fasteners: Sized to support track assembly and drape, and fabricated from metal compatible with track, brackets, and supporting construction. Provide two fasteners to fasten each bracket to supporting construction.
7. Motor Operation: Low-voltage motor with built-in low-voltage interface for direct access to control systems, with thermal-overload switch; sized for weight of drape and track length indicated; and equipped with stops to prevent overdrawing.
  - a. Control: Wall switch.
  - b. Draw: Two way, center opening.
  - c. Electrical Requirements: As indicated on Drawings.
  - d. Travel Speed: 6 inches per second.
8. Carriers: Coordinate with drapery headings indicated.
  - a. Master Carriers: Overlap.
9. End Stops: Manufacturer's standard.
10. Pulleys: Standard duty.

## 2.2 DRAPES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  1. Barjan Manufacturing Ltd.
  2. Contract Shading Systems.
  3. Creative Draperies Inc.
  4. DFB Sales Inc.
  5. Fabricut.
  6. Fabtex.
  7. Lutron.
  8. Quiltcraft Industries, Inc.
  9. Standard Textile Co., Inc.
  10. Wesco Fabrics, Inc.
- B. Source Limitations: Obtain each color and pattern of drapery fabric and trim from one dye lot.
- C. Fire-Test-Response Characteristics: For fabrics treated with fire retardants, provide products that pass NFPA 701 as determined by testing of fabrics that were treated using treatment-application method intended for use for this Project by a testing and inspecting agency acceptable to authorities having jurisdiction.

- D. Drape:
1. Heading:
    - a. Ripplefold: As indicated on Finish Legend.
    - b. Heading Accessories:
      - 1) Nonwoven buckram.
      - 2) Hooks.
  2. Drapery Fabric:
    - a. Reference Finish Legend & drawings for fabric selections.
  3. Textile Treatments: Stain repellent; and flame retardant, polymer type.
  4. Lining Fabric:
    - a. Lining Type: Blackout.
    - b. Product: Selected by fabricator for use with drapery fabric indicated, to match face fabric selection.

### 2.3 DRAPE FABRICATION

- A. Fabricate drapes in heading styles and fullnesses indicated. Fabricate headings to stand erect. If less than a full width of fabric is required to produce panel of specified fullness, use equal widths of not less than one-half width of fabric located at ends of panel.
1. One-Way-Stacking Drapes: Add 5 inches to overall width for returns.
  2. Center-Opening Drapes: Add 10 inches to overall width for overlap.
- B. Seams: Sew vertical seams with twin-needle sewing machine with selvage trimmed and overlocked. Join widths so that patterns match and vertical seams lay flat and straight without puckering. Horizontal seams are unacceptable.
- C. Side Hems: Double-turned, 1-1/2-inch-wide hems consisting of three layers of fabric, and blindstitched so that stitches are invisible on face of drape.
- D. Bottom Hems: Double-turned, 4-inch-wide hems consisting of three layers of fabric, and weighted and blindstitched so that weights and stitches are invisible on face of drape.
1. Sew in square lead weights at each seam and at panel corners.
- E. Interlinings: Extend from top of drape to within 1/2 inch of lining's bottom hem and to leading edge of side hems to produce full-shadowed appearance.
- F. Linings: Equal to widths of drapery fabric and joined to drapery fabric at top by inside invisible seam, and hand stitched at side hems and shadowed with 1-1/2-inch return of face fabric.
1. Bottom Hem: Blind stitch to drapery fabric.
  2. Refer to Finish Legend and drawings for all fabric sections.
- G. Baton/Pull Rod
1. Provide metal pull rod at each length, typical.

## PART 3 - EXECUTION

### 3.1 DRAPERY TRACK INSTALLATION

- A. Install track systems according to manufacturer's written instructions, level and plumb, and at height and location in relation to adjoining openings as indicated on Drawings.
- B. Isolate metal parts of tracks and brackets from concrete, masonry, and mortar to prevent galvanic action. Use tape or another method recommended in writing by track manufacturer.

**3.2 DRAPE INSTALLATION**

- A. Where drapes abut overhead construction, hang drapes so that clearance between headings and overhead construction is 1/4 inch.
- B. Where drapes extend to floor, install so that bottom hems clear finished floor by not more than 1 inch and not less than 1/2 inch.
- C. Where drapes extend to windowsill, install so that bottom hems hang above sill line and clear sill line by not more than 1/2 inch.

**3.3 ADJUSTING**

- A. After hanging drapes, test and adjust each drapery track to produce unencumbered, smooth operation.
- B. Steam and dress down drapes as required to produce crease- and wrinkle-free installation.
- C. Remove and replace drapes that are stained or soiled.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 12 36 16 - METAL COUNTERTOPS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Stainless-steel countertops.

**1.2 COORDINATION**

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded wall-mounted shelves.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For metal fabrications.
  - 1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
  - 2. For countertops, show locations and sizes of cutouts and holes for items installed in metal countertops.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products only after casework and supports on which they will be installed has been completed in installation areas.
- B. Keep finished surfaces of products covered with polyethylene film or other protective covering during handling and installation.

**1.5 FIELD CONDITIONS**

- A. Field Measurements: Where products are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Established Dimensions: Where products are indicated to fit to other construction, establish dimensions for areas where products are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

**PART 2 - PRODUCTS****2.1 STAINLESS-STEEL COUNTERTOPS FABRICATIONS**

- A. Countertops: Fabricate from 0.062-inch-thick, stainless-steel sheet. Provide smooth, clean exposed tops and edges in uniform plane, free of defects. Provide front and end overhang of 1 inch over the base cabinets.
  - 1. Joints: Fabricate countertops without field-made joints.
  - 2. Weld shop-made joints.
  - 3. Sound deaden the undersurface with heavy-build mastic coating.
  - 4. Extend the top down to provide a 1-inch-thick edge with a 1/2-inch return flange.

5. Form the backsplash coved to and integral with top surface, with a 1/2-inch-thick top edge and 1/2-inch return flange.
  - a. Provide endsplash at all locations where countertop is butted up against a side wall. Open countertop ends are to have endsplashes only when detailed on Drawings.
6. Provide raised (marine) edge around perimeter of tops containing sinks; pitch tops containing sinks two ways to provide drainage without channeling or grooving.
7. Where stainless-steel sinks occur in stainless-steel tops, factory weld into one integral unit.

## 2.2 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- B. Sealant for Countertops: Manufacturer's standard sealant that complies with applicable requirements in Section 07 92 00 "Joint Sealants" and the following:
  1. Mildew-Resistant Joint Sealant: Mildew resistant, single component, nonsag, acid curing, silicone.
  2. Color: As selected by Architect from manufacturer's full range.
  3. Sealant shall have a VOC content of 250 g/L or less.

## 2.3 STAINLESS-STEEL FINISH

- A. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish, with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install metal countertops level, plumb, and true; shim as required, using concealed shims.
- B. Field Jointing: Where possible, make field jointing in the same manner as shop jointing; use fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
- C. Secure countertops to cabinets with Z- or L-type fasteners or equivalent; use two or more fasteners at each front, end, and back.
- D. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
- E. Seal junctures of countertops, splashes, and walls with sealant for countertops.
- F. Wall-Mounted Shelves: Fasten to supporting construction through upturned back edge at not less than 24 inches o.c.
  1. For framed construction, fasten through wall or partition finishes directly to framing, blocking, or reinforcements.

**3.3 CLEANING AND PROTECTION**

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces. Remove and replace damaged products or touch up and refinish damaged areas to match original factory finish, as approved by Architect.
- C. Protection: Provide 6-mil plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 12 48 13 - ENTRANCE FLOOR MATS AND FRAMES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Resilient entrance mats.
  - 2. Recessed frames.

**1.2 COORDINATION**

- A. Coordinate size and location of recesses in concrete to receive floor mats and frames.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.
- B. Shop Drawings:
  - 1. Items penetrating floor mats and frames, including door control devices.
  - 2. Divisions between mat sections.
  - 3. Perimeter floor moldings.
  - 4. Custom Graphics: Scale drawing indicating colors.
- C. Samples: For the following products, in manufacturer's standard sizes:
  - 1. Floor Mat: Assembled sections of floor mat.
  - 2. Frame Members: Sample of each type and color.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Resilient-Tile Entrance Mats: Full-size tile units equal to 2 percent of amount installed, but no fewer than 10 units.

**PART 2 - PRODUCTS****2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL**

- A. Structural Performance: Provide roll-up rail mats and frames capable of withstanding the following loads and stresses within limits and under conditions indicated:
  - 1. Uniform floor load of 300 lbf/sq. ft..
  - 2. Wheel load of 350 lb per wheel.
- B. Accessibility Standard: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

**2.2 RESILIENT ENTRANCE MATS**

- A. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
1. American Floor Products Company, Inc.
  2. American Mat & Rubber Company.
  3. Arden Architectural Specialties, Inc.
  4. Balco, Inc.
  5. Cactus Mat Mfg. Co.
  6. Consolidated Plastics Company, Inc.
  7. C/S Group.
  8. Durable Corporation.
  9. Flexco.
  10. Mats Inc.
  11. Musson Rubber Company.
  12. Pawling Corporation; Architectural Products Division.
  13. Sbemco International Inc.; Matting by Design.
  14. Tennessee Mat Company, Inc.
  15. Tepromark International, Inc.
  16. U.S. Mat & Rubber Corporation.
- B. Cocoa Mats: Constructed from cocoa fiber yarn permanently bonded to PVC backing for dimensional stability and resistance to shedding; 1-inch overall thickness; 2.0-lb/sq. ft. weight.
1. Color: As selected by Architect from full range of industry colors.
  2. Mat Size: As indicated.
- C. Graphics: Custom inlaid or woven-in graphic design, as indicated.

## 2.3 FRAMES

- A. Recessed Frames: Manufacturer's standard extrusion.
1. Extruded Aluminum: ASTM B 221, Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.
    - a. Color: Clear.

## 2.4 CONCRETE FILL AND GROUT MATERIALS

- A. Provide concrete fill and grout equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.

## 2.5 FABRICATION

- A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.
- B. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.
1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.
- C. Coat concealed surfaces of aluminum frames that contact cementitious material with manufacturer's standard protective coating.

**2.6 ALUMINUM FINISHES**

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine substrates and floor conditions for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 CONSTRUCTION WASTE MANAGEMENT**

- A. Construction Waste shall be managed in accordance with provisions of Section 01 74 19 "Construction Waste Management and Disposal". Documentation shall be submitted to satisfy the requirements of that section.

**3.3 INSTALLATION**

- A. Install recessed mat frames and mats to comply with manufacturer's written instructions so that tops of mats will be flush with adjoining finished flooring. Set mats with tops at height recommended by manufacturer for most effective cleaning action; coordinate tops of mat surfaces with bottoms of doors that swing across mats to provide clearance between door and mat.
  - 1. For installation in polished concrete flooring areas, allow for grinding and polishing of concrete without grinding surface of recessed frames. Coordinate with other trades as required.
  - 2. Install necessary shims, spacers, and anchorages for proper location, and secure attachment of frames.
  - 3. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.
  - 4. Delay setting mats until construction traffic has ended.

**3.4 PROTECTION**

- A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 12 63 26 – ARENA SEATS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Types of arena chairs specified in this section include the following:
  - 1. Cushioned arena chairs
  - 2. Integral platform chairs
  - 3. Main concourse club, Event club, and Goalie seating chairs
  - 4. Event suite chairs
  - 5. Suite chairs
  - 6. Video room chairs
- B. Related Requirements: The following Section contains requirements that relate to this Section:
  - 1. Division 12 Section “Multipurpose Seating” for telescoping seating platforms for installation of integrally ganged platform chairs.
  - 2. Division 12 Section “Portable Platforms” for aluminum platforms for installation of arena chairs.
- C. Work Provided by Owner: Folding chairs for wheelchair companion chairs.

**1.2 UNIT PRICES**

- A. Provide Unit Prices for each Chair Type and Size.

**1.3 PERFORMANCE REQUIREMENTS**

- A. General: The completed arena chair installation shall provide the following minimum performance requirements:
  - 1. Mechanical fastening devices: Non-corrosive materials.
  - 2. Seat hinge assemblies: Non-corrosive materials.
  - 3. Fasteners: Threaded except for mounting numberplates. Threaded fastener engagement shall be into threaded metal.
  - 4. Seat hinge assembly shall raise, without assistance, the seat pan to within one inch plus or minus of the end of the armrest.
  - 5. Easy Access Chair: Provide end standard with hinged armrest to allow access to the chair from the side.
    - a. Height of armrest: Match fixed arena chairs.
    - b. Quantity: Equal to one percent of overall seating capacity.
  - 6. Seating envelope: Comply with clear aisle access way width requirements of NFPA 101, Life Safety Code, Chapter entitled, “New Assembly Occupancies.”
  - 7. At expansion joints that fall within a row of arena chairs, accommodate for the movement of the expansion joint without any detrimental effects on the performance of the arena chair.
  - 8. Install as many chairs as possible to fill each row in each seating section, but no less than indicated on the Architectural Drawings. Fill all rows with larger sized chairs so that no gap exceeds 2”.

**1.4 SUBMITTALS**

- A. Required With The Bid
1. Base bids on chair quantities included in the Chair Summary included on the Drawings.
  2. Provide Unit Prices for each chair type and size, complete with all accessories, including removable painted tubular steel beam-mounted chairs.
    - a. Unit Prices will be used to adjust the Contract Sum for adjustments to the quantities indicated in the Chair Summary.
    - b. Future Orders: Provide the order lead time and unit prices (with a yearly escalation factor) for a period of five (5) years, for any component purchased to replace the extra stock after Substantial Completion of the Project.
  3. Pricing for Listed Alternates: Provide separate pricing for each of the listed alternates.
  4. Provide copies of the manufacturer's written warranty.
  5. Provide full sized sample of each arena chair required.
  6. Product Literature for each type of chair proposed, including standard specifications for treatments for cast iron, cast aluminum, steel, and plastic.
  7. Anchor bolt information.
- B. Required After Award Of Contract
1. Product Data: Submit technical data, performance test data certified by an independent testing laboratory and product information describing durability and maintenance requirements as applicable for the following items:
    - a. Anchor bolts
    - b. Chair assembly.
    - c. Plastic materials and additives.
    - d. Padding and upholstery.
    - e. Coating materials, and application procedures.
    - f. Armrests and cup holders
  2. "Shop Drawings: Provide the following drawings
    - a. Complete seating bowl with tread and riser mounting details and aisle locations
      - 1) Show joints between precast treads and risers and attachments.
      - 2) Show locations of wheelchair companion seating.
      - 3) Show easy access chairs.
    - b. End standard design with logo.
    - c. Hinged armrest for Easy-Access chair end standards.
    - d. Low riser height mounting bracket, if required.
    - e. Seat and back design.
    - f. Seat assembly.
    - g. Seat and row identification graphics.
    - h. Seat attachment at unique conditions such as angled corners and where chairs span across a control or expansion joint.
  3. Seating Chart: Submit a seating chart that shows the total quantity of seats, seat widths, aisle widths, and mounting conditions. Each chair shall be represented by a rectangle. Following approval of the seating chart, the Owner will furnish the numbering systems for section, seat, and row identification.
  4. Seating Manifest: Owner will use seating manifest to determine allocation of chairs for marketing and distribution of tickets. Provide Seating Manifest to Owner as follows.
    - a. Prepare seating manifest based on verified field measurements of seating bowl, aisle locations, and aisle widths.
      - 1) Each seat shall be represented by a rectangle and shall include Owner supplied numbering systems.
      - 2) Indicate each easy access chair and companion chairs.
      - 3) Submit within 30 days of completion of seating bowl construction, except where sections of seating bowl are withheld as construction access. In the event of hold out seating bowl, submit manifest within 30 days after completion of all other seating bowl construction.

- 4) Indicate total quantity of seats, seat widths, aisle widths, and mounting conditions.
- 5) View and scale of chart shall be coordinated with the Architect.
5. Samples: Submit custom color samples to match the Architect's color sample for the selection of colors for plastic components and ferrous or non-ferrous metal components.
6. Submit one assembled arena chair in selected color, one chair on a tubular steel assembly, and one Easy Access Chair.
  - a. Approved chair samples may be used as part of the work.

## 1.5 QUALITY ASSURANCE

- A. Life Safety: The seating layout and installation shall comply with the requirements of the NFPA 101 Life Safety Code.
- B. Seat Widths: Increase width of individual seats within a row so that the end standards are in general alignment from one row to another, whether aisles are of constant or configuring widths.
  1. Minimum width of general arena chairs shall be 20 inches. Increase chair width to align end standards.
  2. Minimum width of arena chairs on telescoping platforms shall be 21-1/2 inches. Increase chair width to align end standards.
  3. Minimum width of suite chairs shall be 24 inches. Increase chair width to align end standards.
  4. Minimum width of main concourse club, event club and goalie seating chairs shall be 23 inches. Increase chair width to align end standards.
  5. Quantity of Seats: The manufacturer shall maximize the quantity of the seating based on row lengths, row configuration, and minimum seat widths indicated on the Drawings.
    - a. Changes to the base bid quantity shall be made by Change Order based on the unit prices provided with the Bid.
- C. Forest Certification: Fabricate products with wood components produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- D. "Easy Access Chair" seating, evenly distributed throughout the seating bowl, shall be understood to mean arena chair with an armrest design that complies with applicable requirements of the American with Disabilities Act and the Performance Requirements of this Section. Provide each chair with universal symbol of access.
- E. Testing: Determine resistance of seat to deformation when loaded in accordance with the requirements of ANSI-BIFMA Seat Impact Test, modified to analyze front and back of seat.
- F. Materials (Flammability) shall satisfy applicable test, codes, standards, or requirements as follows:
  1. Polyethylene shall meet the Federal Motor Vehicle Standard No. 302 which specifies a burning rate of less than 4 inches per minute.
  2. Upholstery materials shall meet requirements set forth in the State of California Bureau of Home Furnishings Technical Bulletin No. 117.
  3. Fire-Performance Characteristics of Seat Padding: Provide chairs that comply with test method included in California Technical Bulletin 117.
  4. Cushioning and padding shall be self-extinguishing as defined in the requirements as set forth in the State of California Bureau of Home Furnishings Technical Bulletin No. 117.
  5. Full Scale Fire Performance Characteristics of Finished Chair: If required by State Statute, provide chair that complies with State of California Technical Bulletin No. 133
- G. Pre-Installation Conference: Prior to commencing the chair installation meet at the project site to review the installation.
- H. Single Source Responsibility: Arena chairs shall be provided by a single manufacturer.

**1.6 WARRANTY**

- A. General: The warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor, Installer, or Manufacturer, under the Contract Documents.
- B. Warranty: Provide warranty signed by an officer of the chair manufacturer that provides for repair, replacement, or both, of arena chairs and components found to be defective in appearance or unusable due to defects in performance. Warranty shall provide for materials and labor.
  - 1. General Warranty Period: 12 months after the Date of Substantial Completion.
  - 2. Special Warranties: Provide the following special warranties:
    - a. Chair Standards: 10 year period against failure of the base material.
    - b. Hinge mechanism: 5 year period against failure of the hinge to provide for automatic rising.
    - c. Painted components: 10 year period against color change, beyond normal use. Deterioration of metals due to corrosion resulting from physical damage to the paint finish, after acceptance by Owner, is not covered by the warranty.
    - d. Plastic Components: 3 year period against cracking, crazing, color change, or other failure of backs and seats.
    - e. Upholstery: 1 year period against breakdown of fabric and padding, beyond normal use.

**1.7 SCHEDULING**

- A. Coordinate Work of this Section with the construction of the seating bowl precast concrete and installation of handrails and guardrails.
- B. Provide detailed schedule in Critical Path Method (CPM) for fabrication and installation of chairs. Include decision dates for input to manufacturer on logo design, seat and row identification numbers, and completion of supporting construction.

**1.8 DELIVERY STORAGE AND HANDLING**

- A. Deliver chair components in manufacturer's unopened cartons clearly labeled with manufacturer's name and contents of cartons.
- B. Packaging and shipping methods shall prevent painted chair standards from coming in contact with each other as well as other painted metal components by utilizing protective covering over each component. Maintain the protective covering on each metal component until after metal component is installed. Coating failures resulting from improper packaging, shipping, and handling during installation shall be repaired or replaced prior to installing plastic components.
- C. Protect chair units from physical damage and abuse by other trades. Replace damaged units.
- D. Environmental Limitations: Do not install arena chairs until spaces are enclosed and weathertight; wet work in space is complete and dry; finishes, including painting, are complete; and work above ceilings is complete. Do not install chairs until ambient temperature and humidity conditions are continuously maintained at the levels anticipated for final occupancy.
- E. Field Measurements: Verify chair layout by field measurements before chair fabrication and indicate measurements on Seating Manifest. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

**1.9 MAINTENANCE**

- A. Maintenance Manuals: Provide maintenance manuals that describe procedures for the cleaning and service of the arena chairs. Include replacement part numbers and procedures for replacement.



- B. Extra Stock: Provide the following chair components that are manufactured from the same lot as the installed components. Prorate quantities among chair sizes, types and colors furnished.
1. Seats: 1 percent
  2. Backs: 1 percent
  3. Center Standards: 1 percent
  4. End Standards: 1 percent
  5. Cup Holders: 1 percent
  6. Hinge Components: 2 percent
  7. Fasteners and mounting hardware: 10 percent
  8. Easy access armrest: 2 percent
  9. Row Identification Plates: 5 of each
  10. Seat Identification Plates: 5 of each
  11. Fabrics:
    - a. Provide 200 yards each of main/upper concourse chair fabric.
    - b. Provide 40 yards of suite/club chair fabric.

## PART 2 - PRODUCTS

### 2.1 ARENA SEATING

- A. Basis-of-Design Products: The design is based on the products named. Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers specified.
1. General Arena Seating (Fixed Seating).
    - a. Riser Mounted, Upholstered Chairs.
    - b. Seat Width: 21" – 22"
    - c. Irwin Seating: "Millenium" 91.12.18.12 with 40-inch high back.
    - d. No. 18 cast iron end with screen printed logo plate.
    - e. Polymer armrests.
    - f. Color: As selected by Architect.
    - g. Fabric: DesignTex – Play Ball 1402-981 (Freestyle Blue).
  3. Sideline Club and Bunker Club Seating (Fixed Seating).
    - h. Riser Mounted, Upholstered Chairs.
    - i. Seat Width: 23"
    - j. Irwin Seating: "Marquee" 51.12.18.12 with 40-inch high back.
    - k. No. 18 cast iron end with screen printed logo plate.
    - l. Polymer cupholder armrests.
    - m. Color: As selected by Architect.
    - n. Fabric: Paul Brayton Designs – Almost Calf ACF822 Columbine.
  2. Suite Level Seating (Fixed Seating).
    - a. Riser Mounted, Upholstered Chairs.
    - b. Seat Width: 24"
    - c. Irwin Seating: "Marquee" 51.12.18.12 with 40-inch high back.
    - d. No. 18 cast iron end with screen printed logo plate.
    - e. Polymer armrests with drink table.
    - f. Color: As selected by Architect.
    - g. Fabric: Paul Brayton Designs – Almost Calf ACF822 Columbine.
  7. General Arena Seating (Fixed Telescoping Platforms for Retractable Seating).
    - h. Riser Mounted, Integral Telescoping Platform, Upholstered Chairs.
    - i. Seat Width: 21.5"
    - j. Irwin Seating: "Millenium" 91.12.18.12 with 40-inch high back.
    - k. No. 18 cast iron end with screen printed logo plate.
    - l. Polymer armrests.
    - m. Color: As selected by Architect.
    - n. Fabric: DesignTex – Play Ball 1402-981 (Freestyle Blue).

- o. Folding Mechanism: Chairs shall be ganged in no more than groups of five.
- 8. Goalie Seating (Fixed Telescoping Platforms for Retractable Seating).
  - p. Riser Mounted, Upholstered Chairs.
  - q. Seat Width: 23"
  - r. Irwin Seating: "Marquee" 51.12.18.12 with 40-inch high back.
  - s. No. 18 cast iron end with screen printed logo plate.
  - t. Polymer cupholder armrests.
  - u. Color: As selected by Architect.
  - v. Fabric: Paul Brayton Designs – Almost Calf ACF822 HG Columbine.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hussey Seating
  - 2. Irwin Seating Company
    - a. Basis of Design
  - 3. Camatic Seating

## 2.2 MATERIALS

- A. Anchor Bolts: The Chair Manufacturer shall provide compatible anchorbolts appropriate for mounting riser and tread mounted chairs. The Chair Manufacturer shall provide all necessary materials for a complete seating installation.
- B. Plastic Components: Plastic seat and back components shall be double-wall construction, high density polyethylene plastic formulated with ultra-violet inhibitors to minimize surface deterioration. Surface finish shall be manufacturer's standard textured finish.
- C. Steel Shapes, Plates, and Sheet Metal: ASTM A 36/A36M; coated as specified for chair standards.
- D. Standards: Provide riser mounted standards. Provide manufacturer's "low riser" unit if required to accommodate concrete substrate anchorage. Provide custom riser mount as required for lower bowl ventilation system per the details.
  - 1. Provide manufacturer's standard cast iron, cast aluminum, or tubular steel design.
  - 2. Provide riser mounted end of row standards.
  - 3. If required, provide steel transfer plate to accommodate concrete substrate anchorage.
  - 4. Chair standard design: End of row standards shall be custom for this project. Provide custom logo insert as follows:
    - a. Logo: Artwork for logo is available from the Owner. Provide logo in raised, three dimensional pattern; right and left hand applications.
- E. Hinge Mechanism: Provide automatic lifting of the seat to a full fold position, allowing for manually lifting the seat to a full fold position regardless of arena chair design.
  - 1. Hinge mechanism shall perform to the requirements of ASTM F851, Test Method for Self-Rising Seat Mechanisms plus the performance requirements required by this specification section.
- F. Seat and Row Identification: Aluminum plates with identification graphics in color, font, and design as selected by Architect.
  - 1. Seat Identification: Securely affix to recess in center of seat back.
  - 2. Row Identification: Securely affix to the end standard of each row, including "Easy Access Chair" end.
  - 3. Identification mounting: Recessed and canted mounting above the cast team logo.
- G. Concealed Plywood: HPVA HP-1 hardwood plywood, made with adhesive containing no urea formaldehyde, or DOC PS 1 softwood plywood, as standard with manufacturer.
- H. Plastic Laminate: NEMA LD 3, Grade VGS for vertical surfaces and Grade HGS for horizontal surfaces.
  - 1. Color and Pattern: As indicated on the Finish Legend.

- I. Cup Holders: Cup holders shall be mounted to the back of fixed tread or riser mounted arena chair standards in the lower seating bowl. Manufacturers of cup holders include Caddy Products and Cy Young Industries.
  1. Mount cup holders to the backs of arena chairs.
  2. Provide integral cup holders and armrest caps for arena chairs in front rows of seating levels.
  3. Color of cup holder shall match the color of the standards.
  4. Advertising for cup holders will be provided by the Owner. The cup holder manufacturer shall apply advertising on the cup holder in the factory prior to shipping the cup holders to the chair manufacturer.

### **2.3 GENERAL ARENA CHAIR CONSTRUCTION**

- A. Standards: Riser Mounted, Single pedestal center and end standards with integral arm rests.
  1. Color: Black.
- B. Chair Backs: 40 inch high outer back; injection molded textured high impact polypropylene.
  1. Pad: 2 inch polyurethane pad over contoured wood frame; face upholstered.
  2. Rear of Back: Textured high impact polypropylene.
- C. Chair Seats: Injection molded textured high impact polypropylene seat bottom, with self rising mechanism.
  1. Pad: 3 to 4 inch molded polyurethane ergo system pad, face upholstered.
  2. Seat Bottom: Textured high impact polypropylene.
- D. Concourse Chair Fabrics: Class A fire rated in accordance with ASTM E84 Tunnel Test.
  1. Acceptable Manufacturers: Subject to compliance with the requirements of the specified material, other acceptable manufacturers include the following:
    - a. Absecon
    - b. Bernhardt
    - c. Cartwright
    - d. DesignTex
    - e. Paul Brayton Designs

### **2.4 GOALIE SEATING SIDELINE CLUB AND BUNKER CLUB SEATING CONSTRUCTION**

- A. Standards: Riser Mounted, Single pedestal center and end standards with integral arm rests.
  1. Color: Black.
- B. Chair Backs: 40 inch outer back; injection molded textured high impact polypropylene.
  1. Pad: 2 inch polyurethane pad over contoured wood frame; face upholstered with tufting.
  2. Rear of Back: Textured high impact polypropylene.
- C. Chair Seats: Injection molded textured high impact polypropylene seat bottom, with self rising mechanism.
  1. Pad: 3 to 4 inch molded polyurethane ergo system pad, face upholstered.
  2. Seat Bottom: Textured high impact polypropylene.
- D. Club Chair Fabric: Class A fire rated in accordance with ASTM E84 Tunnel Test.
  1. Acceptable Manufacturers: Subject to compliance with the requirements of the specified material, other acceptable manufacturers include the following:
    - a. Cartwright
    - b. CMI Enterprises
    - c. Naugahyde
    - d. Paul Brayton Designs

### **2.5 SUITE CHAIR CONSTRUCTION**

- A. General: Provide chairs for Typical Suites, Large Suites, Suite Lounges, Loge Boxes.
- B. Standards: Riser Mounted, Single pedestal center and end standards.
  - 1. End Standards: Stained wood panel as selected by Architect.
  - 2. Center Standards: Powder coated.
    - a. Color: Black.
- C. Chair Backs: 40 inch high profile outer back; injection molded textured high impact polypropylene.
  - 1. Pad: 3 inch polyurethane pad over contoured wood frame; face upholstered.
  - 2. Rear of Back: Textured high impact polypropylene.
- D. Chair Seats: Injection molded plastic seat bottom, with self rising mechanism;
  - 1. Pad: 3 to 4 inch molded polyurethane ergo system pad, face upholstered.
  - 2. Seat Bottom: Textured high impact polypropylene.
- E. Arm Rests for Suite Chairs: Where indicated on the Drawings, provide wood armrests.
  - 1. Wood Armrests: Hardwood stained and finished to match suite casework.
- F. Suite Chair Fabric: Class A fire rated in accordance with ASTM E84 Tunnel Test.
  - 1. Acceptable Manufacturers: Subject to compliance with the requirements of the specified material, other acceptable manufacturers include the following:
    - a. Cartwright
    - b. CMI Enterprises
    - c. Naugahyde
    - d. Paul Brayton Designs

## 2.6 INTEGRAL PLATFORM CHAIR CONSTRUCTION

- A. Standards: Riser mounted.
  - 1. Color: Black.
- B. Chair Backs: 40 inch high profile outer back; injection molded textured high impact polypropylene.
  - 1. Pad: 2 inch polyurethane pad over contoured wood frame; face upholstered.
  - 2. Rear of Back: Textured high impact polypropylene.
- C. Chair Seats: Injection molded plastic seat bottom, with self rising mechanism;
  - 1. Pad: 3 to 4 inch molded polyurethane ergo system pad, face upholstered.
  - 2. Seat Bottom: Textured high impact polypropylene.
- D. Arm Rests: Plastic armrests with cup holders.
- E. Chair Fabric: Class A fire rated in accordance with ASTM E84 Tunnel Test.
  - 1. Acceptable Manufacturers: Subject to compliance with the requirements of the specified material, other acceptable manufacturers include the following:
    - a. Cartwright
    - b. CMI Enterprises
    - c. DesignTex
    - d. Naugahyde
    - e. Paul Brayton Designs

## 2.7 FINISHES

- A. Plastic Component Color: Two as selected by Architect
- B. Standards, seat arms and related cast iron, cast aluminum, or ferrous metal components:
  - Factory applied coating as follows:
    - 1. Surface Preparation: Grit blasting and washing process, in addition to special surface preparation treatments that are standard to the manufacturer.

2. Pretreatment: Manufacturer's standard multi-stage bonderization process.
3. Primer: Manufacturer's standard electrodeposition epoxy primer.
4. Finish Coating: Manufacturers standard superpolyester TGIC resin powder coating.
5. Colors of Standards: As selected by Architect.
9. Colors of Logos: Three colors plus base color of standard.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions with Installer and Chair manufacturer present for compliance with requirements for construction tolerances and resultant impact on anchors, fasteners, and alignment. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. General: Install arena chairs in locations indicated and fasten securely to substrates according to manufacturer's recommendations and approved submittals.
  1. Use installation methods and fasteners that produce fixed audience seating assemblies with individual chairs capable of supporting an evenly distributed 600-lb (272-kg) static load without failure or other conditions that might impair the chair's usefulness.
- B. Install seating with chair ends aligned from first to last row and with backs and seats varied in width to optimize sightlines.
- C. Install riser-mounted attachments to maintain uniform chair heights above floor and to ensure level alignment of chair backs.
  1. Anchors: Tread and riser mounted standards shall be attached to the substrates with the appropriate anchors. Ends of anchors shall not protrude from the face of nut any more than 3/8 inch. Trim anchors as necessary and provide a finished end with no burrs or sharp edges.
- D. Install seating so moving components operate smoothly and quietly.
- E. Fasteners: Seats and backs shall be connected to hinge mechanisms and chair standards using screws of sufficient length for attachment, but not protruding from face of nut any more than 1/8 inch. Provide a finished end with no burrs or sharp edges.
- F. Adapter Plates: Design adapter plates to support chairs over expansion joints to allow for no deflection. Anchor adapter plates to risers to span expansion joints with no vertical deflection.

#### **3.3 ADJUSTMENT AND CLEANING**

- A. Adjust self-rising seat mechanisms to align seats in each row when in upright position.
- B. Before final inspection, thoroughly clean arena chairs using the manufacturer's recommended procedure.
- C. Repair minor abrasions and imperfections in finishes with coating that matches factory-applied finish.
- D. Replace padding damaged during installation.

#### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer or its assigned agent shall provide supervision of the Work and perform field inspection prior to request for final punchlist.
  1. Correct identified defects or irregularities.

END OF SECTION

**SECTION 12 66 00 - TELESCOPING STANDS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Electrically operated telescoping stands.

**1.2 DEFINITIONS**

- A. Forward Folding: Wall- or floor-attached bleachers that open in the forward direction by moving the front row away from the stack to the fully extended position.
- B. Reverse Folding: Floor-attached bleachers that open in the backward direction by moving the last row away from the stack to the fully extended position.
- C. Freestanding: Being free or away from a permanent wall.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for telescoping stands.
  - 2. Include load capacities, assembly characteristics, and furnished accessories.
  - 3. Include electrical characteristics of electrical components, devices, and accessories.
- B. Shop Drawings: For telescoping stands in both stacked and extended positions.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include load capacities.
  - 3. Show seating layout, aisle widths, row-lettering and seat-numbering scheme, and wheelchair accessibility provisions.
  - 4. Show locations and details for installing operator components, switches, and controls.
  - 5. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
  - 6. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of exposed product and for each color and texture required.
  - 1. Include Samples of accessories involving color and finish selection.
- D. Samples for Verification: For the following products prepared on Samples of size indicated below:
  - 1. Decking: 6-inch-square Samples of finished material.
  - 2. Metal Components: 6-inch-square Sample of each color and finish indicated.
  - 3. Seating Material: 6-inch-square Sample of each seating material, color, and finish indicated.
  - 4. Seat Unit: Full-size unit of each type.
  - 5. Upholstery Fabric: 12-inch-square Sample of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric.

6. Signage: Full-size units for row letters, seat numbers, each type of accessibility sign, and custom graphics.
- E. Delegated-Design Submittal: For telescoping stands indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Product Certificates: For each type of telescoping stand assembly.
- D. Material Certificates: For each type of flame-retardant treatment of upholstery fabric.
- E. Field quality-control reports.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For telescoping stands to include in operation and maintenance manuals.
  1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
    - a. Procedures for conducting periodic inspections.
    - b. Precautions for cleaning materials and methods that could be detrimental to telescoping-stand finishes and performance.
    - c. Methods for maintaining upholstery fabric.

### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- D. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the state where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of pipe and tube railings that are similar to those indicated for this Project in material, design, and extent.
- E. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
  1. Build mockup of typical telescoping stand as shown on Drawings.
  2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### 1.8 FIELD CONDITIONS

- A. Finished Spaces: Do not deliver or install telescoping stands until finishes in spaces to receive them are complete, including suspended ceilings, floors, and painting.
- B. Field Measurements: Indicate measurements on Shop Drawings.



**1.9 WARRANTY**

- A. General: Provide Manufacturers standard coverage on all parts and systems – minimum 1 year from Substantial Completion and completed training.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Telescoping stands to withstand the effects of gravity loads, operational loads, and other loads and stresses according to ICC 300.
- B. Fire-Test-Response Characteristics of Upholstered Chairs: Comply with California Technical Bulletin 117 and Bulletin 133.
- C. Accessibility Standard: Comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design, the ABA Standards of the Federal agency having jurisdiction, and ICC A117.1.

**2.2 TELESCOPING STANDS**

- A. System Description: Operable system of multiple-tiered seating on interconnected folding platforms that close for storage, without being dismantled, into a nested stack. Telescoping-stand units permit opening and closing of adjacent, individual and multiple rows, and close with vertical faces of platforms in the same vertical plane.
  - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Telescoping-Stands Standard: ICC 300.
- B. Wall-Attached Telescoping Stands: Forward-folding system, in which the bleachers open in the forward direction by moving the front row away from the stack to the fully extended position and the rear of bleacher understructure permanently attaches to wall construction.
  - 1. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
    - a. Hussey Seating Company.
    - b. StageRight
    - c. Irwin Telescopic Seating
  - 2. Row Spacing: As indicated on Drawings.
  - 3. Row Rise: As indicated on Drawings.
  - 4. Seat Type: As indicated on Drawings.
  - 5. Elevated Front Row: Height indicated on Drawings.
  - 6. Operation: Electrically operated, with friction-type, integral power unit.
  - 7. Electrical Characteristics for Each Seating Section:
    - a. Horsepower: As indicated on Drawings.
    - b. Single-Phase Voltage: As indicated on Drawings.
    - c. Three-Phase Voltage: As indicated on Drawings.
  - 8. Electrical Controls:
    - a. Control Devices: Wireless control system unless indicated otherwise.
    - b. Limit Switches: Automatically stop power system when telescoping stands reach fully opened or closed positions.
    - c. Motion Monitor: Flashing light with self-contained warning horn, rated at 85 dB at 10 feet, mounted under telescoping seating for audio and visual warning during operation.
    - d. Transformer: As required to coordinate current characteristics of motor and control station with building electrical system.

- C. Recessed Telescoping Stands : Forward-folding system, in which the bleachers open in the forward direction by moving the front row away from the stack to the fully extended position and the rear of bleacher understructure permanently attaches to building construction so that closed stands are recessed in opening.
1. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
    - a. Hussey Seating Company.
    - b. Interkal LLC.
    - c. Irwin Telescopic Seating Company.
    - d. Kodiak Industries Ltd.
  2. Row Spacing: As indicated on Drawings.
  3. Row Rise: As indicated on Drawings.
  4. Seat Type: As indicated on Drawings.
  5. Elevated Front Row: Height indicated on Drawings.
  6. Operation: Electrically operated, with friction-type, integral power unit.
  7. Electrical Characteristics for Each Seating Section:
    - a. Horsepower: As indicated on Drawings.
    - b. Single-Phase Voltage: As indicated on Drawings.
    - c. Three-Phase Voltage: As indicated on Drawings.
  8. Electrical Controls:
    - a. Control Devices: Wireless control system unless indicated otherwise.
    - b. Limit Switches: Automatically stop power system when telescoping stands reach fully opened or closed positions.
    - c. Motion Monitor: Flashing light with self-contained warning horn, rated at 85 dB at 10 feet, mounted under telescoping seating for audio and visual warning during integral power operation.
    - d. Transformer: As required to coordinate current characteristics of motor and control station with building electrical system.
- D. Freestanding, Forward-Folding, Telescoping Stands: Floor-attached system, in which the bleachers open in the forward direction, by moving the front row away from the stack to the fully extended position, and the rear of bleacher understructure permanently attaches to floor construction.
1. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
    - a. Hussey Seating Company.
    - b. Interkal LLC.
    - c. Irwin Telescopic Seating Company.
    - d. Kodiak Industries Ltd.
  2. Row Spacing: As indicated on Drawings.
  3. Row Rise: As indicated on Drawings.
  4. Seat Type: As indicated on Drawings.
  5. Elevated Front Row: Height indicated on Drawings.
  6. Operation: Electrically operated, with friction-type, integral power unit].
  7. Electrical Characteristics for Each Seating Section:
    - a. Horsepower: As indicated on Drawings.
    - b. Single-Phase Voltage: As indicated on Drawings.
    - c. Three-Phase Voltage: As indicated on Drawings.
  8. Electrical Controls:
    - a. Control Devices: Wireless control system unless indicated otherwise.
    - b. Limit Switches: Automatically stop power system when telescoping stands reach fully opened or closed positions.

- c. Motion Monitor: Flashing light with self-contained warning horn, rated at 85 dB at 10 feet, mounted under telescoping seating for audio and visual warning during integral power operation.
  - d. Transformer: As required to coordinate current characteristics of motor and control station with building electrical system.
- E. Freestanding, Reverse-Folding, Telescoping Stands: Floor-attached, reverse-opening system, in which the bleachers open in the backward direction, by moving the last row away from the stack to the fully extended position, and the front of bleacher understructure permanently attaches to floor construction.
  - 1. Basis-of-Design Product: Refer to the Finish Legend on Drawings. Subject to compliance with requirements, provide the product listed in the Finish Legend or comparable products including but are not limited to the following:
    - a. Hussey Seating Company.
    - b. Interkal LLC.
    - c. Irwin Telescopic Seating Company.
    - d. Kodiak Industries Ltd.
  - 2. Row Spacing: As indicated on Drawings.
  - 3. Row Rise: As indicated on Drawings.
  - 4. Seat Type: As indicated on Drawings.
  - 5. Elevated Front Row: Height indicated on Drawings.
  - 6. Aisle Recovery: Equip unit with ability to create a front cross-aisle 42 inches wide when stand is open.
  - 7. Operation: Electrically operated, with friction-type, integral power unit.
  - 8. Electrical Characteristics for Each Seating Section:
    - a. Horsepower: As indicated on Drawings..
    - b. Single-Phase Voltage: As indicated on Drawings.
    - c. Three-Phase Voltage: As indicated on Drawings.
  - 9. Electrical Controls:
    - a. Control Devices: Wireless control system unless indicated otherwise.
    - b. Limit Switches: Automatically stop power system when telescoping stands reach fully opened or closed positions.
    - c. Motion Monitor: Flashing light with self-contained warning horn, rated at 85 dB at 10 feet, mounted under telescoping seating for audio and visual warning during integral power operation.
    - d. Transformer: As required to coordinate current characteristics of motor and control station with building electrical system.

### 2.3 COMPONENTS

- A. Benches: Seats and skirts.
  - 1. Material: As indicated on Drawings.
    - a. Color: As selected by Architect from manufacturer's standard.
  - 2. Bench Height: As indicated on Drawings.
  - 3. Bench Depth: As indicated on Drawings.
  - 4. Backs: Folding backrests permanently attached to bench units.
    - a. Material: As indicated on Drawings.
    - b. Operation: Manual.
- B. Chairs: Rotating from upright, locked position to folded-down position that allows supporting platform to telescope for storage. In upright position, seats fold up to allow passage of persons within row.
  - 1. Operation: Automatic.
  - 2. Chair Width: As indicated on Drawings.
  - 3. Seat Height: Not less than 17 inches or more than 18 inches.
  - 4. Seats: As indicated on Drawings..
    - a. Color: As selected by Architect from manufacturer's full range.

5. Backs: As indicated on Drawings.
  - a. Color: As selected by Architect from manufacturer's full range.
6. Armrests: As indicated on Drawings.
  - a. Color: As selected by Architect from manufacturer's full range.
- C. Wheelchair-Accessible Seating: Locate seating to provide wheelchair-accessible seating at locations indicated on Drawings.
  1. Equip tiers adjacent to wheelchair-accessible seating with front rails as required by ICC 300.
  2. Equip cutouts with full-width front closure panels that match decking construction and finish and that extend from underside of tiers adjacent to cutouts to 1-1/2 inches from finished floor.
- D. Deck: As indicated on Drawings.
  1. Finish: Manufacturer's standard.
    - a. Color: As selected by Architect from manufacturer's standard colors.
- E. Risers: Steel sheet with manufacturer's standard, rust-inhibiting coating or hot-dip galvanized finish.
- F. Safety Rails: Steel, finished with manufacturer's standard powder coat system.
  1. Removable mid-aisle handrails located at centerline of each aisle with seating on both sides.
  2. End rails (guards) that are removable.
  3. Back rails (guards) along rear of units where required by ICC 300.  
Removable front rails (guards) along front of units where required by ICC 300.
  4. Removable rails around accessible seating cutouts and truncations.
  5. Removable, programming-support front rails to allow seating in upper rows while lower rows remain in the stored position.
  6. Color: Match Architect's sample.
- G. Understructure: Structural steel.
  1. Finish: Manufacturer's standard rust-inhibiting finish.
  2. Color: Manufacturer's standard.
- H. Support Column Wheels: Nonmarring, soft, rubber-face wheel assembly under each support column.
  1. Include wheels of size, number, and design required to support stands and operate smoothly without damaging the flooring surface, but no fewer than four per column or less than 4 inches in diameter and 1-1/2 inches wide.
- I. Control Devices:
  1. Wireless: Hand-held, wireless transmission unit that operates wireless receivers in each operating section, with a transmission range to keep handheld control unit within close proximity and with full view of stand and its movement area. Provide one unit for each operating section.
- J. Fasteners: Vibration proof, in manufacturer's standard size and material.

## 2.4 ACCESSORIES

- A. Steps:
  1. Slip-resistant, abrasive tread nosings at aisles.
  2. Intermediate aisle steps, fully enclosed, at each aisle.
  3. Transitional top step, fully enclosed, at each aisle where last row of telescoping stands is adjacent to a cross aisle.
  4. Removable front steps, fully enclosed, at each aisle, that engage with front row to prevent accidental separation or movement and are equipped with a minimum of four skid-resistant feet.

- B. Portable Stairs: Portable access-stair units equipped with handrails, with no fewer than four full-swiveling, nonmarring wheels and a locking mechanism to prevent movement during use.
- C. Ramps: Portable access-ramp units, slope as indicated on Drawings, equipped with handrails, with no fewer than four full-swiveling, nonmarring wheels and a locking mechanism to prevent movement during use.
- D. Closure Panels and Void Fillers:
  1. Aisle closures at foot level that produce flush vertical face at aisles when system is stored.
  2. End panels covering exposed ends of stands in the stored position.
  3. Back panels covering rear of freestanding units. Panels extend full height and width of unit.
  4. Panels at cutouts and truncations for accessible seating.
  5. Rear fillers including supports for closing openings between top row and rear wall of adjoining construction.
  6. Gap fillers for closing openings between stand units or between stand units and adjoining construction.
- E. Spanner Seats: Removable, designed to span area between adjacent stand units, in locations indicated on Drawings.
- F. Signage:
  1. Row letters at each row end.
  2. Seat numbers at 18 inches o.c. on benches and on each chair.
  3. Accessibility signs at each accessible space and accessible aisle seat.
  4. Custom graphics as indicated on Drawings on whole seating array.
- G. Scorer's Table: Removable unit that attaches to mounting sockets installed in telescoping stand unit.

## 2.5 MATERIALS

- A. Lumber: Kiln dried, surfaced four sides; southern pine complying with SPIB's "Standard Grading Rules for Southern Pine Lumber" for B & B finish (B and better) grade-of-finish requirements.
- B. Plywood: PS 1 as standard with manufacturer.
- C. Molded Plastic: High-density polyethylene; blow or injection molded, color-pigmented, textured, impact-resistant, with integral reinforcing ribs for attachment and anchoring points. Provide with UV inhibitors to retard fading.

## 2.6 FABRICATION

- A. Fabricate telescoping stands to operate easily without special tools or separate fasteners unless otherwise indicated.
- B. Round corners and edges of components and exposed fasteners to reduce snagging and pinching hazards.
- C. Form exposed work with flat, flush surfaces, level and true in line.
- D. Supports: Fabricate supports to withstand, without damage to components, the forces imposed by use of stands without failure or other conditions that might impair their usefulness.
  1. Cantilever bench seat supports to produce toe space uninterrupted by vertical bracing.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install telescoping stands according to ICC 300 and manufacturer's written instructions.

### **3.3 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
  - 1. ICC 300 Inspection: Inspect installed telescoping stands to verify that construction, installation, and operation are according to ICC 300 requirements.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Telescoping stands will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### **3.4 ADJUSTING**

- A. Adjust backrests so that they are at proper angles and aligned with each other in uniform rows.
- B. Adjust hardware and moving parts to function smoothly, and lubricate, test, and adjust each telescoping stand unit to operate according to manufacturer's written instructions.
- C. Clean installed telescoping stands on exposed and semi-exposed surfaces. Touch up factory-applied finishes or replace components as required to restore damaged or soiled areas.
- D. Replace upholstery fabric damaged during installation or work of other trades.

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to inspect, adjust, operate, and maintain telescoping stands.

### **3.6 MAINTENANCE AND OPERATION**

- A. The Owner is responsible for maintaining, monitoring the operation of, and performing periodic inspections on telescoping stands to ensure building-occupant safety. The Owner must be aware of and able to fulfill this obligation.

END OF SECTION

**SECTION 12 66 23 - PORTABLE PLATFORMS****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
  - 1. Portable platforms.
  - 2. Movable pedestal platform chairs
- B. Related Requirements: The following Sections contain requirements that relate to this Section:
  - 1. Division 12 Section "Bench Seating" for aluminum benches to be mounted on portable seating platforms.
  - 2. Division 12 Section "Arena Chairs" for fixed stadium chairs to be mounted on portable seating platforms.

**1.2 DEFINITION**

- A. Portable platforms are demountable systems of multiple-tiered platforms on interconnected, demountable supports that permit dismantlement, into a stacked relationship for purpose of storing and/or moving.
- B. Movable pedestal platform chairs are contoured polyethylene units mounted on steel beams in groups of up to 7 chairs to facilitate removal, storage, and re-installation.

**1.3 SYSTEM PERFORMANCE REQUIREMENT**

- A. Structural Performance: Design, engineer, fabricate, and install platforms to withstand the following structural loads without exceeding the allowable design working stresses of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each respective component of each platform unit.
  - 1. Design Load: NFPA 102, Chapter 5.
  - 2. Live Load: 125 lbs. per square foot.
  - 3. Side sway load: 24 lbs. per linear foot of row.
  - 4. Front to rear load sway load: 10 lbs. per linear foot or row.
- B. Structural Performance of Seating Units: In the mounted position, seating units shall resist damage caused from the following forces:
  - 1. 600 pound load applied vertically to each seat pan.
  - 2. 350 pound load applied horizontally to each seat back.
- C. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding the following structural loads without exceeding allowable design working stresses of materials for handrails, railings, anchors, and connections:
  - 1. Top Rail of Guards: Capable of withstanding the following loads applied as indicated:
    - a. Concentrated load of 200 lbf applied at any point and in any direction.
    - b. Uniform load of 50 lbf/ft. applied horizontally and concurrently with uniform load of 100 lbf/ft. applied vertically downward.
    - c. Concentrated and uniform loads above need not be assumed to act concurrently.
  - 2. Handrails Not Serving As Top Rails: Capable of withstanding the following loads applied as indicated:
    - a. Concentrated load of 300 lbf applied at any point and in any direction.
    - b. Uniform load of 50 lbf/ft. applied in any direction.
    - c. Concentrated and uniform loads above need not be assumed to act concurrently.

3. Infill Area of Guards: Capable of withstanding a horizontal concentrated load of 200 lbf applied to 1 sq. ft. at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.
  - a. Load above need not be assumed to act concurrently with loads on top rails in determining stress on guard.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

#### 1.4 SUBMITTALS

- A. Shop drawings indicating layout of portable platforms with seating heights and layouts, row spacing and rise, aisle widths and locations, overall dimensions for installed and stored units, connections and relationship to adjoining work, accessories, types of materials, and finishes.
- B. Where installed products are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis that has been signed and sealed by a qualified professional engineer responsible for their preparation.
- C. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 01 including detailed instructions indicating proper means for installing, dismantling, and maintaining platforms is required.

#### 1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide portable platforms by the same manufacturer as the telescoping platforms, if provided.
- B. NFPA Standard: Comply with requirements of NFPA 102, "Standard for Grandstands, Folding and Telescopic Seating, Tents, and Membrane Structures," and specifically with Chapter 5, "Folding and Telescopic Seating," except where more stringent requirements are indicated or imposed by authorities having jurisdiction.
- C. Installer Qualifications: Engage an experienced Installer to perform unit of work of this section who has specialized in the installation of types of portable platforms similar to that required for this project and who is acceptable to, and certified by, manufacturer of portable platforms.
- D. Engineer Qualifications: Professional engineer licensed to practice in jurisdiction where project is located and experienced in providing engineering services of the kind indicated that have resulted in the successful installation of portable platforms similar in material, design, and extent to those indicated for this Project.
- E. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" and D1.3 "Structural Welding Code - Sheet Steel."

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Check actual dimensions of construction affecting portable platforms by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.

#### 1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.



- B. Special Warranty: Manufacturer shall warrant all items against defects in material and workmanship for one year from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Stageright
  2. Sightline Commercial Solutions.
  3. Sico America Inc.

### **2.2 MATERIALS**

- A. Structural Steel Shapes, Plates, and Bars: ASTM A 36, except where higher strength steel is indicated or standard with manufacturer.
- B. Uncoated Steel Sheet: ASTM A 366, commercial quality, cold-rolled sheet, stretcher leveled.
- C. Steel Tubing: ASTM A 501, hot-formed.
- D. Extruded Aluminum: Manufacturer's standard extrusions of sizes and profiles required to achieved tread and riser dimensions indicated, 6063-T52, AA-C22A41 clear anodized finish; 0.094-inch minimum thickness.
- E. Aluminum Tubing: ASTM B 429, 6063-T6, Schedule 40.

### **2.3 MANUFACTURED UNITS**

- A. Portable Platforms: Construct units to stand on the arena floor and support the design loads specified. Seating shall be manually placed on the platforms and ganged together.
- B. Understructure: Fabricate understructure from structural steel or aluminum members of size, spacing, and form required to support design loads.
- C. Deck system: Decking and aisle steps shall be unitized assemblies of snap interlocked, extruded aluminum shapes with one-piece, non-slip ribbed extruded aluminum nosings and one-piece high tensile galvanized steel sheet risers. Pre-finished steel sheet riser with black vinyl finish risers as standard with manufacturer are acceptable. Painted steel risers are unacceptable
  1. Underside of deck shall consist of inverted "T's" approximately 3 inches on center with a material thickness to meet design criteria. Deck ends to be rigidized and protected with heavy aluminum end caps.
  2. Provide fully closed tread and riser construction.
  3. Attachment of Deck System to Understructure: Through-bolted with extrusion clips fore/aft to deck stiffeners, doublers, and frame cantilevers or manufacturer's standard locator pin fastening system. Attachment by the use of self tapping fasteners is unacceptable.
  4. Aisle Steps: Fabricate aisle steps to match deck system in strength and appearance

- D. Deck system:
1. Lower rear riser shall be a continuous formed steel member recessed to provide full heel room and provide a continuous envelope for the deck and longitudinal support of the deck surface.
  2. Front nose beam shall be a continuous structural member to support design loads and provide continuous longitudinal support of the deck surface.
  3. "Panelam" decking shall have a 0.030 inch high density polyethylene overlay, permanently bonded to structural western fir plywood in strict compliance with U.S. Product Standard PS 195. Finished thickness shall be 5/8 inch minimum. Polyethylene or polypropylene finish shall be textured grey. Plywood shall be supported along the front and back edge for maximum rigidity. An "H" type aluminum splice beam shall be provided between all decks.
  4. Decking shall be through bolted to steel supports with locking hardware. Decking attached by the use of self tapping fasteners is unacceptable.
- E. Platform Chairs: Mount up to 7 chairs on steel mounting beams.
1. Seats and backs: One-piece double wall construction of polyethylene.
    - a. Colors: To match Architect's sample.
  2. Supports: Heavy gauge brackets screw attached to seat and back with threaded inserts.
  3. Operation: Chairs shall be rigidly anchored to platform with stainless steel nuts and bolts which prevent rocking or swaying of in-place chairs.
- F. Rails: Provide removable guardrail sections with intermediate members to fulfill design criteria for exposed bank ends and front row of each platform seating unit per NFPA 101.
1. Aluminum: 1-1/4 inch schedule 40 aluminum pipe, unless indicated otherwise.
    - a. Provide 42 inch high rails at ends of rows.
    - b. Provide 34 inch high rails along aisles and stairs.
  2. Aluminum with Polycarbonate Infill panels: 1-1/4 inch schedule 40 aluminum pipe with plastic glazing panels as indicated on the drawings.
    - a. Provide 30 inch high guardrails in front of seating areas.
- G. Accessories: Provide the following accessories of manufacturer's standard design and construction at locations indicated or required.
1. Storage racks or carts: Provide for storage of portable platforms.
  2. Integral Lift Beams: Provide integral steel lifting beams on each platform section. Lift beams shall be designed to facilitate transporting of platforms without damaging the structure, per manufacturer's requirements.
  3. Aisle Lights: Install strip aisle lights full width of aisle at each face of the riser and each aisle step riser unless otherwise indicated and as required to provide minimum one foot candle on the horizontal surface of each aisle tread. Provide junction boxes and interconnecting wiring required to connect to building electrical systems.
  4. Transport Trucks: Heavy duty mobile handling trucks for storage and transportation of all demountable rails associated with each platform seating system. Transport trucks to be approximately 4'-0" wide and 8'-0" long with support brackets as required to store rails double high and from two sides of truck. Fit trucks with a sufficient quantity of 360 deg. swivel 6" diameter x 2" face wheels to insure ease of manual movement and stability of truck. Wheel treads to be molded polyurethane bonded to metal hub. Coordinate number of trucks required with event configurations indicated.
  5. Row Letter/Number Plates: Provide 2" x 2" etched anodized aluminum row letter plates to be affixed to the front riser of each row. Row lettering/numbering shall be silk screened in the size, style and color as approved by the Architect.

6. Fabric End Closure: Provide 16 oz. nylon reinforced coated vinyl fabric end closures at each exposed end of each seating bank. Closures shall be designed to be attached by 3/8 inch diameter brass grommets spaced at 6 inches on center along all perimeter edges. Provide integral polyethylene rubber shock cord with nylon jacket around rubber core and plasticized steel hooks through grommets to stretch fabric over exposed ends of seating banks. Sew panels together to form single piece closure. Provide continuous hem at perimeter as required to prevent pull-out of grommets. Provide portable storage units designed to transport fabric end closures from installed locations to storage and protect fabric end closures from damage while stored.

## 2.4 FINISHES

- A. Aluminum Finishes: Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
- B. Steel Finishes
  1. Surface Preparation: Solvent-clean surfaces in compliance with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel in compliance with SSPC-SP 5 (White Metal Blast Cleaning) or SSPC-SP 8 (Pickling).
  2. Baked Enamel Finish: Immediately after cleaning and pretreatment, apply manufacturer's standard 2-coat baked enamel finish consisting of prime coat and thermosetting topcoat to exposed and concealed metal surfaces including understructure, except where other types of finishes are indicated
  3. Vinyl-Clad Steel Finish: Apply manufacturer's standard flow-coated vinyl plastisol finish over shop-cleaned steel sheet to produce a vinyl coating with a cured thickness of not less than 8 mils and in manufacturer's standard, uniform color.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install portable platforms to comply with manufacturer's instructions and final shop drawings. Provide anchors, fasteners, inserts, and other accessories required for installation of units and attachment of units to adjoining construction.
- B. Firmly secure chairs to platforms using manufacturer's recommended hardware and fasteners.

### 3.2 ADJUSTMENT AND CLEANING

- A. Clean installed platform units on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

### 3.3 PROTECTION

- A. Protect platforms and seating from damage or deterioration until Substantial Completion.

### 3.4 TRAINING OWNER'S PERSONNEL

- A. Demonstrate and explain the operation and maintenance procedures of the portable platforms and accessories to Owner's operation personnel.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 13 17 00 - HYDROTHERAPY EQUIPMENT, POOLS, AND TUBS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Types of equipment specified in this section include the following:
  - 1. Aquatic therapy pool systems.
- B. Scope of Work: Provide hydrotherapy equipment compliant with the Authority Having Jurisdiction (AHJ) regulations for room indicated on the Drawings.
- C. Related Requirements:

**1.2 SUBMITTALS**

- A. Product Data: For each model indicated. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- B. Shop Drawings: For each type of equipment required.
  - 1. Include dimensioned plans, elevations and details, and large-scale sections of typical components. Show anchors, grounds, reinforcement, and layout, and indicate finishes.
  - 2. Include setting drawings, templates, and directions for installing anchor bolts and other anchorages to be installed as a unit of Work in other Sections.
  - 3. Wiring diagrams from manufacturer for electric components.
- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors and textures available for each component.
- D. Samples for Verification: Of the following products, showing color and texture, or finish selected. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected. Prepare Samples from the same material to be used for the Work.
  - 1. Trim and Accessories: Samples of each finish type and color, on 6-inch- (150-mm-) long sections of extrusions and not less than 4-inch (100-mm) squares of sheet or plate.
- E. Maintenance manuals for each different piece of equipment, including operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include all diagnostic and repair information available to manufacturer's and Installer's maintenance personnel. Submit for Owner's information at project closeout as specified in Division 01.

**1.3 QUALITY ASSURANCE**

- A. Installer Qualifications: Engage an experienced installer who is an authorized representative of the equipment manufacturer for installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain hydrotherapy equipment through one source.
- C. Electrical Components: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- D. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of hydrotherapy equipment and are based on the specific types and models indicated. Other manufacturers' appliances with equal performance characteristics may be considered. Refer to Division 01 Section "Product Requirements."

## 1.4 WARRANTIES

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranties: Written warranties, executed by manufacturer of each piece of equipment specified agreeing to repair or replace equipment or components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty:
    - a. Structural: 5-years from date of Substantial Completion.

## 1.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance service by skilled, competent employees of the equipment Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Use parts and supplies as used in the manufacture and installation of original equipment.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.
  - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
    - a. Response Time: 2 hours or less.

## PART 2 - PRODUCTS

### 2.1 HYDROTHERAPY EQUIPMENT

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product:
  - 1. Aquatic Plunge Pools:
    - a. Basis of Design: Custom Tile Pool
      - 1) Pricing Alternate: Hydroworx Rejuvenate
    - b. Quantity: two (2) each
    - c. Size: 7'-6" x 9'-0"
    - d. Type: combination hot/cold
- B. Aquatic Therapy Pool Systems: Provide a complete operating system for the specified product, including but not limited to the following:
  - 1. Recessed installation as indicated on the drawings
  - 2. Commercial installation
  - 3. Electric water heater
  - 4. Load bearing capacity of 460 lbs./sq. ft
  - 5. Access door to pit area
  - 6. Water test kit
  - 7. Water start-up treatment kit
  - 8. Ozonator
  - 9. Color tile as selected by Architect
  - 10. Equalization Skimmer
  - 11. Magnetic Water Conditioner

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of therapeutic pools.
  - 1. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine roughing-in before installation.

### **3.2 INSTALLATION**

- A. Install therapeutic pools level and plumb, according to manufacturer's written instructions and roughing-in drawings.

### **3.3 DEMONSTRATION**

- A. Startup Services: Engage a factory-authorized service representative to provide startup services and to demonstrate and train Owner's maintenance personnel as specified below.
  - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
  - 3. Review data in the operation and maintenance manuals. Refer to Division 01 Section "Operation and Maintenance Data."
  - 4. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

### **3.4 PROTECTION**

- A. Secure installed therapeutic pools to ensure that they will not be used before Substantial Completion.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 13 18 11 - ICE RINK GENERAL REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Quality assurance - prequalification criteria.
- B. General description of ice system requirements including ice rink floor, refrigeration system, and waste heat recovery systems.
- C. Reinspection.
- D. Submittal and project closeout requirements.
- E. Electrical requirements.
- F. General concrete requirements.
- G. Floor drain containment systems.
- H. Start-up and shutdown procedures.
- I. Emergency Preparedness Planning/Process Hazard Assessment Assistance (ammonia systems).

**1.2 QUALITY ASSURANCE**

- A. Contractors wishing to bid/quote on this project must submit, with their bid, the following prequalification criteria.

To demonstrate the qualifications to perform the Work, the Ice Rink Contractor shall submit the information requested below with their Bid. Ice Rink Contractor is defined as the contractor responsible for completing all Division 13 work and all work shown on the "R" drawings. Subcontractors performing the work identified below shall also meet the qualifications. Qualification document submitted by the low bidder will be evaluated after the bid opening to determine if the Ice Rink Contractor meets these qualifications.

1. As evidence and assurance of the contractor's ability to construct the project and support the Owner's system with service the contractor installing and constructing the primary and secondary refrigeration systems must have successfully installed and constructed ammonia refrigeration systems and ice rink floors for **(5)** years of completed projects. Submit information on each project. Submittal shall be on company letterhead, signed by an authorized representative of the company and include project description, portion of project completed by the company, location, construction cost, completion date, owner's name, owner's representative, phone number and completion date of work.
2. As evidence and assurance of the contractor's concrete subcontractor's ability to construct the project the contractor placing and finishing the concrete must have successfully completed the placement and finishing of concrete on **(8)** years of completed projects. Submit information on each project. Submittal shall be on company letterhead, signed by an authorized representative of the company and include project description, portion of project completed by the company, location, construction cost, completion date, owner's name, owner's representative, phone number and completion date of work.

3. As evidence and assurance of the contractor's controls subcontractor's ability to construct the project the control subcontractor must have successfully completed the programming and installation of two (2) ice rink construction projects that are similar to this project that were completed within the past five (5) years. Submit information on each project. Submittal shall be on company letterhead, signed by an authorized representative of the company and include project description, portion of project completed by the company, location, construction cost, completion date, owner's name, owner's representative, phone number and completion date of work.
  4. As evidence and assurance of the contractor's expansion joint subcontractor's ability to construct the project the ice rink floor expansion joint subcontractor must have successfully completed twenty (20) construction projects that use the same type of joint. Submit information on each project. Submittal shall be on company letterhead, signed by an authorized representative of the company and include project description, portion of project completed by the company, location, construction cost, completion date, owner's name, owner's representative, phone number and completion date of work.
  5. Submit the name of at least one (1) person employed by the company that will supervisor the fusion welding process along with their certifications, training and qualifications for performing the fusion welding process for high density polyethylene pipe (HDPE).
- B. Contractors wishing to bid on this project shall perform an on-site investigation prior to submitting a bid for the project. Contractor shall field verify all equipment and materials that will be affected by the work of this project and report any concerns to the Engineer at least ten (10) business days prior to the bid opening date.

### 1.3 GENERAL PROJECT DESCRIPTION

- A. The following is a general description of the project and may not include all materials and labor required or covered elsewhere in the contract documents.
1. Furnish and install a complete ice system including refrigeration system, ice rink floor, and waste heat recovery systems for sub-floor heating and snow melting.
  2. Furnish and install an indirect refrigeration system including equipment, piping, insulation, valves, refrigerant, brine, gas monitoring system, controls, motor control center, electrical, accessories and all other necessary materials and labor required for a complete operating system.
  3. Furnish and install a concrete ice rink floor including floor insulation, vapor barrier, pipe supports, welded steel piping, reinforcement, concrete, expansion joint, accessories and all other necessary materials and labors required for a complete operating system.
  4. Furnish and install waste heat recovery systems for sub-floor heating and snow melting including sand, piping, coil for pit, heat exchanger, pumps, valves, glycol, controls, electrical, accessories and all other necessary materials and labor required for complete operating systems.
  5. Schedule and pay for all testing and start up services required by the contract documents pertaining to the ice system.

### 1.4 REINSPECTION

- A. In addition to the Engineer's standard site visits throughout the project, the Engineer will be on-site at the end of the project to generate a list of uncompleted, or unsatisfactorily completed items, (i.e., punch list) after the project is reported complete by the Contractor and prior to the project's required completion date. If the items are not satisfactorily completed and should additional site visits be required to follow up on uncompleted items, the Engineer shall be

compensated at the typically hourly rate for each person involved in the re-inspection. The Contractor will be back charged the amount of the additional inspections.

### 1.5 RELATED SECTIONS

- A. Division 0, Division 1, General and Supplementary Conditions.
- B. Section 131812 - Ice Rink Refrigeration System.
- C. Section 131813 - Ice Rink Floor System.
- D. Section 131814 - Ice Rink Piping, Valves and Accessories.
- E. Section 131815 - Ice Rink Waste Heat Recovery Systems.
- F. Section 131817 – Ice Rink Central Control System.

### 1.6 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 305 - Hot Weather Concreting.
- C. ACI 306 - Cold Weather Concreting.
- D. ACI 309 - Recommended Practices for Consolidation of Concrete.
- E. ASHRAE/ANSI - 15 Safety Code for Mechanical Refrigeration.
- F. ASME B31.5 - Refrigeration Pressure Piping Code.
- G. IEEE Standard 112 - Standard Test Procedure for Polyphase Induction Motors and Generators (Method B).
- H. NECA - Standard of Installation.
- I. NEMA ICS2 - Industrial Control Devices, Controllers and Assemblies.
- J. NEMA -MG - Motor and Generators.
- K. NEMA TC2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
- L. NEMA-WC5 - Thermoplastic Insulated Wire and Cable.
- M. NEMA -WC7 - Cross Linked Thermosetting Poly Insulated Wire and Cable.
- N. NEMA 250 - Enclosures for Electrical Equipment.
- O. NFPA 70 - National Electrical Code.
- P. UL-83 - Thermoplastic - Insulated Wires and Cables.
- Q. UL 360 - Liquid-Tight Flexible Steel Conduit.
- R. UL 508 - Industrial Control Equipment.
- S. UL 651 - Schedule 40 and 80 PVC Conduit.
- T. UL 797 - Electrical Metallic Tubing.
- U. UL 810 – Capacitors.
- V. UL 845 - Control Panels.
- W. International Fire Code.
- X. International Building Code.

- Y. International Mechanical Code.

## 1.7 CODES AND STANDARDS

- A. All parts of the project shall be performed in accordance with the most recent version of the following codes and standards and all amendments:
  1. State Building Codes.
  2. State Electrical Codes.
  3. State Mechanical Codes.
  4. State Fire Codes.
  5. National Fire Protection Association Codes.
  6. ANSI/ASHRAE 15 -Safety Code for Mechanical Refrigeration.
  7. ASHRAE 34-Number Designations and Safety Classification of Refrigerants .
  8. OSHA.
  9. American Standard Code for Pressure Piping ASA B31.1.
  10. American Standard Code for Refrigeration Piping ASA B31.
  11. American Standard Code for Pressure Vessels.
  12. ANSI/IIAR Standard.

## 1.8 SUBMITTALS

- A. See General Conditions, Division 0 and additional requirements below.
- A. Shopdrawings and Submittals:
  1. The Contractor's approval stamp is required on all submittals and indicates that the Contractor has reviewed all materials and has a completed understanding of the specifications and requirements. Contractor shall clearly mark all deviations from the contract documents on all submittals.
  2. Shop Drawings. All submittals shall conform to the requirements the General Conditions and these specifications.
  3. Submit each item/material/equipment in a separate submittal and clearly labeled as follows using specification section, article and title.
    - a. For example: Rink Piping, Title: Polyethylene Rink Pipe, Submittal No. 131813.2.05.001
- B. Progress Schedule. Submit progress schedule before project begins.
- C. Test Reports. Submit one (1) electronic copy of test reports to the Engineer when specified.
- D. Certifications. Submit one (1) electronic copy of certifications to the Engineer when specified.
- E. Operation and Maintenance Manuals
  1. Submit one (1) electronic copy for initial review. After reviewed by the Engineer and all changes are made, submit one (1) final electronic copy and two (2) final printed copies for the Owners use.
  2. Prepare manuals, instructions and data by personnel experienced in maintenance and operation of described products.
  3. Prepare data in form of an instructional manual.
  4. Binders: Commercial quality, 8 1/2 x 11-inch text pages, three D size, 3 ring binders with durable plastic covers, 2-inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
  5. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.
  6. Sheets: Printed sheets in Part 1 shall have page protectors for each sheet. Printed sheets at the start and end of each additional section of the manual shall have page protectors.
  7. Drawings: Provide with reinforced edges.

8. Manual covers to have printed title “OPERATION AND MAINTENANCE INSTRUCTIONS”, title of project, and subject matter of manual when multiple manuals are required.
9. Contents of Manuals:
  - a. Table of Contents: Provide for each volume with each product or system identified, typed on white paper.
  - b. **P0001**: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, subcontractors, and major equipment suppliers for each product or system.
  - c. **P0002** Operation and maintenance instructions arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:
    - 1) Provide logical sequence of instructions for each procedure, incorporating manufacturer’s instructions.
    - 2) Description of each unit, equipment or system.
    - 3) Significant design criteria, normal operating characteristics and limiting conditions for each equipment and system. Include performance curves, engineering data and tests.
    - 4) Operating Procedures: Include start-up, break-in, routine normal operating instructions, sequences, and shutdown of the system including, but not limited to, system checks, controls, stopping, valve number references, typical fluid levels in all vessels, emergency instructions, etc. Include winter, summer, and any other special operating instructions.
    - 5) Start-up and shut-down procedure description including a step by step written description of how to start up and shutdown the system including, but not limited to, system checks, safety device checks, valves number references, typical levels in vessels, etc.
    - 6) Instructions of care and maintenance instructions for equipment and systems including, but not limited to, manufacturer’s recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
    - 7) Maintenance Requirements: Include routine maintenance procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
    - 8) Detailed description of control system including a step-by-step written description of how to operate the control system. See Section 131817 - Ice Rink Control System for additional requirements.
    - 9) List of equipment.
    - 10) Parts list for each component.
    - 11) Valve list that includes valve number, description, manufacturer, operation (normal closed or open, etc.). Provide schematic drawing of refrigeration system that shows locations of each valve.
    - 12) Servicing and lubrication schedule, list of lubricants required.
    - 13) Troubleshooting information.
  - d. **P0003** Project documents and certificates, including the following:
    - 1) Approved shop drawings and product data.
    - 2) Manufacturer’s printed operation and maintenance instructions.
    - 3) Detailed wiring diagrams of all electrical and control systems and all other electrical and control information.
    - 4) Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
    - 5) Air and water balance reports.
    - 6) Test records
      - a) Material and fluid tests for concrete, sand, glycol, CaCl<sub>2</sub>, etc.

- b) Pipe pressure tests for refrigeration system piping, rink floor piping, and transmission mains.
- 7) Certifications of inspections by regulatory agencies.
- 8) Warranties. Including project warranty and all equipment and material warranties.
- 9) Maintenance Drawings – Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- 10) Record Drawings including pipe routing, joint locations on all underground transmission mains, wiring diagrams, equipment layout, valve locations, etc. Reduce to half size and insert into back of manual
- 11) Training and reporting forms.
  - a) Provide daily checklist form for recording operation of refrigeration system.

### 1.9 WARRANTY GUARANTY

- A. In addition to the standard manufacturer's warranty on all equipment and materials, the contractor shall provide a standard one-year materials and labor warranty on all work performed for this project.

### 1.10 PRODUCT DELIVERY STORAGE AND HANDLING REQUIREMENTS

- A. Transport, handle, store and protect products in accordance with manufacturer's recommendations. Secure products at all times.
- B. Store products with seals and labels intact and legible.
- C. Store products in a secure environment at all times.
- D. Provide adequate labor to handle products and prevent damage.
- E. All damaged materials and equipment will be rejected.

## PART 2 - PRODUCTS

### 2.1 ELECTRICAL

- A. See requirements in Section 131812 - Ice Rink Refrigeration Systems.

### 2.2 GENERAL CONCRETE REQUIREMENTS

- A. This section refers to all concrete work outside the ice rink floor unless otherwise noted. For concrete ice rink floor see Section 131813 - Ice Rink Floor.
- B. Concrete Mix:
  - 1. Submit mix design fourteen (14) business days prior to placement.
  - 2. Concrete shall be produced by a Ready-Mix Plant approved by the Engineer. Concrete shall meet the requirement of ASTM C94 - Standard Specifications for Ready Mix Concrete.
  - 3. Mix Design Requirements

Minimum 28-day compressive strength	4000 psi
Coarse aggregate size	3/4 inch to #44 (ASTM C33 No. 67)
Maximum water to cement ratio	0.45

Maximum pozzolan content	25% of cement content
Minimum cement plus pozzolan content	564 lbs/cy
Slump	3 inches +/- 1 inch
Entrained air content	6% +/- 1.5%

C. Material Requirements

1. Cement: Shall meet ASTM C150, Type 1
2. Aggregates: Shall meet ASTM C33
3. Water: Shall be clean, potable water.
4. Admixtures:
  - a. Air Entrainment: Shall meet ASTM C260
  - b. Water Reducing Agent: Shall meet ASTM C494, Type A
  - c. Fly Ash: Shall meet ASTM C618 class C or F.

D. Reinforcement and Formwork

1. Formwork shall meet ACI 347 - Recommended Practice for Concrete Formwork.
2. Reinforcement shall be tagged and conform to ASTM A615 Grade 60. Installation shall meet ACI 315.
3. Tire wire: Shall be 16-gauge black annealed wire or heavier.

E. Related General Materials

1. Polyethylene Sheeting: Shall conform to ASTM C171.
2. Finishing Compound: Thoroseal by Thoro System Products or equal.
3. Expansion Joint: Bituminous fiber type meeting ASTM D1751.
4. Joint Sealant: Two part - self leveling, polyurethane sealant. MasterSeal SL2 by BASF or equal.
5. Anchor Adhesive: For anchoring dowels. Hilti HIT Doweling Adhesive C-100 by Hilti Fastening Systems, Powers Pure 110 , or equal.

## 2.3 FLOOR DRAIN CONTAINMENT SYSTEMS

A. Floor Drain Covers

1. Approved manufacturers: CPLabSafety (California Small Business #58199) or equal.
2. Provide one Drain Seal product for each of the floor drains in the ammonia refrigeration room.
3. Size: shall be 6" larger than the outside of the drain grate or as required by the manufacturer.
4. Material: The Drain Seal system shall be water-tight, Ultra-Tech flexible, 2-hour rated, non-absorbing urethane material, shall resist oil and ammonia, and made with reinforced and tear resistant mesh. System shall seal using either side of material the material.
5. Color: orange

## PART 3 - EXECUTION

### 3.1 CONSTRUCTION UTILITIES AND FACILITIES

- A. Unless specified elsewhere, all temporary utilities and facilities required to complete the project shall be the responsibility of the contractor and costs for these utilities and facilities shall be incidental to the project costs.

### 3.2 NOTIFICATIONS OF WORK

- A. The Contractor shall notify the Engineer, a minimum of seven (7) business days, prior to the following phases of the work:
1. Completion of subgrade preparation.

2. Start of sub-floor heating system piping.
  3. Completion of transmission main installation
  4. Start of floor insulation.
  5. Completion of floor insulation.
  6. Start of rink piping and header piping.
  7. Completion of rink piping and header piping.
  8. Final flushing of all piping systems.
  9. Start of concrete placement.
  10. Start of refrigeration piping insulation installation.
  11. Start and completion of all pressure tests.
  12. Start up and Training
- B. See Section 1.04 of this section for requirements regarding re-inspection of uncompleted or unsatisfactorily completed items.

### 3.3 CLEANING PAINTING AND RESTORATION

- A. Contractor shall be responsible for cleaning the immediate construction area including the rink floor, perimeter concrete where work or demolition is conducted and the mechanical rooms where work is being performed.
- B. Patch and paint all holes caused or left by construction and demolition work. Match adjacent textures and colors.
- C. Clean all equipment and piping to original condition after project has been completed.
- D. Touch up all equipment paint, using paint provided by the manufacturer, after the installation is complete.
- E. All piping, valves, and other items related to the ice system resulting from required demolition shall be removed and disposed of off-site by the contractor unless specifically designated to be salvaged.
- F. Clean out snow melt pit.

### 3.4 CONCRETE WORK

- A. Reinforcement shall be installed with a minimum of 2" of cover. Adequately support reinforcement with concrete blocks or wire/plastic chairs. Splices shall be installed with minimum lapping distances shown on the plans and bars wired tightly together.
- B. Concrete Placement: shall conform to ACI 309 - Consolidation, ACI 306 - Cold Weather Placement, ACI 307 - Hot Weather Placement.
- C. All new concrete adjacent to the ice rink floor shall be placed at the same tolerance as specified for the ice rink floor and shall use the same benchmark, unless otherwise noted.
- D. Finishing: Apply float finish and uniform textured surface to all interior slabs. Apply broom finish to exterior slabs. Edge or chamfered the edge of all concrete that is adjacent an expansion or construction joint.
- E. Joints: Install control and construction joints as follows unless otherwise stated elsewhere:
1. Install control joints every 10 feet o.c. in each direction.
  2. Install construction joints with expansion material and caulk at any new cold joints.
- F. Curing: Cover with burlap-polyethylene and damp cure for a minimum of 7 days.
- G. Testing: Contractor shall hire a testing agency to perform the following tests and shall pay for all testing and laboratory costs. Tests shall include air content (ASTM C 231), slump (ASTM C143)



and compressive strength (ASTM C31, C39) for all concrete placed. Three (3) copies of the results shall be submitted to the Engineer.

### 3.5 START-UP AND FOLLOW UP SERVICES

- A. Test all refrigeration systems, including secondary refrigeration systems, according to the specifications and current codes and have been thoroughly cleaned, fill all piping systems with a complete charge of the specified primary and secondary refrigerants. Remove all free air from the systems. The contractor shall be responsible for removing air from the system throughout the warranty period of the project. The contractor shall take every precaution to fill the piping system in such a manner that results in maximum air removal and avoids trapping air in the system (for example, the ice rink floor). If air becomes trapped in the piping system, the contractor shall remove the fluid and refill the system as many times as required until the air is removed. Provide field report for each site visit where air is removed, or systems checked clearly detailing processes and observations.
- B. Provide documentation of all piping pressures tests and vacuum tests on systems. All tests shall be witnessed by Owner or Owner's representatives.
- C. After all piping systems have been tested according to the specifications and current codes and have been thoroughly cleaned, fill all piping systems with a complete charge of the specified primary and secondary refrigerants. Remove all free air from the systems. The contractor shall be responsible for removing air from the system throughout the warranty period of the project. The contractor shall take every precaution to fill the piping system in such a manner that results in maximum air removal and avoids trapping air in the system (for example, the ice rink floor). If air becomes trapped in the piping system, the contractor shall remove the fluid and refill the system as many times as required until the air is removed. Provide field report for each site visit where air is removed, or systems checked clearly detailing processes and observations.
- D. Provide all additional primary and secondary refrigerants necessary to maintain fully charged systems throughout the warranty period of the project. Test all refrigerants at frequency specified in Section 131812 – Ice Rink Refrigeration System and provide final test reports of each refrigerant (including moisture content, inhibitor concentration, solids, refrigerant content, etc.).
- E. Start-Up and Commissioning: Provide a factory trained technician for a minimum of 30 hours to completely check the operation of the refrigeration system and equipment and all associated systems and equipment during start up. Startup shall follow all requirements of ANSI/IIAR-5 Startup of Closed-Circuit Ammonia Refrigeration Systems. Provide documentation and certification from trained technician with completed, detailed, check list for each piece of equipment.
- F. Inspection, Testing, and Maintenance Service: The Contractor shall provide the following follow-up services, at minimum. The cost of these services shall be incidental.
1. 6 Month (Semi-Annual) System ITM: Perform all recommended system tests, inspections and maintenance per *ANSI/IIAR-6 Standard for Testing, Inspection and Maintenance of Closed-Circuit Ammonia Refrigeration System* including but not limited to:
    - a. Testing of Secondary Refrigerants
    - b. Calibration of Ammonia Leak Detectors.
  2. 12 Month (Annual) System ITM: Perform all recommended system tests, inspections and maintenance per *ANSI/IIAR-6 Standard for Testing, Inspection and Maintenance of Closed-Circuit Ammonia Refrigeration System* including but not limited to:
    - a. Testing of Secondary Refrigerants
    - b. Calibration of Ammonia Leak Detectors.
  3. Site visits during the warranty period as required to make adjustments to control settings, equipment functions, and any other parts of the system
- G. Concrete ice rink floors shall cure a minimum of 28 days prior to lowering the temperature of the ice rink floor. After the 28-day cure, lower the temperature of the ice rink floor at a maximum rate of 1-degree F per hour until a slab temperature of 34 degrees F and then 1-degree F every 2 hours until a slab temperature of 16-18 degrees F or as desired by the Owner. Apply water only after the desired operating temperature is reached. Provide documentation that procedure was witnessed by Owner or Owner representative.

- H. Provide the Owner's operating staff with fourteen (14) hours of hands-on instructions on the safe operation of the entire ice system. This shall be provided in a minimum of two (2) separate days. Include detailed instructions on how to build the first ice sheet. Operation and Maintenance Manuals must be completed and approved at by this time so they can be reviewed during the training sessions. Provide a minimum of fourteen (14) days' notice for all training sessions. Training sessions shall be coordinated with Owner's schedule.
- I. Demonstrate that all control and alarm systems are working as required by code and specified in the contract documents. All necessary adjustments, additions, and electrical modifications shall be made to provide these systems. Provide documentation that procedure was witnessed by Owner or Owner representative.
- J. Variable Frequency Drives: Provide start up services by a certified manufacturer's representative to provide an additional 1-year warranty. Provide field report and documentation of all work performed and observations.
- K. Provide on-site monitoring for first four (4) hockey games. The contractor's representative shall be on-site during 10 hours before the start of the game and for the duration of the game to monitor system operations.
- L. Assist the Owner in preparing an Emergency Preparedness Plan, Process Hazard Assessment, or related documents by providing the Owner's planning consultant/engineer with the required information on the ice system as requested and take part in two planning sessions with the Owner via teleconference.
- M. Provide laminated drawings of all the flow diagrams and P&IDs, valve list and reference for the project. Mount drawings to refrigeration room wall. Minimize size of drawings shall be 22" x 34".
- N. System Function Testing: Contractor shall prove system function by refrigerating the ice rink floor and by building a layer of "black ice" (+/-1/4"). The system shall remain operational for a minimum of 48 hours after black ice has been formed. Contractor shall inspect entire ice rink floor with a thermal imaging camera.

### **3.6 SHUTDOWN SERVICES**

- A. Provide the Owner's operating staff with eight (8) hours of hands-on instructions on the shutdown procedures of the system after the first ice season has finished. Provide a minimum of fourteen (14) days' notice for all training sessions. Training sessions shall be coordinated with Owner's schedule.

### **3.7 COORDINATION OF WORK**

- A. The contractor shall be responsible for coordinating all work in Division 13 – Ice Rink. The contractor shall also work closely with the other subcontractors on the project and help coordinate all associated structural, electrical and mechanical systems.

### **3.8 PERMITS**

- A. The contractor shall apply for and obtain all permits required to construct the project at no additional cost to the Owner unless specified otherwise.

END OF SECTION

**SECTION 13 18 12 - ICE RINK REFRIGERATION SYSTEM****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. General system description, design criteria and control criteria.
- B. Motor Control Center
- C. Motor Starters.
- D. Motors.
- E. Other Electrical Components (enclosures, emergency switch, dialer, meter, etc.).
- F. Compressors.
- G. Chiller and Surge Drum.
- H. Rink Pumps.
- I. Condenser System (incl. water pump, sump & chemical treatment system).
- J. Gas Monitoring System.
- K. Primary Refrigerant.
- L. Secondary Refrigerant.
- M. Storage Receiver System.
- N. Thermosyphon Receiver.
- O. Wind Sock

**1.2 RELATED SECTIONS**

- A. Division 0, Division 1, General and Supplementary Conditions.
- B. Section 131811 - Ice Rink General Requirements.
- C. Section 131813 - Ice Rink Floor System.
- D. Section 131814 - Ice Rink Piping, Valves and Accessories.
- E. Section 131815 - Ice Rink Waste Heat Recovery Systems.
- F. Section 131817 – Ice Rink Central Control System.

**1.3 GENERAL REQUIREMENTS**

- A. General Refrigeration System Description:
  - 1. Furnish and install a complete ice rink refrigeration system including but not limited to chiller, compressors, pumps, condenser system, piping, valves, controls, motor control center, and all related electrical components and connections necessary for a completely automatic refrigeration system with alarms, operating at the conditions described in, and meeting the requirements of, the contract documents.
- B. Refrigeration System Design Criteria:
  - 1. Design Parameters: See Ice Equipment Schedule on drawings.
  - 2. All primary refrigeration piping shall be sized by the Contractor unless otherwise specified or indicated on the drawings. The piping shall be sized for the full capacity of the system

except where manufacturer recommends a different size to optimize operation of the system.

3. Furnish and install isolation valves, unions, purge valves, etc. required for isolating and servicing each piece of equipment and system components whether or not they are shown on the drawings.
4. The cost of all piping, electrical, equipment, controls, or other changes required for the proper installation of all equipment shall be included in the Contractors bid. If equipment substitutions require revisions in the design of the systems or facility, the Contractor shall reimburse the Owner for the cost of the redesign services.
5. The Contractor shall provide all electrical work, design, materials and equipment necessary for a complete, operational ice system. All work, materials and equipment shall meet the required electrical codes for the Project's location. A licensed electrician shall perform all electrical work. The main electrical feed for each piece of equipment shall be routed beneath the floor slab, not overhead. Provide all low voltage wiring required for alarms, controls and other related system for a complete operating system.

**1.4 SUBMITTALS**

- A. Shop Drawings. All submittals shall conform to the requirements of the General Conditions and these specifications.

**1.5 WARRANTY GUARANTY**

- A. As required in Section 131811 - Ice Rink General Requirements and as follows:
  1. Manufacturer's standard warranties that exceed the specified warranty.
  2. Evaporative Condenser: 5-year warranty
  3. Motors and Variable Frequency Drives: In addition to the standard 1-year warranty, provide start-up services from a certified manufacturer's representative to provide an additional 1-year warranty.
  4. Test and maintain chemical balance of all refrigerants in all systems including inhibitors in all solutions during warranty period.

**1.6 PRODUCT DELIVERY STORAGE AND HANDLING REQUIREMENTS**

- A. As required in Section 131811 - Ice Rink General Requirements.

**PART 2 - PRODUCTS**

**2.1 MOTOR CONTROL CENTER**

- A. Approved Manufacturers: Eaton/Cutler Hammer Westinghouse, Allen Bradley, General Electric, Siemens, Square D, Rockwell Automation or equal.
- B. Panels designed and manufactured by custom panel shops will not be approved.
- C. **P**anel schedule shall be provided to the contractor for review and approval. See equipment chart on drawings for MCC loads.
- D. Provide a Motor Control Center (MCC) to house and including all starters, breakers, controls, running lights, contacts, relays, switches, fuses, safety switches, alarms, overload relays, resets, VFDs and all other electrical devices required for a fully operational ice system. The MCC shall include but not limited to, the following:
  1. Starters for compressors, and pumps.
  2. Variable frequency drives for condenser fan and rink pumps



- D. Solid State Starters (Soft Starts): Required for motors 75-HP and greater. Shall be UL listed and include isolation contacts, current limiting fuses, capacitors for noise protection, microprocessors and all other circuitry required to function properly, overload protection, LED indicators, auxiliary contacts, heat sink, integral cooling fan, phase loss and stall protection, soft stop, adjustable starting and stopping times, and adjustable initial voltage level to adjust torque for motor starts. Shall have standard handle with four positions; ON, OFF, TRIPPED, and RESET. Part winding or wye-delta starters will not be accepted.
- E. All motors for use with Variable Frequency Drives shall be listed suitable for use with VFD equipment to prevent premature bearing failure as specified in the VFD section.
- F. Variable Frequency Drive (VFD):
1. Approved Manufacturers: ABB, Allen Bradley, Bell & Gossett, Cutler Hammer or equal.
  2. Materials and Construction: NEMA 1 Enclosure, pad lockable input disconnect switch, electronic overload protection, input fuses, HOA switch, selectable operating modes, protection circuits, UL/CSA Approved.
  3. Display: Output frequency and voltage, motor current, kwh meter, fault indication with text, % torque, % power (kW), and speed (RPM).
  4. Voltage Tolerance: +/- 10%.
  5. Options: Manual bypass (2 contactors) for condenser fan, auxiliary contact for disconnect.
  6. All motors for use with Variable Frequency Drives shall be listed suitable for use with VFD equipment to prevent premature bearing failure. This includes, but is not limited to, providing NDE and DE bearings and shaft grounding rings or system, etc. Shall be installed prior to start-up.

## 2.4 MOTORS

- A. Motors shall be 460 volts, 3 phase, 60 Hz, squirrel cage induction motors with a service factor of 1.15. Shall have adequate torque to accelerate the load at operating conditions without exceeding the nameplate rating, not including the service factor. Motors shall be designed, constructed and tested in accordance with ANSI/NEMA Publication No.MG-1 and meet NEMA specifications. Shall be premium efficiency design as determined by IEEE Standard 112, Method B. Minimum motor efficiencies shall meet the following.

*Table for Premium Efficiency Motors (ODP type)*

M <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> HP	1200 RPM	1800 RPM	3600 RPM
1	82.5	85.5	77.0
1.5	86.5	86.5	84.0
2	87.5	86.5	85.5
3	88.5	89.5	85.5
5	89.5	89.5	86.5
7.5	90.2	91.0	88.5
10	91.7	91.7	89.5
15	91.7	93.0	90.2
20	92.4	93.0	91.0
25	93.0	93.6	91.7
30	93.6	94.1	91.7
40	94.1	94.1	92.4
50	94.1	94.5	93.0
60	94.5	95.0	93.6
75	94.5	95.0	93.6

100	95.0	95.4	93.6
125	95.0	95.4	94.1
150	95.4	95.8	95.0
200	95.4	95.8	95.0

- B. Motor enclosures shall be open drip proof (ODP). Bearings shall be shielded and regreasable steel ball bearings. Stator windings shall be copper. Insulation shall be Class F non-hygroscopic materials.
- C. Motor shall be factory aligned and if necessary, shall be realigned by the Contractor after installation and prior to start-up.
- D. Motors shall be inverter duty where VFDs are being used.

## 2.5 OTHER ELECTRICAL COMPONENTS

- A. All electrical components if not specified elsewhere shall be UL listed where possible, meet all code requirements and approved for specific application.
- B. Enclosures: Enclosures shall be NEMA 1 rated for indoor applications and NEMA 3R for outdoor applications.
- C. Disconnects: Approved Manufacturers for disconnects: Cutler Hammer, General Electric, Square D, Westinghouse or equal. Enclosure shall be NEMA rated for environment where it will be located. Disconnects for motors with VFD drives shall have auxiliary contacts to shut down VFD per manufactures recommendations.
- D. Fuses: Provide one spare fuse for each type and size used on the project.
- E. Emergency Devices
  - 1. Furnish and install an emergency remote control push/pull button (off-only control) and all associated electrical for a complete system to stop the operation of all electrically energized equipment related to the refrigeration system as required by the current state and local mechanical codes.
  - 2. For interior devices and locations, furnish and install a clear Plexiglass protective, lockable, wall mounted case for devices.
  - 3. For exterior devices and locations, furnish and install NEMA Type 3R, continuous hinge, lockable enclosure (Weigmann RHC121206 or equal). Emergency ventilation remote switch provided by others will also be installed by others in this enclosure. Verify enclosure space needs with ventilation contractor.
  - 4. See Gas Monitoring section for additional requirements.
  - 5. Provide all low voltage wiring and connections required for alarms, controls and all other related devices for complete operating systems.
- F. Power Monitor: Furnish and install a microprocessor-based monitor panel to provide the following readings: voltage, amperage, power, power factor, and energy consumption. The panel shall conform to the following:
  - 1. Approved Manufacturers: Rockwell Automation (Allen Bradley) PowerMonitor 5000 or equal.
  - 2. Current transformers, 5A secondary.
  - 3. Four (4) protection functions shall be provided which shall include the following: overvoltage and undervoltage. Protective functions shall be field settable for alarm and/or trip outputs.
  - 4. One alarm relay shall be programmable for KWH pulse output.
  - 5. A serial port for data transmission to remote location shall be provided.
  - 6. Provide monitoring software for multiple computers as required by Engineer/Owner. Connect unit to Ice Rink Center Control System for data collection and manipulation.

- G. Automatic Alarm Dialer.
1. Furnish and install a complete automatic alarm dialer system, compatible with the Owner's telephone system, that will monitor the following alarm conditions and points. This system is required by IIAR 6.14.7.4 "A monitored location shall be notified upon loss of power to or failure of the emergency mechanical ventilation system".
  2. Before ordering the dialer system, the contractor shall verify with the Owner the type of phone system that is being used (standard dial type telephone system, Voice over Internet Protocol (VoIP) system, etc.). The contractor shall select the correct dialer system for their application. If VoIP is available, that system shall be selected.
  3. Monitor the following alarm conditions and points:
    - a. Power loss to refrigerant leak detection dedicated circuit branch (per IIAR).
    - b. Power loss to emergency mechanical ventilation system's dedicated circuit branch (per IIAR).
    - c. Start/Fail for the emergency ventilation system's fan (per IIAR).
    - d. High brine temperatures from compressor microprocessor.
    - e. Alarm conditions from compressor microprocessor to be named later by Owner.
    - f. Power failure to refrigeration system.
  4. Manufacturer: Sensaphone 800 system, Sensaphone Sentinel Monitoring System with Cellular Modem or equal.
  5. Unit to provide up to 12 different status conditions.
  6. Dial a minimum of eight (8) different phone numbers.
  7. Uninterrupted Power Supply (UPS) for 20 minutes.
  8. Additional requirements for standard telephone system:
    - a. Operate with standard dial telephone line.
    - b. Respond to status interrogation from any touch-tone telephone.
  9. Additional requirements for VoIP system:
    - a. Include 12-month subscription to cellular dialer system for time of startup. Coordinate with City on selection of service provider.
    - b. Shall instantly sends alerts via phone, text or email over cellular connection.
    - c. Shall deliver event reports, and audit logs.
    - d. Shall store all data in the cloud, with unlimited information storage and allows multiple devices to be managed from one account. No software shall be required.
    - e. Shall be accessible by any web-enabled device.

## 2.6 SCREW COMPRESSOR PACKAGE

- A. Approved manufacturers: Mycom Compressor Package, Bitzer ACP or equal.
- B. Design Parameters: See Ice Equipment Schedule on drawings for design conditions. System basis of design is based on Mycom I Series screw compressors package. If alternative compressor manufacture is used, contractor shall submit revised design documents including but not limited to: design data, flow diagram, package layout, etc. Package shall be designed and constructed to meet all applicable codes including but not limited to: ANSI IIAR, ASHRAE 15, ASME B31.3, etc. All compressors, vessels, piping, and accessories shall be mounted to a single industrial strength steel frame and be fully piped, wired and tested prior to delivery.
- C. Compressors: Open drive ammonia screw compressor. Compressors shall have stepped capacity control (50%-75%-100%) via solenoid valves. Bitzer OS 74/85 Series, Mycom i-Series or equal.
- D. Motors: NEMA Premium Efficiency Motors, 1.15SF Motor (s) C-Flange, 3,300 ft elevation, 40C ambient, 460v/3p/60Hz, ODP, suitable for Solid State Soft Starter.
- E. Accessories: Suction check valve, Suction shut-off valve, Suction Strainer, Discharge shut-off valve, Discharge check valve with cold start pressure control.
- F. Oil Cooling / Separation System



1. Provide a complete thermosyphon oil cooling and separation system.
  2. Combination Oil Separator: Horizontal type multi-stage oil separator with sump oil heaters, dual relief valve assembly, sight glasses, and access cover for replacement of internal coalescing elements. The separator shall be designed and constructed in accordance with ASME Section VIII, Div.1 for a minimum design working pressure of 300 PSIG. The separator shall be sized for full capacity of associated compressors.
  3. Oil Cooling Heat Exchanger: Shall be plate and shell or shell and tube type heat exchanger. The heat exchanger shall be sized for full capacity of associated compressors. The oil side of heat exchanger shall include a 3-way thermostatic mixing valve to maintain required oil temperature. See ice equipment schedule on drawings for design conditions.
  4. Oil Filter: Package shall include dual oil filters (20 Micron) or a single oil filter with bypass. Provide one complete set of spare oil filters and O-rings/gaskets for owners use after warranty period.
  5. Oil: Package shall come with complete charge of manufacturer approved oil. Provide (10) gallons of spare oil for owners use after warranty period.
- G. Wiring/Controls: All sensors, transducers, and controls necessary for a fully functioning system shall be wired to a central terminal box. See ice rink control system specification for additional requirements.
- H. Startup: Package shall be started up by a factory trained technician. Start up service shall include (2) eight-hour days of onsite service. The technician shall provide a complete start-up report and pre-start checklist.
- I. Post Start-Up Maintenance/Service: Following initial startup, at minimum the contractor shall perform the following manufacture recommended inspection/maintenance/service items and all other inspection/maintenance/service items recommended by the manufacture to maintain warranty:
1. At 100 hours or per manufacturers recommendations (whatever comes first), replace compressor oil filters.
  2. At 500 hours or per manufacturers recommendations (whatever comes first), clean suction strainer.
  3. At 500 hours or per manufacturers recommendations (whatever comes first), analyze oil. Oil shall be analyzed every 5,000 hours or annually (whatever comes first) thereafter throughout the warranty period.
  4. At 500 hours or per manufacturers recommendations (whatever comes first), replace primary oil filter(s).
- J. Warranty: 24-month factory warranty on compressor package from compressor startup or 30 months from ship date of equipment. Warranty shall include all parts and labor.

**2.7 THERMOSYPHON RECEIVER**

- A. Approved Manufacturers: HT Industrial, Bitzer, H.A. Phillips, Docal, or equal.
- B. Capacity: See Ice Equipment Schedule on drawings.
- C. Construction: Designed for minimum design parameters outlined in table below. Vessel shall be constructed and stamped per ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 98E/99A. Shall be pass through design.
- |       |          |                |   |   |   |
|-------|----------|----------------|---|---|---|
| R     | M        | D              | P | T | R |
| R-717 | 250 PSIG | -20 F to 250 F |   |   |   |
- D. Accessories: Provide a dual relief valve assembly as specified and per code requirements. Provide all valves, piping and other related materials and accessories as necessary for a fully operational system. Name plate shall clearly display code compliance and capacity of vessel.
- E. Vessels shall be mounted on a factory constructed steel legs or frame system.



- J. Finish: Prepare exterior surface of all vessels in accordance with SSPC-SP3 Power Tool Cleaning or SSPC-SP10/NACE 2 Near-White Blast Cleaning. Paint with one coat of primer and one coat of alkyd egg-shell enamel for exterior use.
- K. Drip Pan: Provide a stainless steel drip pan under oil pot with integral drain.

**2.9 RINK PUMPS**

- A. Approved Manufacturers: Pentair Aurora Series 3800 Series, Xylem Inc. Bell and Gossett Series e1510, Armstrong or equal.
- B. Design Parameters: See Ice Equipment Schedule on drawings. Motor size is based on the pump manufacturer listed in the schedule on the drawings. If the motor size increases due to the use of pump another manufacturer, the contractor is responsible for all changes associated with the motor size change at no additional cost to the Owner.
- C. Pump Construction and Materials
  - 1. Centrifugal, end suction design, base mounted, single stage. Shall be serviceable without disconnecting to piping system. Pumps shall be capable of continuous operation without fault. Pump shall be rated at 175 psi.
  - 2. Volute: Heavy-duty cast-iron conforming to ASTM A48, Class 30, integrally cast pedestal support. Provide drain and vent plugs. When calcium chloride (CaCl<sub>2</sub>) is specified as the secondary refrigerant or brine all surfaces in contact with the liquid shall have an epoxy coating.
  - 3. Impellers: Enclosed type, cast bronze conforming to ASTM B584 (for glycol use only), vacuum cast, keyed to shaft with non-corrosive fasteners, statically and dynamically balanced. When calcium chloride (CaCl<sub>2</sub>) is specified as the secondary refrigerant or brine the impeller material shall be cast iron conforming to ASTM A48, Class 30 or stainless-steel conforming to AISI 316.
  - 4. Shafts: Carbon steel conforming to AISI C1045 machined and polished. Replaceable bronze sleeve conforming to ASTM B62. Maximum deflection of 0.002 inches at the seal face under a maximum load condition. Provide ANSI/OSHA-compliant coupling guard with slotted viewing window. When calcium chloride (CaCl<sub>2</sub>) is specified as the secondary refrigerant or brine the sleeve shall be stainless steel conforming to AISI 316 when using calcium chloride.
  - 5. Bearings: Heavy duty, grease lubricated, regreasable, ball bearings with B10 minimum bearing life of 50,000 hours per AFBMA test procedures. Shall be replaceable without disconnecting pump from pipe system.
  - 6. Seal Assembly:

M	C C2 G S	W S
Elastomer	EPR (Ethylene Propylene Rubber)	Buna
Rotating Face	Silicon Carbide	Carbon
Stationary Face	Silicon Carbide	Silicon Carbide
Hardware	Stainless Steel	Stainless Steel
Spring	18-8-Stainless Steel	18-8-Stainless Steel
Other	Internal flushing capabilities	Internal flushing capabilities
Other	Easily Inspected	Easily Inspected
Other	Replaceable	Replaceable

- 7. Wearing Ring:

M	G S	C C2 S
Material	Bronze	Cast Iron
ASTM Specification	B62	A48
Type	Replaceable	Replaceable

- 8. Motor: Shall conform to the requirements of this Section.
- 9. Accessories: See Section on Ice Rink Piping, Valves, and Accessories and other requirements herein.

**2.10 EVAPORTIVE CONDENSER**

- A. Approved Manufacturers: Evapco PHC-E, Baltimore Air Coil CXVB, Marly, or equal.
- B. Provide one (1) condenser system with design parameters listed on the Ice Equipment Schedule on drawings. See warranty in Section 1.5 of this specification.
- C. Material Construction: Induced draft design with vertical discharge condenser with all stainless-steel panel construction.
- D. Fan: Fans shall be heavy-duty, axial type with aluminum alloy blades driven by a one-piece, multi-groove neoprene/ polyester belt designed for a minimum of 150% of the motor nameplate horsepower. Fan(s) and shafts shall be supported by heavy-duty, self aligning, grease-packed ball bearings with moisture-proof seals and integral sealer rings, designed for a minimum L10 life of 80,000 hours. Fan and motor sheaves shall be fabricated from corrosion resistant materials.

Fan motor(s) shall be totally enclosed fan cooled (TEAO) type, premium efficiency/VFD ready with a 1.0 service factor, suitable for 460 V, 3 phase, 60 Hz electrical service and shall be mounted on an easily adjusted, heavy-duty motor base. Fan motors shall comply with NEMA Standard MG 31, Section IV, Part 31. Shall be oversized for dry operation and shall conform to the requirements of this Section. Motor shall be inverter duty type for operation with VFD.

  - 1. Variable Frequency Drive (VFD): Furnish and install VFD as specified in this section, for the fan motor.
- E. Coil: Material shall be 304 stainless steel pipe suitable for specified refrigerant. Shall be rated at 280 PSIG working pressure and tested at 375 PSIG air pressure under water. The coil shall be designed for low-pressure drop with sloping tubes for free drainage of fluid. The refrigerant condensing coil shall be ASME B31.5 compliant.
- F. Water System and Eliminators: Shall include headers, Sch 40 PVC spray branches with distribution nozzles. All components and fasteners shall be made of non-corroding material and designed for easy removal and cleaning. Removable PVC drift eliminators shall have a minimum of three changes in air direction with hooked leaving edge. Drift loss shall be less than 0.001 percent of total water circulated.
- G. Sun Blockers: Provide sun blocker system for coil and fill.
- H. Basin Assembly: The cold water basin shall be constructed of heavy-gauge type 304 stainless steel panels and structural members, with all welded seams. The welded stainless steel basin shall be leak tested at the factory. Basin shall include a depressed section with drain/cleanout connection. The basin area under the fill surface shall be sloped toward the depressed section to facilitate cleaning.
- I. Water Pump: The cold water basin shall include: a drain/clean-out connection; a stainless steel strainer; a corrosion resistant make-up valve; overflow connection; and a water recirculation pump assembly. Cold water basin shall be designed so that the strainer, makeup valve and float, and pump assembly are easily accessible without removing any of the unit panels or other components. Lift-out steel strainer shall be supplied with perforated openings sized smaller than the water distribution nozzle orifices and an integral anti-vortexing hood to prevent air entrainment. Water recirculation pump shall be a close-coupled, bronze fitted centrifugal pump equipped with a mechanical seal, mounted on the basin and piped from the suction strainer to the water distribution system. The pump shall be installed with adequate drains so that it may drain freely when the basin is drained. The pump assembly shall include an integral metering valve and bleed line to control the bleed rate from the pump discharge to the overflow connection. The pump motor shall be totally enclosed fan cooled (TEFC) type suitable for 460 volt, 3 phase, 60Hz electrical service.
- J. Walkways, Ladders and Platforms

1. Furnish and install a complete, elevated, walkway/platform system for easy and safe access of equipment. The system shall include:
  - a. External Louver Face platform: Aluminum, galvanized steel, or stainless steel complete with knee rail and toe board. Comply with 29 CFR 1910.23.
  - b. Internal Walkway: Same material as external platform. Shall span the collection basin from one end of the tower to the other and positioned to form a path between the access doors.
  - c. External Ladders: Provide a ladder for each access panel and platform. Aluminum galvanized or stainless steel, fixed ladders with ladder extensions to access external platforms and top of cooling tower from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27. Provide extensions as needed to meet roof or slab elevation. Provide cage around ladder if required by OSHA, and other code requirements.

## 2.11 CHEMICAL TREATMENT SYSTEM

1. Furnish and install a complete chemical water treatment system for the condenser system to control scale, corrosion and biological growth. Provide all piping, valves, controls, wiring, meters, strainers, equipment and chemicals required for a complete operating system. Interlock with water pump as necessary for automatic operation.
  2. Approved water treatment company: Verify with Owner.
  3. All chemical feed piping to the internal sump of the unit that is located outside the building shall be stainless steel.
  4. Provide chemicals for one year for the prevention of scale, corrosion and biological growth. All chemicals must be compatible with the equipment materials used in the system and must meet or exceed all environmental requirements. Annual chemical cost information and name of suppliers must be submitted with the proposed chemical treatment system shop drawings.
  5. Provide quarterly water testing for the duration of the warranty period.
  6. Accessories: Furnish a pH cube kit as manufactured by HACH Cat. No. 12519 Phenol red.
  7. Chemical treatment supplier to provide a passivation plan for the condenser.
- B. Containment Tray: Furnish and install a containment tray for the chemical drums. Approved manufactures: PIG [www.newpig.com](http://www.newpig.com) or equal. System shall be durable plastic, one-piece utility tray with 5" minimum side walls.

## 2.12 REFRIGERANT GAS MONITORING SYSTEM

- A. Approved Manufacturer: Bacharach (Pat McClernon, Control House Ltd. 952-746-3485), Calibration Technologies, Inc., Cool Air Mechanical, or equal
- B. Provide one (1) complete refrigerant gas monitoring system for the specified refrigerant. System shall continuously monitor for refrigerant leaks and meet ASHRAE 15 Standard current edition.
- C. System shall include:
  1. One (1) Main Controller Panel mounted inside ice equipment room.
  2. One (1) Remote Display Panel mounted outside main door to ice equipment room.
  3. Sensors, strobes and audible devices as defined herein.
  4. One (1) Uninterruptable Power Supply (UPS) to provide power for 20 minutes.
- D. Features:
  1. Multi-zone detection with expandable capabilities.
  2. Main Controllers and remote displays shall have a front panel display with backlit graphic LCD, system and alarm status indicators, and keypad.
  3. Displays shall show zone specific refrigerant concentration for all sensors.
  4. Four (4) SPDT relays contacts (minimum).

5. 4-20 mA analog output.
6. Sampling: Automatic and continuous or manual.
7. Automatic reboot and system alarm reset after power failure.
8. Trend / Data Logging: Graphic display of trend data, alarm log and fault log.
9. NEMA 4X, UL-listed, CSA, IEC, IP66 enclosure.
10. Provide a silence and reset switch at the gas monitoring panel inside the refrigeration room as required by code.

E. Sensors and transmitters

1. Approved type of sensors:
  - a. Infrared transmitters and sensors with a sensing range of 25ppm to 10,000ppm.
  - b. Electrochemical transmitters and sensors
  - c. Solid state
2. Accuracy of +/- 5% of value.
3. Zero Drift: Less than 0.1% of full-scale.
4. Response time: less than 20 seconds
5. Linearity: +/- 1% of full-scale
6. Ranges:
  - a. Provide ranges most suitable for the ranges specified in the table below except that one sensor in the ice equipment room must have a high range of 10,000 ppm.
7. Certification: ETL listed to UL standard.
8. Sensors shall be installed in the locations shown on the plans (if indicated) and in accordance with the table below. The exact locations shall be verified during construction.

L □□□□□□	S □□□□□T□□□	Q □□□□□□□
Ice Equipment Room	Infrared/Electrochemical/SS	3

F. Alarm Settings

1. Alarm concentration levels shall be adjustable. Initial settings and sequences shall be in accordance with the table below.

A □ □ □□□□ C □□□□□□□□□□□□	D □□□□□□□□□ □□A □□□□□□
25 ppm	1. Notify Ice Rink Control System <ol style="list-style-type: none"> <li>a. Notification sent to facility personnel</li> </ol> 2. Controller to initiate the following alarm sequences per IIAR: <ol style="list-style-type: none"> <li>a. Strobes and audible alarm in ice equipment room, vestibule and exterior door only activated</li> </ol>
50 ppm	1. Notify Ice Rink Control System <ol style="list-style-type: none"> <li>a. Notification sent to facility personnel</li> </ol> 2. Controller to initiate the following alarm sequences: <ol style="list-style-type: none"> <li>a. <u>A</u> strobes and audible alarms activated. This may be the same as 25 ppm.</li> </ol>
150 ppm	1. Notify Ice Rink Control System <ol style="list-style-type: none"> <li>a. Notification sent to facility personnel.</li> </ol> 2. Controller to initiate the following alarm sequences per IIAR: <ol style="list-style-type: none"> <li>a. All strobes and audible alarms activated.</li> <li>b. Emergency purge ventilation system is activated.</li> <li>c. Send signal to fire alarm system.</li> </ol>

250 ppm	<ol style="list-style-type: none"> <li>1. Notify Ice Rink Control System                         <ol style="list-style-type: none"> <li>a. Notification sent to facility personnel.</li> </ol> </li> <li>2. Controller to initiate the following alarm sequences per IIAR:                         <ol style="list-style-type: none"> <li>a. All strobes and audible alarms activated.</li> <li>b. De-energize pumps, compressors, and normally closed automatic refrigerant valves that are not part of an emergency control system.</li> </ol> </li> </ol>
---------	--

G. Alarm Devices

1. Alarm devices shall be combination strobe lights and audible alarms.
2. Strobe light single color shall be selected by Owner.
3. Furnish and install as required by current state and local mechanical codes.
4. Device locations shall be as shown on the plans and in accordance with the table below. The exact locations shall be verified during construction.

L □□□□□□	A □□□□ D □□□□□	Q □□□□□□
Inside Refrigeration Room	Strobe & Audible	2
Outside Refrigeration Room Doors	Strobe & Audible	3

- H. Provide all necessary auxiliary equipment relays as required to operate strobes / audible devices, start emergency ventilation, shut down refrigeration system, fire alarm system notification, etc.
- I. Leak detector shall turn on exhaust fan even when control panel is powered off or not functioning.
- J. Connection from the emergency ventilation to the auxiliary relay will be by building electrical or mechanical contractor.
- K. Connection from the fire alarm system to the auxiliary relay will be by fire alarm contractor.
- L. Provide connection to ice rink control system for monitoring concentrations and alarms.

**2.13 PRIMARY REFRIGERANT**

- A. Furnish and install a complete operating charge of anhydrous ammonia (R-717) refrigerant to fill entire refrigeration system. The refrigerant charge shall meet the following chemical properties:
  1. Ammonia: 99.999% minimum
  2. Moisture (as H2O): 10 ppm maximum
  3. Oil: 1 ppm maximum

**2.14 SECONDARY REFRIGERANT**

- A. Ethylene Glycol Solution
  1. Furnish and install a complete operating charge of 40% by volume of inhibited ethylene glycol and deionized water. The fluid shall be an industrial heat transfer fluid specifically designed for HVAC systems.
  2. Approved Manufacturers: Dow Chemical Company Dowtherm SR-1, Texaco Texcool E100, Dynalene EG, Interstate Chemical Company Intercool, or equal.
  3. The solution shall have a factory mixed corrosion inhibitor or neutralizing agent, an anti-foaming agent to n
  4. The solution mixture shall meet the following parameters:

P □□□□ □□□□	40 EG
Specific Gravity @ 15F	1.077
Viscosity @15F	9.3017
Freezing Point	-9.8 F
pH	8.0 to 9.2
Density @ 15F	68 lbs./cf
Specific Heat @15F	0.700 BTU/lb. F

Thermal Conductivity @15F	0.21 BTU/hr-SF
---------------------------	----------------

5. The deionized water shall conform to the following properties in maximum allowable concentrations:
 

Calcium Carbonate Hardness	100 ppm
Chlorides	25 ppm
Sulfates	25 ppm
- B. Submit a product data sheet and MSDS sheet for the solution including the inhibitor and/or neutralizing agent.
- C. Provide a weather resistant tag on the fill valve for the system that includes description of fluid, freezing and burst point, total gallons of system, Material Safety Data Sheet reference and date of original charge.
- D. Provide certified test results for all solutions in systems. At minimum samples for the secondary refrigerant solution shall be drawn at the following times:
  1. 3 months after start-up.
  2. 11 months after start-up.

**2.15 SIGNAGE**

- A. Furnish and install legible permanent signs on the outside of all ice rink equipment mechanical room doors as detailed on the drawings and as follows:
  1. All signs informative signs, emergency signs, charts and labels shall be in accordance with NFPA 704, ANSI/IIAR, ANSI Z535.2 and the International Mechanical Code.
  2. For ammonia refrigerant, the NFPA 704 or Fire Diamond numbering shall be 3-3-0-blank (blue-red-yellow-white) or per current code requirements.
  3. Provide all other signs required by code even if not shown on the drawings.
- B. Furnish and install signage, as detailed on the drawings, next to each strobe light and audible alarm.
- C. Furnish and install signage, as detailed on the drawings, next to each refrigeration system emergency stop button and ventilation enable switch.
- D. Furnish and install schematic drawing or panel giving directions for operation of the system per ASHRAE-15 paragraph 11.7.
- E. If Owner requires the format (font, size, colors, etc.) of the signage to match other signage in the facility, provide the format required by the Owner unless it does not meet code requirements.

**2.16 STORAGE RECEIVER**

- A. Approved Manufacturers: HT Industrial, Bitzer, H.A. Phillips, Docal, or equal.
- B. Capacity: See Ice Equipment Schedule on drawings.
- C. Construction: Designed for minimum design parameters outlined in table below. Vessel shall be constructed and stamped per ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 98E/99A.

R-717	M 250 PSIG	T -20 F to 250 F
-------	------------	------------------

- D. Accessories: Provide a dual relief valve assembly as specified and per code requirements. Provide a 2" diameter external steel site glass column with: welded caps; a minimum of three (3) 1-¼"-12 SPUD with 1-1/4" sight glasses; and two ¾" NPS connections to the vessel with shut-off valves. Provide all valves, piping and other related materials and accessories as necessary for a



fully operational system. Name plate shall clearly display code compliance and capacity of vessel.

- E. Vessels shall be mounted on a factory constructed steel legs or frame system.
- F. Finish: Prepare exterior surface in accordance with SSPC-SP3 Power Tool Cleaning or SSPC-SP10/NACE 2 Near-White Blast Cleaning. Paint with one coat of primer and one coat of alkyd egg-shell enamel for exterior use.
- G. Rust inhibitor shall be used when hydro-testing system. Thoroughly dry vessel interior after hydro-testing and prior to filling system with refrigerant.

## 2.17 DIFFUSION TANK

- A. Approved Manufacturers: Midwest Tank Company (Big Lake, MN) or equal.
- B. Design Conditions:
  - 1. See Ice Equipment List on drawings for capacity.
  - 2. Provide 3-year warranty for defects in materials and workmanship and 1 year for fittings and accessories.
- C. Construction:
  - 1. Upright, single wall, flat bottom, closed top.
  - 2. Molded one-piece seamless construction according to ASTM D 1998. Virgin polyethylene resin and shall be Type I (cross-linkable polyethylene) or Type II (linear polyethylene) and shall be FDA or NSF 61 listed.
  - 3. Shall be designed for chemical applications and specifically ammonia refrigerant storage.
  - 4. Submit factory test report for verification of wall thickness, impact tests, hydrostatic tests, verification of materials and visual inspection.
  - 5. Tanks shall be manufactured with a minimum of two lift lugs integrally molded into tank.
  - 6. Tanks shall be marked to identify the product, date (month and year) of manufacture, capacity and serial number.
- D. Fittings and Accessories
  - 1. Provide all necessary fittings and accessories required for the layout and function of the tank.
  - 2. Double bolted 150-pound flange fittings required for fittings 2 inches and larger below liquid level.
  - 3. Drain fitting and PVC ball valve at lowest possible point. Provide siphon tube to improve drainage capability.
  - 4. Vents and vent line for atmosphere pressure and pressure during filling of tank for proper ventilation complying with OSHA and other requirements.
  - 5. Ammonia sparger tube.
  - 6. Provide flange connections and adapters as required for connecting equipment, piping, relief inlets and outlets, etc.
  - 7. 18-inch threaded manway with 15-inch access. No vent.
  - 8. Integrally molded gallonage marks on side of tank.
  - 9. 1" flange connection on top of tank for make-up water connection.

## 2.18 WIND SOCK

- A. Furnish and install a wind sock on the exterior of the building as required by code. Coordinate sock size, mounting details and location with owner.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

- A. All equipment shall be installed per manufacturer's requirements.
- B. All equipment shall be installed as individual components and not on a steel frame system unless otherwise shown on the drawings. All equipment shall be accessible for safe operation and maintenance.
- C. All equipment bases shall be bolted down and filled with concrete unless otherwise specified or noted. Adjust level of concrete as required to provide access to anchor bolts for compressors, motors, etc.
- D. All equipment shall be installed and designed such that vibration is minimal and meets acceptable limits. If the amount of vibration is in question, the Contractor shall be responsible for hiring a certified, experienced vibration company to perform the necessary test. A certified test report shall be submitted to the Engineer. If results are not satisfactory, the Contractor shall be responsible for correcting the problem and retesting for vibration as previously specified.
- E. Connect cold water make-up line to remote sump. Provide drain line, valves, etc. as shown on the drawings.
- F. All meters, gauges, and readouts shall be mounted at eye level.
- G. All equipment, vessels, and tanks shall be fully supported with a structural steel framing system anchored to the wall and floor and not to the roof structure unless otherwise approved.
- H. Tanks. If tanks (for example, sump, water, diffusion, expansion, etc.) do not fit through existing or proposed door opening, make all necessary accommodations, including removal and replacement of door(s) and wall(s) for required access.

### **3.2 VARIABLE FREQUENCY DRIVES (VFD)**

- A. Provide start-up services by a certified representative of the manufacturer.

### **3.3 MOTORS**

- A. Provide motor circuits as required by NFPA 70 including a motor grounding conductor.
- B. Testing:
  - 1. Voltage and current measurements shall be performed on all motor driven equipment to confirm that the voltage and current is within the operating range of the motor and the nameplate rating.
  - 2. Perform an insulation resistance test or megger test on each 460-volt motor by applying 500 Vdc phase to ground on each phase for 10 minutes with readings taken at the end of one (1) minute and ten (10) minutes. Minimum acceptable reading is 5 megohms.

### **3.4 ELECTRICAL**

- A. Provide all electrical work necessary for a complete, operational ice system. All work shall meet the required electrical codes for the Project's location. A licensed electrician shall perform all electrical work. The main electrical feed for each piece of equipment shall be routed beneath the floor slab, not overhead.
- B. Locate the Emergency Remote Control button(s), protective case(s), audible alarm(s) and strobe light(s) outside the ice mechanical room at a distance from the entrance door(s) to the ice mechanical room as required by code. Locate other strobe lights and audible alarm assemblies were shown on the drawings and as required by code.

### **3.5 REFRIGERANT GAS MONITORING SYSTEM**

- A. Monitoring and display units shall be mounted at eye level.

- B. Recalibrate unit at both the unit and each sensor after final completion of project. Provide verification that the unit has been calibrated. Provide calibration and test kits from the manufacturer as required to calibrate the unit per manufacturers recommendations and as specified.

### **3.6 PAINTING AND FINISHES**

- A. All structural supports and framing shall be painted with one coat of primer and one coat of alkyd egg-shell enamel.
- B. Touch up paint on all equipment, vessels, supports and exposed pipes after project is complete.
- C. Provide additional touch up paint for equipment and vessels for Owners use.
- D. Touch up damaged galvanized coatings and corrosion protection systems on condenser and remote sump.

### **3.7 CLEANING**

- A. Clean and vacuum all debris from inside the Motor Control Center and all other electrical enclosures. Do not use compressed air to clean out panel.
- B. Thoroughly clean equipment of all temporary protective coatings and foreign material prior to assembly of erection.
- C. After project completion thoroughly clean all equipment and piping systems.

### **3.8 START UP AND SHUTDOWN SERVICES**

- A. See Section 131811 - Ice Rink General Requirements.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 13 18 13 - ICE RINK FLOOR SYSTEM****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Sand.
- B. Insulation, jacketing and vapor barrier.
- C. Pipe and reinforcement support chairs.
- D. Reinforcement.
- E. Pipe and fittings.
- F. Expansion joint.
- G. Concrete.
- H. General materials.
- I. Temperature sensors and monitors for sub-floor and ice rink floor.
- J. Subgrade preparation.

**1.2 RELATED SECTIONS**

- A. Division 0, Division, General and Supplementary Conditions.
- B. Section 131811 - Ice Rink General Requirements.
- C. Section 131815 - Ice Rink Waste Heat Recovery Systems.
- D. Section 131817 – Ice Rink Central Control System.

**1.3 REFERENCES**

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 304 - Concrete Placement.
- C. ACI 305 - Hot Weather Concreting.
- D. ACI 306 - Cold Weather Concreting.
- E. ACI 309 - Recommended Practices for Consolidation of Concrete.
- F. ASTM C94 - Standard Specifications for Ready Mix Concrete.
- G. ASTM D 2513 - Thermoplastic Gas Pressure Pipe.
- H. ASTM D 2683 - Socket Type Polyethylene Fittings.
- I. ASTM D 3261 - Butt Fusion Polyethylene Fittings.
- J. ASTM D 3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings.
- K. ASTM F 2164-21 Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure
- L. NSF Standard 61 - Plastic Piping Components and Related Materials.
- M. AWWA C901 - Polyethylene Pipe.

- N. The Plastic Pipe Institute Handbook of Polyethylene Pipe.
- O. Pipe Manufacturer for fusion welding procedure.

#### 1.4 SUBMITTALS

- A. Shop Drawings. All submittals shall conform to the requirements of the General Conditions and Section 131811 - Ice Rink General Requirements.
- B. Test Reports. Submit four (4) copies of test reports to the Engineer when specified.
- C. Gradation of clean sand fill.
- D. Concrete mix design. Submit fifteen (15) business days prior to placement.
- E. Two (2) samples of a typical fusion welded pipe to fitting connection. Samples shall come from a demonstration performed in the field prior to placement of polyethylene pipe.
- F. Rink subgrade and top of pipe surveys.

#### 1.5 WARRANTY GUARANTY

- A. As required in Section 131811 - Ice Rink General Requirements

#### 1.6 PRODUCT DELIVERY STORAGE AND HANDLING REQUIREMENTS

- A. As required in Section 131811 - Ice Rink General Requirements.

### PART 2 - PRODUCTS

#### 2.1 SAND

- A. Sub-Floor and Trench Back Fill Material: Clean sand consisting of sound, durable particles. Material gradation shall meet 100% passing the #4 sieve and not more than 5% passing the 200 sieve. Material shall be clean, free of all debris, roots, or other foreign material or chemicals.

#### 2.2 INSULATION JACKETING AND VAPOR BARRIER

- A. Approved manufacturers: Styrofoam brand by the Dow Chemical Company, CertainTeed, Owens-Corning, DiversiFoam, or equal.
- B. Floor Insulation: Insulation material shall meet ASTM C 578 Type VI with a minimum compressive strength of 40 psi, maximum water absorption of 0.1% by volume (ASTM C272) and an R-value per inch at 75 F of 5 Fxsfhx/Btu. Provide the sheet dimensions as indicated on the drawings.
- C. Pipe Insulation System:
  - 1. Direct Bury: As specified in Section 131814 – Ice Rink Piping, Valves and Accessories.
- D. Accessories: Provide all adhesives, sealants and other products as required by the manufacturer to provide a completely sealed system. Provide vapor barrier for the piping that is non-flammable and fire resistant for all systems operating below 65 F.
- E. Vapor Barrier (for Rink Floor):
  - 1. Concrete Rink Floor: Shall conform to ASTM D-4397 for Clear Polyethylene Film except the thickness shall be 6-mil. Tensile strength shall be a minimum of 1700 psi (long direction) and Elongation shall be a minimum of 225% (long direction). The materials shall be supplied in 20'-0" x 100'-0" minimum size sheets. Provide tape manufactured for sealing the seams of poly sheeting.

**2.3 PIPE AND REBAR SUPPORT CHAIR**

- A. Approved Manufacturers: Hunter Wire Products or equal.
- B. U-type or M-type configuration designed for both supporting rink piping and reinforcement or equal. Six (6) foot long sections.
- C. Material: Wire shall be a minimum of #7-gauge (0.187") steel. Base plate shall be a minimum of 20-gauge steel for sand floors and 24-gauge steel for concrete floors except that 20-gauge steel shall be used on all rink floors with steel rink piping.
- D. Shims (for adjusting pipe elevation): Shims shall be plastic or steel and shall be a minimum size of 2" wide x 2" long to provide full support beneath the pipe and rebar support chair.

**2.4 REINFORCEMENT**

- A. Reinforcement: Shall be tagged and conform to ASTM A615 Grade 60.
- B. Wire Mesh: 6x6 W4.0/W4.0 (4 gauge) steel mesh conforming to ASTM 1064.
- C. Tie Wire: Shall be 16-gauge yellow-coated annealed wire or heavier.

**2.5 PIPE AND FITTINGS**

- A. Steel Pipe:
  1. Schedule 40 black carbon steel ASTM A53 Grade B Type S (seamless) or Type E (Electric-Resistance-Welded), SRL. Rink piping shall be random 40-foot lengths. Headers shall be shop fabricated. Field verify rink radius prior to fabricating. All steel pipe shall be cleaned and capped prior to shipping to the jobsite.
  2. Joints/Connections: All connections shall be welded in accordance with pipe manufacturer's requirements and as specified below:
    - a. All joints on butt welded connections, 1 ½" diameter pipe and smaller, shall use a backer ring.
    - b. Welded socket joints/connections may be used for the rink piping.
    - c. Threaded joints or connections are not allowed.
  3. Fittings:
    - a. All fittings shall be carbon steel with welded end type and shall meet ANSI 11.9. Fittings shall be manufactured and not shop or field fabricated. All welded fittings shall be of the long radius type.
    - b. Rink piping return bends: Schedule 40 black carbon steel ASTM A53 grade B SRL or Electric-Resistance-Welded ASTM A135 Grade B.
  4. Flanges shall be of the same material as the pipe and shall be rated for a minimum of 150 psi.
  5. Protective coating. All steel pipe headers and mains shall be painted with two coats of primer paint.

## B. Polyethylene Pipe:

1. SDR 17, pressure rating 100 psi (rink transmission pipe only)

Nominal I.D.	1"	6"	8"
Actual O.D.	1.135	6.625"	8.625"
Wall Thickness	0.077"	0.390"	0.507"

Minimum thickness. Wall thickness shall be within 10% of that specified.

2. SDR 11, pressure rating 200 psi (subfloor piping and headers, subfloor transmission mains).

Nominal I.D.	¾"	1"	3"	6"	8"	10"
Actual O.D.	1.050"	1.315"	3.5"	6.625"	8.625"	10.750"
Wall Thickness	0.095"	0.119"	0.318"	0.602"	0.784"	

- Minimum thickness. Wall thickness shall be within 10% of that specified.
3. Shall be high density polyethylene complying with requirements of ASTM D3350 cell classification and have a Plastic Pipe Institute (PPI) designation of PE4710. Minimum density shall be 58 lbs/cf (0.957 gm/cc).
  4. Joints/Connections: Fusion welded. Welding process shall be performed by fully trained personnel in the fusion welding process.
  5. Fittings:
    - a. Approved manufacturers: Charter Plastics, Performance Pipe, Rahn, Georg Fisher, Polycam or equal.
    - b. All fittings shall be socket type and conform to ASTM 2683. Fittings shall be manufactured and not field or shop fabricated. The inside diameter of the fittings shall be equal to the inside diameter of the pipe.
    - c. Use manufacturer recommended coupling when fusion welding pipe of different gauges or wall thickness.
  6. The pipe shall have product traceability by inclusion of product code on the exterior of the pipe and include the manufacturer, the date of manufacture, the lot and supplier of the raw material, the location of the manufacture, and the production shift of which the product was produced.

## 2.6 COMPRESSION SEAL AND EXPANSION JOINT MATERIALS

- A. Compression Seals: Shall be D.S. Brown Delastic or equal.
  1. D.S. Brown Delastic Catalog Numbers shall be as follows:
    - a. For ½" joint (width at time of concrete placement) shall be Catalog No. E-1006.
    - b. For 1" joint (width at time concrete placement) shall be Catalog No. CV-1752.
    - c. Provide dimensions as required for the joint width shown on the drawings.
  2. Material shall be polyethylene, non-absorbent, non-staining.
  3. Compression seal material shall meet the parameters for the specified D.S Brown product.
  4. Color: Black
  5. Expansion Joint Material: Ceramar by W.R. Meadows or extruded polystyrene insulation (thickness of expansion joint by depth of rink floor) in one piece with top scored to depth of expansion joint material or as recommended by the manufacturer.

## 2.7 CONCRETE

- A. This section refers to concrete for the ice rink floor only. For perimeter slab concrete and other miscellaneous concrete requirements see Ice Rink General Requirements Section.
- B. Concrete Mix:
  1. Submit mix design fifteen (15) business days prior to placement.
  2. Concrete shall be produced by a Ready-Mix Plant approved by the Engineer. Concrete shall meet the requirement of ASTM C94 - Standard Specifications for Ready Mix Concrete.
  3. Mix Design Requirements. Prepare design mix for type and strength of concrete in accordance with applicable provisions of ASTM C94, Alternative #3.
 

Minimum 28-day compressive strength	5,000 psi
Coarse aggregate size	3/4 inches to #4 (ASTM C33 No. 67)
Maximum water to cement ratio	0.40
Minimum cement content	600 lbs/cy
Fly ash	15% of cement content max.
High Range Water Reducing Admixture	
Slump (prior to addition of HRWRA)	3 inches maximum
Slump (after addition of HRWRA)	7 inches maximum
Air content	3% maximum



4. Proportion aggregates such that the concrete mix adequately flows into all corners and around reinforcement without segregating, leaving voids or producing honeycombs. There shall be no free water in the mix.
  5. The consistency of the concrete mix shall be uniform and such that the cement and other ingredients are uniformly distributed throughout the mix and such that the mortar clings to the coarse aggregate.
- C. Material Requirements
1. Cement: Shall be Portland Cement that meets ASTM C150, Type I or Type I/II. Only the specified manufacturer submitted with design mix will be allowed.
  2. Fine Aggregates: Shall be clean, natural sand free of loam, clay and other deleterious or foreign materials. Shall meet ASTM C33 and come from a single source.
  3. Coarse Aggregates: Shall be clean, processed aggregates free of loam, clay or other deleterious or foreign materials. Shall be crushed stone or crushed gravel.
  4. Water: Shall be clean, potable water. Maximum concentration of chloride ions of 0.1%.
  5. Admixtures: All admixtures shall conform to ASTM C494. A representative for the HRWRA supplier shall be on-site at the start of the concrete placement until consistency in the mix has been proven by the testing agency. No changes are allowed once the design mix is approved.
    - a. Air Entrainment:
      - 1) Shall meet ASTM C260.
      - 2) Approved manufacturers:  
 Axim Concrete Tech. - Catexol AE 260, VR  
 Euclid Chem. Co. - AEA 92S, AEA 92, Air Mix 250  
 General Resource Tech - Polychem AE, VR  
 GCP – Applied Technologies - Darex II AEA, Daravair 1000, 1400, Airalon 3000  
 Master Builders - MB VR standard, Micro Air, MasterAir AE 90  
 Sika Corporation – Sika AEA-14, Sika Multi AIR 25  
 Premiere – ConAir
    - b. Water Reducing Admixture:
      - 1) Shall meet ASTM C494, Type A and shall not contain more chloride ions than in potable water source with a maximum of 0.1%.
      - 2) Approved manufacturers:  
 Axim Concrete Tech. - Catexol 800N, 1000N, 2000N  
 Euclid Chem. Co. - Eucon MR, WR, WR-91  
 General Resource Tech - Polychem 1000, KB1000, 400NC  
 GCP – Applied Technologies - WRDA 82, MIRA 110  
 Master Builders - Pozzolith 220N, MasterPolyhead 997  
 Sika Corporation - Sikament HP, Plastocrete 169, 161  
 Premiere – OptiFlo MR
    - c. High Range Water Reducing Admixture (HRWRA) Superplasticizer
      - 1) Shall meet ASTM C494, Type F or G and shall not contain more chloride ions than in potable water source with a maximum of 0.1%.
      - 2) Approved manufacturers:  
 Euclid Chem. Co. - Eucon 37  
 GCP – Applied Technologies - ADVA 140M, ADVA CAST 575, 600  
 Sika Corporation – Sikament 686  
 Master Builders – MasterGlenium 7500  
 Premiere – OptiFlo MR

## 2.8 GENERAL MATERIALS

- A. Nylon Ties: Shall be 3/16" wide and UL recognized. For sand rink floor ties shall have a minimum tensile strength of 100 lbs, with metal tabs. For concrete rink floor ties shall have a minimum tensile strength of 50 lbs.

- B. Moisture Curing Covers: Shall be a curing cover such Ultra Cure by McTech Group, Hydrocure by PNA Construction Technologies or equal. Polyethylene sheeting is not approved.

## **2.9 TEMPERATURE SENSOR AND MONITORS**

- A. Provide sensors for sub-floor heating system and the rink floor. See drawings for number and location.
- B. Approved Manufacturers: Omega Engineering, Thermokon, Kele, Honeywell, or equal.
- C. Sensor (thermistor or RTD):
  1. Accuracy: +/- 1% accuracy of measuring range.
  2. Sensor pocket shall be aluminum.
  3. Protection: Shall be protected against humidity, vibration and mechanical overstress.
  4. Construction: Shall be suitable for temperature extremes and immune to the effects of moisture and condensation.
  5. Provide wiring as required by monitor manufacturer.
  6. Other control systems – provide compatible 4-20mA sensor.
- D. Box: Aluminum construction with 3/4" hub size, threaded connections, flat removable iron or steel cover with neoprene gasket.
- E. Conduit: Schedule 80 PVC from box to mechanical room and from box to depth of sensor to prevent heat transfer.
- F. Wire: Provide all wiring sizes for application and per code requirements.

## **2.10 FLOOR INSERTS**

- A. Furnish and install floor inserts as detailed on the drawings and for the quantity shown. Inserts shall be designed for 5,000-pound load in any direction.
- B. Plug Materials: Furnish and install threaded plugs for each insert. The plug material for goal post inserts shall be 303 stainless steel. The material for dasher board and circus inserts shall be 360 brass.
- C. Insert Materials: As shown on the drawings. If not shown, then material shall be 303 stainless steel inserts.
- D. Base Plate Material: 303 Stainless steel or carbon steel.
- E. Wrench: Furnish two plug wrenches. Each wrench shall have a minimum shaft length of 6", a minimum handle length 10" and designed to fit insert plugs. Wrench shall be constructed of coated steel or equal.
- F. Flexible goal post pegs will be provided by the dasher board manufacturer. Verify peg dimensions prior to manufacturing floor inserts.

## **2.11 FLOOR HARDENER**

- A. Approved manufacturer: Prosoco Consolideck LS or approved equal.
- B. Penetrating lithium silicate hardener, densifier and sealer for concrete surfaces.
- C. Form: Clear to cloudy, colorless, orderless liquid.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. The Contractor shall notify the Engineer a minimum of seven (7) business days prior to the phases of work described in the Ice Rink General Requirements Section. Piping shall not be covered without notifying the Engineer.

**3.2 EXCAVATION AND BACKFILL**

- A. The Contractor shall be responsible for verifying the location of all existing piping, electrical, and other utilities prior to excavation.
- B. Benchmark: Contractor shall provide an elevation survey of the existing perimeter concrete, every 10 linear feet, to the Engineer. The Engineer will review and determine the best location for a benchmark.
- C. Excavation: All excavation shall be performed in accordance with OSHA regulations, to the depths shown on the drawings, and to the tolerances specified in the table below.

1.

A	T
Pipe trenches and non-rink floor areas	/- 0.03 feet (3/8")
Rink floor subgrade for rink floor with a subfloor heating system	/- 0.05 feet (5/8")
Rink floor subgrade for rink floor without a subfloor heating system	/- 0.015 feet (3/16")

- D. Verification Surveys and Measurements: The ice rink contractor shall provide verification surveys in the following areas. Submit surveys and measurements to Engineer for review prior to installation of new rink floor system.

1. Perimeter concrete.

- a. Survey top of perimeter concrete within 2" of the rink floor edge every 10 feet around the entire perimeter of the rink floor. This information will be used by the Engineer to establish a benchmark to construct the rink floor.
- b. Measure ice rink floor opening to perimeter concrete at the following locations.
  - i. Length. Provide 2 measurements each from radius point to radius point across the rink floor. 2 measurements total.
  - ii. Width. Take 2 measurements each from radius point to radius point across the rink floor and one at center of rink floor (center ice). 3 measurements total.
  - iii. Radius. Provide measurement of each radius. 4 measurements total.

2. Subgrade. Prior to the installation of the piping systems for the subfloor heating system, survey a 10-foot x10 foot grid pattern across the entire ice rink floor subgrade and include the benchmark elevation that was established in item 1 above.

3. Top of sand layer. Prior to installation of the floor insulation, survey 10-foot x 10-foot grid pattern across the entire final and finished ice rink floor sand layer for the subfloor heating system and include the benchmark elevation that was established in item 1 above.

- E. Backfilling: All excavated areas shall be backfilled as soon as possible but not before compaction tests have been taken and approved where required. Backfill materials shall be placed in lifts less than 12 inches thick, uniformly compacted and follow the requirements of the geotechnical report, if report is available. Backfilled areas shall be fine graded to the tolerances specified in the table below. Care shall be taken while backfilling to protect the pipe from damage.

A	T
Pipe trenches and non-rink floor areas	/- 0.03 feet (3/8")
Rink floor subgrade for rink floor with a subfloor heating system	/- 0.05 feet (5/8")
Rink floor subgrade for rink floor without a subfloor heating system	/- 0.015 feet (3/16")
Rink floor subfloor heating system sand layer	/- 0.015 feet (3/16")
Rink floor sand (for sand floors only)	/- 0.015 feet (3/16")

- F. Compaction: Backfill material shall be uniformly compacted to the densities shown in the table below.

A	S	P	D
Pipe trenches within building footprint and other structural areas	98%		
Rink floor subgrade (below subfloor heating system)	98%		
Rink floor subfloor heating system sand layers 6" thick or less	95%		
Rink floor sand (for sand floors only)	95%		

### 3.3 INSTALLATION OF PIPE

- A. No changes to pipe alignment or elevation shall be made without approval from the Engineer.
- B. All pipe shall be cleaned out prior to installation. Inspect pipe for defects and damage.
- C. Buried piping shall be bedded in material recommended by the pipe manufacturer.
- D. Support rink and header piping systems as shown on the drawings. Provide additional supports for the rink piping system, over the header trench, as necessary to prevent deflection of piping systems during construction and during the concrete pour.
- E. Support all piping in such a manner as to prevent all vibration and vertical or horizontal movement.
- F. For polyethylene pipe, butt or socket fusion welds shall be used to connect pipe and fittings. Electro fusion welded couplings should only be used where it is not possible to make a butt and socket weld due to space constraints. In addition, electro fusion welded couplings and fittings shall not be used in the following locations:
1. In or beneath the ice rink floor system. This includes, but is not limited to, the header pipe systems for both the rink floor and subfloor systems and the rink floor and subfloor piping systems.
  2. Under permanent bleacher systems except where transmission mains connect to header pipe outside of the rink floor perimeter.
  3. Above ground piping systems.

### 3.4 INSULATION JACKETING AND VAPOR BARRIER

- A. Install floor insulation with staggered joints as required on the drawings. Ends shall be tightly butted together and secured. All cuts must be performed with a sharp-edged tool.
- B. Install vapor barrier over insulation with a minimum of 18" overlap at all joints. All joints shall be taped.
- C. Install pipe insulation on transmission mains as specified.

### 3.5 PIPE AND REBAR SUPPORT CHAIR

- A. Install as shown on the drawings.
- B. Additional supports shall be placed as close to the ice rink piping return bends as possible.

### 3.6 REINFORCEMENT

- A. Reinforcement shall be installed as shown in the drawings.
- B. Installation shall meet ACI 315. Reinforcement shall be installed with a minimum of 2" of cover unless otherwise noted on the drawings. Adequately support reinforcement with support chair where specified and concrete blocks. Terminate rebar 2" from the rink edge.

- C. Splices shall be installed with minimum lapping distances shown on the plans and bars wired tightly together. If lapping distances are not shown on the plans the following lapping distances shall apply.

R □□□□□□□□ □□□ B □□ S □□□	L □□ S □□□□□ (□□□□□)	90° H □□□□ E □□
#4	25	8
#5	31	10
#6	37	12

- D. Wire mesh shall be placed over rink piping. The loose ends of the wire mesh shall be bent down. The wire mesh sheets shall be overlapped by a minimum of 6" and wired securely to the reinforcement bars at a minimum of 18" on center or as noted on drawings (whichever is the tighter spacing) in both directions and along all edges of mesh. Consider securing to pipe chairs as well to prevent floating of piping system during the concrete pour especially if air is used for testing the piping system. The mesh shall be tightly wired down in all locations. Terminate mesh 2" from the rink edge. Turn all wires down. Contractors shall monitor the location of the wire mesh throughout the concrete placement and finishing processes and provide additional securing as needed.

**3.7 PIPE AND FITTINGS**

- A. All sub-floor heating and rink piping shall be continuous. There shall be no joints, splices or additional fittings other than were indicated on the drawings. Header and transmission main piping shall be supplied in typical lengths.
- B. All piping and fittings shall be connected by fusion welding. Contractor shall perform and demonstrate in the field, by personal that will be working on this project, for the Engineer prior to placement of polyethylene pipe. Submit two (2) samples of a typical fusion welded joint from the demonstration.
- C. All connections to the header pipe shall be at a 90-degree angle to the header pipe. No connections shall be made at an angle.
- D. Contractor shall inspect the interior and exterior of all butt and socket joints wherever possible to assure there are no blockages and that joints are formed to manufacturer's specifications.
- E. Fasten rink piping to chair supports with specified nylon ties as necessary to secure pipe in position. Varying temperatures may require less restrictions to allow pipe to move. End of ties shall be turned downward.
- F. Placement:
  - 1. Rink piping shall be installed within +/- 3/16" of the elevation shown on the drawings. Shims shall be used to adjust pipe elevations if necessary.
  - 2. Verification Surveys and Measurements:
    - a. Surveys. When rink piping installation is complete the Contractor shall provide a survey of the top of the rink pipe. The survey shall be performed by an independent surveying company and signed by a professional engineer or registered land surveyor licensed in the state of the project. The survey equipment used must have recent documented certification of calibration and must be of the highest accuracy to document the very tight tolerances specified for this work. At minimum, the survey locations shall include the following:
      - 1) Top of rink pipe in an 8-foot x 8-foot grid pattern over the entire rink surface.
      - 2) In addition, top of rink pipe at supply and return headers (next to elbow or tee fitting) at an 8-foot spacing.
      - 3) In addition, the top of rink pipe along radii and ends of rink at a 8-foot spacing, 1 foot from edge of perimeter concrete.
      - 4) In addition, the top of rink pipe along the row of support chairs on each side of the header trench at a 8-foot spacing.

- 5) In addition, perimeter concrete at edge of rink floor every 20 linear feet around entire perimeter of concrete.
- 6) In addition, the top of each floor insert (Circus Anchors, Tennis, etc.)

The information shall be recorded and submitted to the engineer clearly showing top of pipe elevation in reference to the top of concrete elevation and the difference between the two elevations. The survey shall be completed in adequate time for the Engineer to verify the information and the Contractor to make adjustments prior to the concrete pour.

3. Goal insert locations. Provide measurements of each goal insert from center ice, from end of rink, and distance between inserts. 5 measurements total
  4. Cleaning and Flushing: Thoroughly flush and clean all piping systems prior to installation and before installation of secondary refrigerants. Remove all water or other fluids used during the cleaning and flushing procedures. The Engineer shall be notified prior to any final cleaning or flushing.
- G. Testing:
1. The entire sub-floor heating system including the headers and transmission mains and the entire rink piping system including the header and transmission mains shall be hydrostatically tested as two separate systems at 100 psi each for the first four (4) hours and reduced to 60 psi for an additional 20 hours with no pressure drop at either setting and in accordance with ASTM F2164-21 Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure. While each test is being set up the Contractor will likely need to add water for the first 2 to 3 hours as the pipe may stretch slightly. Each test shall not begin until the Contractor is confident all air is removed from the system and the system is completely filled with water. An Owner's representative shall witness and approve the test.
  2. Once the initial testing is approved, the pressure shall be lowered to 50 psi and maintained until 48 hours after the sand and concrete placement is complete.
  3. Gauges used for pressure tests must be designed for pressures greater than the test pressure. For example, a 100-psi gauge cannot be used for a 100-psi test. The scale on the gauge must be the next increment up from 100 psi.
  4. The insulation systems shall not be installed on the piping until the testing has been accepted.
- H. Fill sub-floor piping system with glycol solution specified in Section 131815 - Ice Rink Waste Heat Recovery Systems. Fill rink piping system with secondary refrigerant as specified in Section 131812 - Ice Rink Refrigeration System.

### 3.8 COMPRESSION SEAL AND EXPANSION JOINT MATERIAL

- A. Install extruded polystyrene insulation (thickness of expansion joint by depth of rink floor) in one piece with top scored to depth of expansion joint material or as recommended by the manufacturer.
- B. After concrete has been placed and cured, remove the top piece of insulation.
- C. Clean all dirt, debris and water from space between perimeter concrete and rink floor using a brush, vacuum or compressed air and as recommended by the manufacturer.
- D. Install when concrete substrate is clean, sound, dry and cured for a minimum of 14 days and as recommended by the manufacturer.
- E. Install the compression seal material in longest pieces possible and as recommended by the manufacturer. A series of small sections will not be accepted.
- F. Install adhesive per manufacturer's recommendations. Do not allow to freeze prior to installation. Store all components out of direct sunlight in a clean, dry location between 50 F and 90 F.

- G. Install adhesive per manufacturer's recommendations.
- H. Install compression seal per manufacturer's recommendations.

### 3.9 CONCRETE WORK

#### A. Quality Control:

1. A prepour meeting will be scheduled with the Engineer or Owner's representative to discuss the methods of placement, equipment, and quality control procedures.
2. A benchmark shall be approved by the Engineer prior to starting the pour.
3. The survey of the rink floor piping must be approved by the Engineer prior to concrete placement.
4. Prior to placement, an inspection of the rink floor shall be conducted and all debris, soil, trash, and standing water shall be removed before placement begins.
5. Concrete shall not be placed until authorized by the Engineer or the Owner's representative.
6. At least two (2) standby concrete trucks shall be available in case of equipment failure or loads are rejected.
7. Standby pumping equipment shall be on-site in case primary pumping equipment fails. Hand pushed wheelbarrows will not be accepted.
8. An extra vibrator shall be kept on-site.
9. The concrete placement for the rink floor shall take place as one continuous pour from start to finish. Method of placement, leveling, finishing and curing shall be approved by the Engineer and the Contractor responsible for the ice rink work.
10. Quality control personnel from the ready-mix company, HRWRA admixture supplier and the Contractor shall be present during the pour.
11. All concrete not meeting the approved design mix parameters will be rejected.
12. Testing:
  - a. Contractor shall hire a testing agency to perform the following tests and shall pay for all testing and laboratory costs.
  - b. Temperature: Measure the concrete temperature for each truck.
  - c. Slump: Measure the slump before and after adding the High Range Water Reducing Admixture (HRWRA)/Super Plasticizer for each truck. Tests shall be performed in accordance with ASTM C143.
  - d. Air Content: Tests shall be taken before and after adding the High Range Water Reducing Admixture (HRWRA)/Super Plasticizer during casting of cylinders. Tests shall be performed in accordance with ASTM C231.
  - e. Compressive Strength:
    - 1) Make and cure at least one (1) set of test cylinders, consisting of four (4) individual cylinders, for every 50 cubic yards of concrete placed or fraction thereof. Test specimens and testing shall be performed in accordance with ASTM C31 and ASTM C39.
    - 2) For each set of cylinders, test one specimen at seven (7) days, two specimens at twenty-eight (28) days and one hold. Acceptance shall be based on the average of the two 28-day tests.
  - f. All sampling and tests shall be taken at the point of placement unless otherwise specified.
  - g. An electronic copy of the test results shall be submitted to the Engineer as soon as the tests are completed.

#### B. Placement:

1. All concrete shall be placed and consolidated in accordance with ACI 304 (measuring, mixing, transporting), 305 (hot weather) and 306 (cold weather).
2. The method and manner of placing the concrete shall be such as to minimize the possibility of segregation of the aggregate, the displacement of the reinforcement, pipe or supports and damage to the floor insulation. Place concrete as near to the final position as possible. The

vibrator shall not be used to transport or to flow concrete to the extents that causes segregation.

3. The pumping equipment used for conveyance of concrete the equipment shall be suitable for this type of work and have adequate capacity for the work. The pump shall be operated such that a continuous stream of concrete without air pockets is produced.
4. Proper precautions shall be taken to prevent the polyethylene headers from floating up during the pour.
5. Concrete shall be placed in maximum 12" layers in the header trench. Each layer shall be adequately consolidated before the next layer is placed.
6. Mechanical vibration shall be used to consolidate the concrete. Provide and use two (2) vibrators during the pour. Vibrators shall be capable of operating at frequencies sufficient to achieve thorough and uniform consolidation, but not less than 7000 impulses per minute. Methods such as spading shall be used to consolidate concrete in locations where it's impossible to reach with a vibrator. Vibration shall not be applied directly to the reinforcement or piping. Placement and duration of the vibration shall be such to thoroughly consolidate the concrete without causing segregation or localized areas of grout.
7. Bridge screeds or super screeds shall not be used.
8. Concrete that has been contaminated by foreign materials shall not be deposited or shall be removed from the rink area. Concrete that has been partially hardened shall not be reworked or re-tempered and shall be removed from the rink area.

C. Finishing:

1. Immediately after placement and consolidation, the concrete shall be struck off, screeded, and leveled to the required elevation. Begin floating when the surface is ready and bleed water is no longer visible. Floating may be conducted either by hand or with a machine. Check for levelness, fill or cut as necessary, and refloat surface to a smooth, uniform, granular texture.
2. Chemical finishing aids or fogging system shall be used at the Contractor's discretion to prevent rapid surface moisture loss. Water shall not be added to the concrete at any time.
3. After floating, apply a trowel finish using a power-driven trowel. The Contractor shall determine the time to start troweling. Perform final troweling by a combination of hand and power-driven trowels, leaving the surface free of marks, and uniform in appearance and texture. Provide a smooth surface.
4. The perimeter edge of the rink floor, adjacent to the expansion joint, shall be edged or chamfered to 1/4" radius.
5. Surface Tolerance:
  - a. The top of slab elevation for the rink shall be continuously checked by the Contractor throughout the finishing operation with survey equipment.
  - b. The final concrete surface elevation shall be within +/- 3/16" from a true level plane.

D. Concrete Surface Verification Survey

1. When concrete placement installation for the rink floor is complete the Contractor shall provide a survey of the concrete surface. The survey shall be performed by an independent surveying company and signed by a professional engineer or registered land surveyor licensed in the state of the project. At minimum, the survey locations shall include the following:
  - a. Top of concrete rink floor in a 8-foot x 8-foot grid pattern over the entire rink surface.
  - b. In addition, survey along radii and ends of rink at a 8-foot spacing, 1 foot from edge of perimeter concrete.
2. The information shall be recorded and submitted to the engineer clearly showing the top of concrete elevation in reference to the benchmark used to build the rink floor and the difference between the two elevations. The survey shall be completed the same day as the rink pour and according to ASTM and ACI standards.
3. Concrete Surface Survey (FF/FL): When concrete placement installation for the rink floor is complete the Contractor shall provide a floor profile of the concrete surface using a Floor



Dipstick measurement device or equal that provides instant FF & FL values and floor profiles. The profile/survey shall be performed by an independent testing company and signed by a professional engineer licensed in the state of the project.

The information shall be recorded and submitted to the engineer as a nicely formatted report showing combined section FF and FL numbers and a project summary report for the entire ice rink floor surface in accordance with ASTM E-1155.

- E. Curing: After finishing and as soon as possible provide a wet cure for a minimum of 14 days by covering the entire surface with curing blankets. The curing blankets shall be installed to prevent air pockets and discoloration in the concrete surface. The Contractor is responsible for maintaining the wet condition for the entire 14 days. The curing blankets shall be removed all at one time to avoid potential damage due to differential shrinkage. Approved manufacturers: Ultra Cure by McTech Group, Hydrocure by PNA Construction Technologies or equal. Polyethylene sheeting is not approved.
- F. The concrete floor shall not be refrigerated or open to equipment traffic for 28 days from time of pour. See startup procedures in the Ice Rink General Requirements Section.
- G. Liquid Hardener:
  - 1. A liquid hardener shall be uniformly applied to the surface of the ice rink floor and as recommended by the manufacturer.

### **3.13 TEMPERATURE SENSORS**

- A. Install temperature sensors in accordance with manufacturer's recommendations. Sub-soil temperature sensor shall be installed to 1'-6" depth to bottom of sensor. For each sensor, the top of the box cover shall be even with the top of the ice rink slab for easy access and sensor replacement.

### **3.14 FLOOR INSERTS**

- A. Install inserts at the locations shown on the drawings. Inserts shall be carefully lined and leveled with transit before placing concrete for the rink floor.
- B. Brass plugs should be installed prior to concrete placement. Grease top of plug.

### **3.15 CLEANING**

- A. The ice rink floor shall be completely cleaned of all debris, spills, stains, etc. If requested by the Engineer, the contractor shall wash and mop the entire floor to assure the floor is clean.
- B. Clean all other material, equipment, and debris from other areas of the building on a daily basis and thoroughly clean at the end of the project.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 13 18 14 - ICE RINK PIPING VALVES AND ACCESSORIES****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Pipe and Fittings.
- B. Valves and Accessories.
- C. Pipe Hangers.
- D. Pipe and Equipment Markers.
- E. Expansion Tank.
- F. Pressure Gauges.
- G. Thermometers.
- H. Insulation.
- I. Sealing and Firestopping.

**1.2 RELATED SECTIONS**

- A. Division 0, Division 1, General and Supplementary Conditions.
- B. Section 131811 - Ice Rink General Requirements.
- C. Section 131812 - Ice Rink Refrigeration System.
- D. Section 131813 - Ice Rink Floor System.
- E. Section 131815 - Ice Rink Waste Heat Recovery Systems.
- F. Section 131817 – Ice Rink Central Control System.

**1.3 SUBMITTALS**

- A. Shop Drawings. All submittals shall conform to the requirements of the General Conditions and Section 131811 - Ice Rink General Requirements.

**1.4 WARRANTY GUARANTY**

- A. As required in Section 131811 - Ice Rink General Requirements.

**1.5 PRODUCT DELIVERY STORAGE AND HANDLING REQUIREMENTS**

- A. As required in Section 131811 - Ice Rink General Requirements.

**PART 2 - PRODUCTS****2.1 PIPE AND FITTINGS**

- A. Polyethylene.
  - 1. Subfloor pipe and transmission mains. As specified in Section 131813 – Ice Rink Floor System.

- B. Steel.
1. Primary and secondary refrigerant piping.
  2. Material shall be carbon steel and meet the following:
    - a. Pipe smaller than 1 □ inches diameter shall conform to ASTM A106, Grade B, Schedule 80. Schedule 40 steel may be used for R-22 liquid refrigerant lines for piping sizes 6 inches and smaller and R-717 refrigerant liquid lines 2 inches through 6 inches and all suction and discharge line 6 inches.
    - b. 1 3/4 inch to 12 inches diameter shall conform to ASTM A53, Grade B Schedule 40.
    - c. Larger than 12 inches diameter shall conform to ASTM A53, Grade B Schedule 40.
    - d. Type F steel shall not be used for refrigerant lines except when discharging to atmosphere.
  3. Joints shall be welded end type. No threaded joints.
  4. Fittings shall be carbon steel with welded end type and shall meet ANSI B16.9. Fittings shall be manufactured and not shop or field fabricated.
  5. Flanges shall be of the same material as the pipe and shall be rated for a minimum of 150 psi. Shall meet ANSI B16.5
- C. PVC
1. Drain lines where noted.
  2. Shall be Schedule 40, virgin polyvinyl chloride, with maximum operating and required minimum bursting pressures at 73 degrees F for PVC piping and fittings per ASTM D1785 "Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe. Fittings and flanges shall be the same grade and class of pipe. Solvent welded joints using heavy bodied or heavy-duty cement.

## 2.2 VALVES AND ACCESSORIES

- A. Primary Refrigerant Valves and Accessories
1. Approved Manufacturers: Hansen Technologies, Henry, Refrigeration Specialties, Cyrus Shank Company, Parker, Danfoss, or equal.
  2. Minimum working pressure rating: 400 psig.
  3. Body: Heavy duty ductile iron, cast steel.
  4. Internal parts: Stainless steel.
  5. Gaskets and Seats: Neoprene O-rings or flat composite gaskets, Teflon seats.
  6. Packing nut and hand wheel: Zinc chromate plated steel.
  7. Pressure relief valves to meet requirements of Section IV of the ASME Boiler and Pressure Vessel Code. Maximum release pressure should match vessel pressure rating. Provide discharge indicator such as Pop Eye by Hanson Technologies or equal. Secondary side (glycol/brine) should be set at 150 psi unless otherwise stated.
  8. Refrigerant Strainers: Shall include stainless steel screen and body. Shall be easily serviceable in-line.
  9. Filter Dryer: Steel shell with corrosion resistant finish, aluminum cover plate with 1/8" FPT connection for valve, and copper fittings.
  10. All hand expansion valves, solenoid valves, and regulators shall be supplied with seal caps on the adjusting stem.
  11. Check valves: Shall be Hansen HCK4 LR Gravity Drain check valves for low pressure drop applications of 0.25 psid, Danfoss, or equal.
  12. Solenoid Valves: Shall be Hansen Model HS4A, Danfoss or equal. Piston and spring mechanism shall be pressure operated. Valves using plunger-needle type assemblies shall not be used."
  13. Pressure Regulating Valve(s): Shall be Hansen Standard Regulator HA4A, Danfoss, or equal. The pressure regulating valve for the compressor discharge line(s) shall include a high range (up to 185 psi) spring assembly.
  14. 3-Way Oil Temperature Valve: shall be Hansen HOTV/HOTW or equal.

15. Liquid Level Float Switch (High Level):
    - a. Approved Manufacturers: Phillips Refrigeration, Parker, Danfoss, or equal
    - b. Operating temperature: -50F to 150 F.
    - c. Float chamber: zinc plated
    - d. 10-amp Single pole, double throw switch, hermetically sealed, magnetically actuated.
    - e. Standard DIN connector with 15' cable.
    - f. Housing interchangeable with RS LL float switch.
  16. Adjustable Level Controllers and External Level Column Systems: Shall be Hansen Vari-Level or equal. System shall include, but not limited to; adjustable control unit with Teflon encased stainless steel sensing principle and control cable, level column with site glasses (minimum of 4 positioned at 6" on center), probe, valve position indicator, isolation valves. Probes shall be full length of the columns.
  17. Automatic Expansion Valve: Shall be Hansen Motorized Control Valve and Controller Model MCV, equal by Danfoss, or equal. Provide optional power close feature, remote mounted valve position indicator, Teflon seat, non-electric rotor enclosed in stainless steel case."
- B. Secondary Refrigerant Valves and Accessories
1. Approved Manufacturers: Apollo, Aurora, Bell & Gossett, Crane, Flowseal, Milwaukee, Mueller, Nibco, Stockham or equal.
  2. Minimum working pressure rating: 125 psig
  3. Provide valve neck extensions where needed.
  4. Butterfly Valves: Cast iron or ductile iron (ASTM A536) body; Ni-coated duction iron or 316 stainless steel disc; 416 stainless steel stem; EPDM/Buna-N/Teflon/Viton resilient seat; Teflon (PTFE) stem bushing; 316 stainless steel disc screws; EPDM or Buna-N O-Rings.
  5. Check Valves: Non-slam design; cast iron body, bonnet, disc plate, and disc cage meeting ASTM A-126 Class B.
  6. Combination Valves: Operates as a non-slam check valve, shutoff valve and throttling valve. Cast iron body.
  7. Ball Valves: Bronze body, 316 stainless-steel ball, Teflon seats.
  8. Air Release Valves: Cast iron or bronze body. Provide ball valve and drain line to floor. Include 1/2" FPT and 3/4" MPT connections.
  9. 3-Way Mixing Valves: Cast iron body, flanged. Controls to operate valve based on fluid temperature.
  10. Poly to Steel Transition Fittings:
    - a. Approved manufacturers: Krausz USA (Hymax Cplg), Polycam
  11. Suction Diffuser/Strainer:
    - a. Body and Cover: Cast iron, ASTM A48, flanged.
    - b. Vanes & Orifice Cyl: Steel for glycol systems  
Stainless steel for calcium chloride systems.
    - c. Strainer: 5/32" perforated, 304 stainless steel.
    - d. Start-up Screen: 20 mesh, 304 stainless steel.
    - e. O-ring: Buna-N
    - f. Purge/Drain Plug: Wrought steel or Cast Carbon Steel
    - g. Cap Screws: Wrought steel, SAE Grade 5
    - h. Pipe Supports: Steel, adjustable
  12. Flexible Connectors: 150 lb plate or carbon steel - flat face type, flexible stainless-steel hose and braid material.
  13. Flow Switch or Differential Pressure Switch:
    - a. Approved manufacturers: Johnson Controls, Penn by Johnson Controls, United Electric Controls, Hansen, IFM, or equal.
    - b. Must be compatible with the system fluid.
    - c. Enclosure: NEMA Type 4.
    - d. Gold-plated contacts for improved electrical performance.
    - e. Stainless steel paddle or opposing metal bellows (seal bellows) to detect pressure differences between two sources.

- f. Adjustable set points.
- g. Epoxy coated enclosure.
- 14. Resistance Temperature Detectors (RTD) Assemblies:
  - a. Approved manufactures: Omega, JW Instruments (763.784.5708) or equal.
  - b. RTD: Single Element, platinum, 3 wire, Tolerance Class A, 316 stainless steel sheath. Length to be at approximately 10% longer than radius of pipe.
  - c. Temperature Ranges:
    - 1) Return brine/glycol: 0-50F
    - 2) Others: As required.
  - d. Spring loaded.
  - e. NPT stainless steel hex nipple.
  - f. Aluminum screw cover head – NEMA 4X rated.
  - g. Signal: 4 to 20 mA programmable temperature transmitter, upscale burnout, temperature range to match RTD.
- 15. Thermowell: Shall be standard duty threaded (NPT), 304 stainless steel, NPT size as required to accommodate RTD.
  - a. Shall coordinate type of RTD and transmitter with controls, VFD or other device that is being connected to RTD Assembly.
- C. Valve Tags
  - 1. Provide non-ferrous metal or plastic laminated tags on each valve with non-ferrous or corrosion proof fasteners. Numbering system shall be referenced in the Operation and Maintenance Manual.

### 2.3 PIPE HANGERS AND SUPPORTS

- A. Approved Manufacturers: Anvil International, Crane, Red Head, or equal.
- B. Provide a complete pipe support system including hangers, supports, brackets, guides and anchors even if not specifically shown on the drawings. All supports shall conform to the latest requirements of ASME Code for Pressure Piping B31.1 and MSS Standard Practice SP-58, SP-69, SP-89 and SP-90.
- C. Pipe hangers shall be capable of supporting the pipe in all conditions of operation without transferring excessive stress to the pipe.
- D. Supports shall fit adequately over insulation. Provide 12 gage pipe saddles and inserts of high-density block insulation.
- E. Supports shall not be connected to factory provided framework for equipment.
- F. Exterior pipe supports shall be galvanized steel.

### 2.4 PIPE AND EQUIPMENT MARKERS

- A. All pipe and equipment markers shall conform to IIAR Bulletin No. 114 (most recent edition): Guidelines for Identification of Ammonia Refrigeration Piping and System Components.

### 2.5 EXPANSION TANK (FOR RINK FLOOR PIPING)

- A. Approved Manufacturers: Aurora, Xylem Inc. Bell and Gossett, John Wood Company, H.A. Phillips, Armstrong, or equal.
- B. Capacity: Horizontal compression tank. See capacity in Ice Equipment Schedule on drawings.

- C. Materials: Pressure rating of 125 psig in accordance with Section VIII, Division 1, of the ASME Boiler Pressure Vessel Code, and registered with the National Board of Boiler Pressure Vessel Inspectors.
- D. Accessories: Liquid level gauge assembly by Apollo Valve or equal and shall include gauge glass, drain valve, glass protector and shut off valves. Air control fitting equal to Xylem Inc. Bell and Gossett tank fitting and ATFL including brass vent tube plug and stainless-steel ball check.
- E. Tank shall be painted with one coat of primer and one coat of enamel.

## 2.6 PRESSURE GAUGES

- A. Approved Manufacturers: McDaniel, Ashcroft or equal.
- B. Materials and Accessories: Shall have stainless steel case, minimum 4" diameter, bourdon tube type, liquid filled, 1% scale accuracy over entire range of gauge, 1/2" minimum diameter stainless steel sockets. Provide ball valve and snubber for each gauge. Provide 1/2" minimum diameter steel pipe extension to extend ball valve outside of pipe insulation. Steel pipe and ball valve specified elsewhere in the specifications.
- C. Sizes: Scaled from 0 to 50 psi for snowmelt, sub-floor, and water systems. Scaled from 0 to 100 psi for all other systems.

## 2.7 THERMOMETERS

- A. Approved Manufacturers: Weksler, Trerice or equal.
- B. Materials. Round, bimetal thermometer style using bimetallic sensing element, sensing element consisting of two dissimilar metals, stainless steel stem, highly polished type 300 stainless 4" diameter steel case, adjustable angle, silicone dampened coil, dial pointer, stainless steel stems, non-breakable double strength glass window, accuracy to  $\pm 1.0\%$  full scale ASME B40.3 Grade A, external reset.
- C. Materials: Adjustable base, plastic case, non-breakable window, accuracy of one scale division. Temperature wells to have copper bulbs.
- D. Size: scale ranging from -40 F to 110 F.

## 2.8 INSULATION

- A. Pipe and equipment insulation system.
- B. See Insulation Schedule on drawings for required thickness, type and location.
- C. Insulation and Jacket Type:
  - 1. Materials: Shall be composite insulation system including insulation, jacket (as specified for specific application), and all sealants and shall have a flame spread rating of 25 or less and a smoke development rating of 50 or less. Shall be puncture resistant based on ASTM D-781, moisture and mildew resistant and vermin proof. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.
  - 2. Fittings. All fittings shall be preformed from the factory and match the insulation material, thickness, etc. Field fabricated insulation sections for fittings is not allowed.
  - 3. Type 3 Insulation (exposed, interior of building) - Flexible Elastomeric Thermal Pipe Insulation by Armaflex or equal.
    - a. Jacketing: None.
  - 4. Type 5 Insulation (exposed, interior and exterior of building) – Dow XPS Styrofoam, Certainteed, Owens-Corning, Pittsburgh Corning, Extrol, Fibrex, H.B. Fuller, or equal.
    - a. Insulation shall meet the following properties:

P	V
Density, ASTM D1622, minimum	1.6 lbs/cf
Compressive Strength ASTM D1621, minimum	20 lb/sq. in
K-factor, ASTM C518	0.259 btu-in/hr-cf-F
Water Absorption, % by volume ASTM C272/D2842, max.	0.5/1.0 %
Water Vapor Permeability, ASTM E96, max.	1.5 perm-inch

- b. Jacketing (exposed, interior of building):
  - 1) PVC material with thickness of 20 mils, gloss finish on one side, semi-gloss on other side, FS LP-535D. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet radiation or installed outdoors. Jackets shall be rated for 0 F to 150 F with maximum flame spread rating of 25 meeting ASTM E-84 and maximum smoke development rating of 50 meeting ASTM E-84.
  - 2) Type: Composition A, Type II, Grade GU, jacketing shall meet above requirements. Type 3 jacketing shall meet ASTM D-1784, Grade 1, and high impact in addition to the above requirements.
- c. Jacketing (exposed, exterior of building and vertical pipe chase applications):
  - 1) Aluminum material alloy 3003, 1100, or 3105 meeting ASTM B-209 with H-14 temper, 20 mil, smooth finish, white painted aluminum. UV protected. Jacketing shall have no paper to retain moisture.
  - 2) Provide Polysurlyn moisture barrier with a minimum thickness of 2.5 mil. Dupont, Dow Saran or equal.
  - 3) Banding shall be 0.020" thick by 1/2" wide, 300 series, stainless steel.
  - 4) Aluminum jacketing for fittings, tees, elbows, valves, caps, etc. shall be sectional, factory contoured, to fit closely around insulation.

5. Type 5A (direct bury interior and exterior applications) – FoamGlas by Owens Corning or equal.

a. Insulation shall meet the following properties:

P	V
Density, ASTM C303, minimum	7.18 lbs/cf
Compressive Strength C165/C240/C552, minimum	90 lb/sq. in
K-factor, ASTM C518, C177 at 0F	0.250 btu-in/hr-cf-F
Water Absorption, % by volume ASTM C240, max.	0.2% by Vol
Water Vapor Permeability, ASTM E 96 West Cup, max.	0.0 perm-inch

- b. Jacketing:
  - 1) Approved manufacturers: Pittwrap SS by Pittsburgh Corning or equal. Insulrap 50-SJ-NG is not considered an equal.
  - 2) Modified bituminous membrane.
  - 3) Self-healing material
  - 4) Overlap shall be a minimum of 50%.
  - 5) Apply in temperatures above 50F.
  - 6) Properties:

P	V
Thickness (mils), minimum	70
Permeability, ASTM E96 (perm-inches), max.	.002
Tensile Strength, ASTM D882 (at 78F), min.	1150 lbs/in
Puncture Resistant, ASTM E154, min.	199 lbs

6. Type 5B (direct bury interior and exterior applications) Composite Piping System

- a. **HDPE** such as Tricon Piping Systems, Inc., Energy Task Force Pre-Insulated Pipe or equal. Piping material shall meet the pipe specifications for this project. Shall use HDPE jacket as specified below.
- b. Closed cell polyurethane foam insulation. Foamed in place.



c. Insulation shall meet the following properties:

P	V
Density, ASTM D1622, minimum	2.0 lbs/cf
Closed Cell, minimum	90-95%
K-factor, ASTM C177	0.147 btu-in/hr-sf-F

d. Jacketing

- 1) Direct Bury, Interior and Exterior of Building for Composite Piping Systems:
- 2) Approved manufacturers: Tricon Piping Systems, Inc. or equal.
- 3) HDPE materials.
- 4) Must be applied with manufacturers recommended shrink sleeve material connecting pipe section for waterproof application. No substitutions.
- 5) Properties:

P	V
Resin, ASTM D3350	Type III, Grade P34
Tensile Strength, ASTM D638(at 78F), min.	3300 psi
Ultimate Elongation, ASTM D638 min.	850%
Tangent Flexural Modules, ASTM D790, min.	175,000 psi

D. Insulation Inserts and Pipe Shields

1. Approved Manufacturers: B-Line, Pipe Shields, Value Engineered Products or equal.
2. Construct inserts with calcium silicate, minimum 140 psi compressive strength. Piping 12” and larger, supplement with high density 600 psi structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be a minimum 180 degrees coverage on bottom supported piping and full 360 degrees coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution steel plate. On low temperature systems, extruded polystyrene may be substituted for calcium silicate provided insert and shield length and gauge are increased to compensate for lower insulation compressive strength.
3. Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thickness, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered/pre-manufactured product described above.
4. Precompressed 20 lb density molded fiberglass blocks, Hamfab or equal, of the same thickness as adjacent insulation may be substituted for calcium silicate inserts with a 1” x 6” block for piping through 2 ½” and three 1” x 6” blocks for piping through 4”. Submit shield schedule to demonstrate equivalency to pre-engineered/pre-manufactured product described above.
5. Wood blocks will not be accepted.

E. Accessories:

1. Provide all adhesive, sealants, protective finishes, and other products as recommended by the manufacturer to provide a completely sealed system.
2. Provide vapor barrier that is non-flammable, fire resistant and polymeric resin, for all systems operating below 65 F.
3. Insulation bands shall be □ inches wide, constructed of aluminum or stainless steel. Minimum thickness to be 0.015 inches for aluminum and 0.010 inches for stainless steel.
4. Tack fasteners shall be stainless steel ring grooved shank tacks.
5. Staples shall be clinch style.
6. Insulating cement shall meet ANSI/ASTM C195, hydraulic setting mineral wool. Finishing cement shall meet ASTM C449.
7. Bedding compounds to be non-flammable, fire resistant, polymeric resin.

**2.9 SEALANT AND FIRESTOPPING**

- A. Sealant and fire stopping of sleeves and openings between ductwork, piping, etc. and the sleeve, structural or partition opening shall be the responsibility of the contractor.
- B. Fire and/or Smoke Rated Penetrations:
  - 1. Approved Manufacturers: 3M, Hilti, Rectorseal, STI/SpecSeal, Tremco, or equal.
  - 2. All fire stopping systems shall be provided by the same manufacturer.
  - 3. Fire stop systems shall be UL listed or tested by an independent testing laboratory approved by the State.
  - 4. Use a product that has a rating not less than the rating of the wall or floor being penetrated.
  - 5. Contractor shall use firestop putty, caulk sealant, intumescent wrap strips, intumescent firestop collars, firestop blocks, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.
- C. Non-rated Penetrations:
  - 1. Pipe Penetrations Through Below Grade Walls. In exterior wall openings below grade, use a modular mechanical-type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated pipe and the cored opening or a water-stop type wall sleeve.
  - 2. Pipe Penetrations. At pipe penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between pipe insulation and sleeve.

### **PART 3 - EXECUTION**

#### **3.1 EXCAVATION INSTALLATION OF PIPE AND BACKFILLING**

- A. The Contractor shall be responsible for verifying the location of all existing piping, electrical, and other utilities prior to excavation.
- B. No changes to pipe alignment or elevation shall be made without approval from the Engineer.
- C. All pipes shall be cleaned out prior to installation. Inspect pipe for defects and damage.
- D. Decrease line size to pumps as required with long radius reducing elbows or concentric reducers/increasers in vertical piping. All valves and piping specialties must be full line size.
- E. Excavate pipe trenches in accordance with OSHA regulations. All pipe trenches shall be backfilled as soon as possible. Backfill and compact materials in 12" lifts. Care shall be taken while backfilling to protect the pipe from damage. Backfill material for trenches within the building footprint or other structural areas shall be compacted to at least 100% standard moisture density relationship of soils to prevent settlement of the floor slabs.
- F. Support all piping in such a manner as to prevent all vibration and vertical or horizontal movement. All pipe support systems shall be installed to meet local and state code requirements.
- G. Provide all coring drilling required to install piping system through masonry or concrete walls, screen walls, roof structures and other structures as required to install piping systems. Keep holes to minimal size.
- H. Provide all pipe sleeves required for core drilled penetrations.
- I. Relief lines and devices shall be terminated outside of the building in accordance with all current State and Local codes including minimum distance from ground level, openings and exits unless a containment tank is specified.
- J. All refrigerant piping shall be installed, tested and placed in operation per these specifications and the state and local mechanical codes.

- K. All pipe joints erected on site shall be exposed for visual inspection prior to being covered.

**3.2 TESTING OF PIPING SYSTEMS**

- A. All testing shall be witnessed by the Owner Representative. Provide advanced notification to the Owner and Engineer as specified in Section 131811 - Ice Rink General Requirements.
- B. All piping shall be tested prior to insulating and backfilling. Isolate all equipment and any other devices that may be damaged by the pressure test. Testing procedures shall meet all code requirements.

C. Testing Requirements:

- 1. Polyethylene Pipe: Shall be tested as specified in Section 131813 -Ice Rink Floor System.
- 2. Steel Pipe (secondary refrigerant system): Shall be hydrostatically tested at 75 psig for 24 hours with no pressure drop.
- 3. Steel Refrigerant Pipe (Primary refrigerant system):
  - a. Pressure Test: All refrigeration piping systems shall be pressure tested at the pressures stated in the table below with nitrogen gas for 24 hours with no pressure drop. The pressure shall then be lowered to 200 psig and maintained until system is ready to be charged. The test shall not begin until the Contractor is confident all water and contaminants are removed from the system. The Owner or Owner’s representative shall witness the test.

R	P
Ammonia – High side	250 psi
Ammonia – Low side	250 psi

- b. Vacuum Dehydration: After the piping has been tested, a vacuum pump of adequate size shall be connected to the associated piping and allowed or run continuously until a vacuum reading of at least 1000 microns (29.882 in. vacuum) or lower is obtained. This test must be maintained with the pump valved off for at least ten (10) minutes. Provide an absolute pressure gauge for monitoring and use per the manufacturer’s recommendations. The Engineer shall witness the test.
- 4. Gauges used for pressure tests must be designed for pressures greater than the test pressure. For example, a 100-psi gauge cannot be used for a 100-psi test. The scale on the gauge must be the next increment up from 100 psi.

**3.3 CHARGING OF SYSTEMS**

- A. Primary Refrigerant Systems: After all pressure tests and vacuum dehydration testing has passed, the system shall then be fully charged with the specified refrigerant.
- B. Secondary Refrigerant Systems: After all pressure tests have passed the secondary refrigerant systems shall be fully charged with the specified solutions. Remove all air from the systems.
- C. Waste Heat Recovery Systems: After all pressure tests have passed the waste heat recovery systems shall be fully charged with the specified solutions. Remove all air from the systems.

**3.4 VALVES AND ACCESSORIES**

- A. Install valves at the locations shown on the drawings, described in the specifications as required for system operation and maintenance or as required by the manufacturer.
- B. Install all valves so that they can be easily replaced in the future including installing unions and allowing adequate clearance.
- C. Install isolation valves and unions required for isolation and servicing each piece of equipment and system components whether or not they are shown on the drawings.

- D. Install purges and servicing valves on the systems as needed for operating and servicing the system.
- E. Install all valves with adequate clearance around the valve for maintenance.
- F. Install air release valves at all high points in the system whether or not shown on the drawings.
- G. All pressure relief valves shall be located where ambient temperature is normally above 32 F. Pipe all pressure relief piping to within one foot of ice equipment room floor.
- H. Install valves for system drainage at all exposed low points in the system whether or not shown on the drawings.
- I. Provide all power and electrical systems as necessary for operation.
- J. Expansion tank shall be supported from the ceiling or supported with a floor mounted frame system with adequate supports and gauge glass placed in highly visible arrangement. Location to be approved by the General Contractor.
- K. Construction strainers in suction diffusers shall be removed after system start-up.
- L. Install thermowells for all temperature gauges.
- M. Resistance Temperature Detector (RTD) Assemblies
  1. Piping system shall be drained and fluid stored for installation of threadolets to install wells and RTD probes. No hot taps allowed.
  2. For new projects, installation shall be done prior to installation of insulation systems. For renovation projects, remove pipe insulation as necessary for installation of wells and sensors. Reinsulate piping system with like materials to provide a sealed insulation system.
  3. Wire sensors directly to VFD's or other devices.
  4. Refill piping systems. Provide additional fluid as necessary for full system charge. Remove air from system.

### **3.5 GAUGES AND THERMOMETERS**

- A. All gauges and thermometers shall be installed at eye level wherever possible unless specified otherwise and shall be positioned for ease of reading by operation and maintenance staff. All gauges and thermometers shall be calibrated per the manufacturer's recommendations prior to installation.

### **3.6 HANGERS AND SUPPORTS**

- A. The Contractor is responsible for adequately supporting all piping systems and equipment with hangers, floor supports, framing systems and all other components required to adequately support the piping systems and equipment. If supported from the ceiling, the Contractor shall verify that the building structure can support the total weight of all piping and equipment systems where hangers and supports are installed unless otherwise noted on the drawings. If requested, the contractor shall provide calculations, by a registered engineer, to verify construction of hangers and supports is adequate including the building structure they are attached to.
- B. Support all piping in such a manner as to prevent all vibration and vertical or horizontal movement.
- C. Pipe hangers and supports shall be spaced no more than eight (8) feet on center. Provide additional supports by equipment for assistance with equipment maintenance and replacement. Provide sufficient supports near equipment so that temporary supports are not needed to remove and replace equipment or to service and maintain equipment.
- D. All ground supports shall be located so that equipment, valves, etc. are fully accessible for easy maintenance and supports shall not impede the walkways.

- E. Supports shall not be connected to factory provided framework for equipment.

### 3.7 INSULATION AND JACKETS

- A. Furnish and install insulation and jacketing on equipment and piping as noted on the drawings and all other cold surfaces which are part of the system including, but not limited to, chilled water pump bodies, chilled water filter, chemical bypass feeder, etc.
- B. Systems shall not be insulated until an inspection has been completed by the Engineer and pressure tests have been performed and accepted.
- C. All valves, fittings, and accessories connected to pipe and equipment systems shall be insulated and jacketed. Provide handle extensions as required to allow full insulation of valves.
- D. Provide vapor barrier for all systems operating below 65 F.
- E. Install all insulation and jacketing per manufacturer's recommendations. Use full length materials. Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior of insulation. Where a vapor barrier is not required, hangers or supports may be attached directly to piping with insulation completely covering hanger or support and jacket sealed at support rod penetrations. Where riser clamps are required to be attached directly to piping requiring a vapor barrier, extend insulation and vapor barrier jacketing/coating around riser clamp.
- F. Install all jacketing on exposed exterior piping systems with joints at 3 o'clock and 9 o'clock position and jacketing secured with specified banding and seals. Banding shall be installed at a maximum of 9" on center. End joints shall be secured with bands and seals centered directly over joint. Jacketing shall be installed in a manner to shed water and in accordance with the Midwest insulation Contractors Association (M.I.C.A) National Commercial and Industrial Standards. Jacketing shall be caulked before closing and banding and positioned in an orientation to avoid water infiltration.
- G. All insulation joints shall be staggered and tight. Provide 2" minimum lap on jackets and 2" tape on butt joints, firmly and continuously cemented with lap adhesive or welding solvent as recommended by the manufacturer. Additionally, secure with staples along seams and butt joints. Coat staples with vapor barrier mastic on systems requiring vapor barrier.
- H. Provide inserts and pipe shields at all hanger and support locations. Inserts may be omitted on  $\frac{3}{4}$ " and smaller copper piping provided 12" long 22-gauge pipe shields are used.
- I. Insulate entire piping system for a completely insulated system including all areas that will frost up during operation. This includes filling all gaps, spaces, voids, etc. completely to prevent frost or condensation build up. This also includes providing valve handle extensions and all other material to properly insulate valves and prevent condensation. Insulation shall be tightly butted and free of voids and gaps. Weather seal shall be continuous.
- J. All fasteners and bands shall be neatly aligned, and overall work must be of high-quality appearance and workmanship.
- K. Provide removable insulated covers for fill valves, equipment lifting hooks, access points to strainers, valves, nameplates, and all other areas that require periodic inspection, service or repair.
- L. All site glasses and nameplates shall be insulated to prevent frost build-up.
- M. Provide all adhesive, sealants and other products as required by the manufacturer to provide a completely sealed system. Seal all seams of the jacketing.

### 3.8 SEALING AND FIRESTOPPING

- A. All pipes piercing interior and exterior walls, ceiling, and floor shall be tightly sealed to the walls, ceiling and floors through which they pass as specified herein.
  - 1. Fire and/or Smoke Rated Penetrations. Install approved product in accordance with the manufacturer's instructions where pipes penetrate a fire/smoke rated surface. When pipe is insulated, use a product which maintains the integrity of the insulation and vapor barrier. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support any substantial weight.
  - 2. Non-Rated Penetrations. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve and cored opening and the pipe or insulation is completely blocked.

**3.9 PAINTING AND FINISHES**

- A. All interior steel piping, equipment, fittings, supports, and accessories that are exposed to view shall be painted with one coat of primer and one coat of enamel. Ammonia piping colors per IAR Bulletin No. 114 March 2017. Prepare steel as recommended by the paint manufacturer. Colors shall be as outlined in table below:

A	C
Ammonia high pressure liquid lines	Orange (Pantone 152 C)
Ammonia high pressure vapor lines	Yellow (Pantone 109C)
Ammonia low pressure/high temperature liq. & vapor lines (0F to 47.3F)	Light blue (Pantone 298C)
Ammonia low pressure/low temperature liq.&vapor lines	Dark blue (Pantone 3015C)
Pressure relief vent piping	Grey (Pantone 430C)
Other refrigerant piping and vessels	Color selected by Owner
Condenser water piping (refrigerant piping specified above)	Color selected by Owner
Interior supports and frames in refrigeration room	Color selected by Owner
All other areas not mentioned	Color selected by Owner

- B. All exterior exposed steel piping shall be painted with one coat of primer and two coats of enamel. Prepare steel as recommended by the paint manufacturer. Owner to select color of paint.
- C. Touch up paint on all equipment, vessels, supports and exposed pipes after project is complete.
- D. Touch up damaged galvanized coatings and corrosion protection systems on condenser and remote sump.

END OF SECTION

**SECTION 13 18 15 - ICE RINK WASTE HEAT RECOVERY SYSTEM****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. General system description and design criteria.
- B. Pumps.
- C. Heat Exchanger.
- D. Expansion Tank.
- E. Snowmelt Coil.
- F. Circulation Fluid.
- G. Pipe and Accessories.
- H. Waterproofing for Snow Melt Pit.

**1.2 GENERAL SYSTEM DESCRIPTION AND DESIGN CRITERIA**

- A. Provide all materials, equipment and controls necessary for a fully functional waste heat recovery system that recovers waste heat from the refrigeration system and uses it for heating the sub-floor heating system and for melting snow in the snow melt pit. The system shall be a closed piping system.

**1.3 RELATED SECTIONS**

- A. Section 007200 - General Conditions.
- B. Section 007300 – Supplementary Conditions.
- C. Section 131811 - Ice Rink General.
- D. Section 131812 – Ice Rink Refrigeration System.
- E. Section 131813 - Ice Rink Floor.
- F. Section 131814 - Ice Rink Piping, Valves and Accessories.
- G. Section 131817 – ice Rink Central Control System.

**1.4 SUBMITTALS**

- A. Shop Drawings. All submittals shall conform to the requirements of General Conditions and Section 131811 - Ice Rink General Requirements.

**1.5 WARRANTY GUARANTY**

- A. As required in Section 131811 - Ice Rink General Requirements.

**1.6 PRODUCT DELIVERY STORAGE AND HANDLING REQUIREMENTS**

- A. As required in Section 131811 - Ice Rink General Requirements.







- B. Pipe supports shall be 3" high 304L stainless steel square stock, spaced at 3' on center to support the snow melt coil. If the snow melt pit is specified with a membrane liner, pipe supports shall be steel tubing, all edges shall be rounded to prevent puncturing liner and supports shall be tack welded to coil.
- C. Verify size of snow melt pit and location of drain pipe prior to fabricating the coil.

## **2.7 CIRCULATION FLUID**

- A. Furnish and install a complete charge of 35% inhibited ethylene glycol and deionized water as specified in section 131812.

## **2.8 PIPING AND ACCESSORIES**

- A. Provide all piping, thermometers, gauges, valves, insulation, controls, electric as required for a complete system, as shown on the drawings, and as specified in Section 131814 - Ice Rink Piping, Valves and Accessories.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install, test and start up equipment, piping, valves, insulation, etc. as specified in Sections 131813 - Ice Rink Floor, 131812 - Ice Rink Refrigeration System, and 131814 - Ice Rink Piping, Valves and Accessories.
- B. Verify with General Contractor prior to mounting piping, tanks, heat exchangers, to walls or ceiling in ice mechanical room.
- C. Provide all controls and electrical work as required for a complete operating system.

### **3.2 START UP AND SHUTDOWN SERVICES**

- A. See Section 131811 - Ice Rink General Requirements.

END OF SECTION

**SECTION 13 18 16 - ICE RINK DASHER BOARD SYSTEM AND ACCESSORIES**

**NOTE DASHER BOARD SYSTEM TO BE FURNISHED AND INSTALLED BY OWNER.  
CONTRACTOR SHALL COORDINATE INSTALLATION REQUIREMENTS WITH OWNER S DASHER  
BOARD CONTRACTOR.**

**PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Quality assurance - prequalification criteria.
- B. Approved manufacturers.
- C. Dasher board system materials.
- D. Floor anchors.
- E. Advertisement panels.
- F. Accessories (netting, tools, pegs, carts, edger, etc.).
- G. **ALTERNATE BIDS** As specified herein and on the drawings.

**1.2 QUALITY ASSURANCE**

- A. Contractors wishing to bid/quote on this project must submit, with their bid, the following prequalification criteria.
  - 1. Submit a list of five (5) ice rink construction projects the company has completed that are similar to this project and that were completed within the past five (5) years. Submittal shall be on company letterhead, signed by an authorized representative of the company and include project description, portion of project completed by the company, location, construction cost, completion date, owner's name, owner's representative, phone number and completion date of work.
  - 2. Contractors/manufacturers listed as approved manufacturers in section 2.1 are not required to submit the prequalification material described in paragraph A.1 of this section.
  - 3. Contractors/manufacturers seeking approval shall supply a sample panel section representative of all components to be used in the dasher board section if requested by the Owner.
- B. Contractors wishing to bid on this project shall perform an on-site investigation prior to submitting a bid for the project. Contractor shall field verify all measurements that will affect the work of this project and report any concerns to the Engineer at least five (5) business day prior to the bid opening date. The contractor shall also perform a site visit to verify measurements prior to manufacturing the system.

**1.3 RELATED SECTIONS**

- A. Section 007200 - General Conditions.
- B. Section 007300 - Supplementary Conditions.

**1.4 CODES AND STANDARDS**

- A. All parts of the project shall be performed in accordance with the most recent version of the following codes and standards and all amendments:
  - 1. State Building Codes.
  - 2. National Fire Protection Association Codes.
  - 3. OSHA.

### 1.5 SUBMITTALS

- A. Shop Drawings. All submittals shall conform to the requirements of the General Conditions. Shop Drawings shall include product information on all materials, color samples of all standard colors for top sill, facing, kick plate, backer panels, benches, and tables. Shop Drawings shall clearly highlight and note any materials, dimensions, etc. that do not match the contract documents. Samples shall be representative of thickness of material that will be supplied.
- B. Structural Calculations: If requested, the manufacturer shall supply structural engineering calculations for the dasher board system.
- C. Progress Schedule. Submit progress schedule before project begins.
- D. Certifications. Submit four (4) copies of certifications to the Engineer when specified.
- E. Project closeout documents:
  - 1. Provide all documents required by the General Conditions and these specifications.
  - 2. Final Payment Request: The following information shall be submitted with the final payment request from the contractor:
    - a. Insurance certificates for all products and equipment where required.
    - b. Proof that taxes, fees, and similar obligations are paid.
    - c. Contractors Affidavit of Payment of Debts and Claims, AIA Document G706.
    - d. Contractors Affidavit of Release of Liens, AIA Document G706A.
    - e. Consent of Surety to Final Payment, AIA Document G707.
    - f. Final pay request document shall accurately reflect all changes to the contract amount.
    - g. Final liquidated damages settlement statement.
    - h. And all other requirements of the General and Supplemental Conditions.
- F. Payments for all submittals shall be incidental to the cost of the project.

### 1.6 WARRANTY GUARANTY

- A. In addition to the standard manufacturer's warranty on all equipment and materials, the contractor shall provide a standard two-year materials and labor warranty on all work performed for this project.

### 1.7 PRODUCT DELIVERY STORAGE AND HANDLING REQUIREMENTS

- A. Transport, handle, store and protect products in accordance with manufacturer's recommendations. Secure products at all times.
- B. Store products with seals and labels intact and legible.
- C. Store products in a secure environment at all times.
- D. Provide adequate labor to handle products and prevent damage.
- E. Protect top sill from becoming scratched or marked up during installation.

### 1.8 ALTERNATE BIDS

- A. Definition: Work that is added or deducted from the Base Bid amount if the Owner decides to accept the corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
- B. The cost or credit for each alternate is the net addition to, or deduction from, the Contract Sum to incorporate the alternate into the Work. No other adjustments are made to the Contract Sum.
- C. Alternates may be accepted by the Owner in any order and may be used to determine the low bidder.
- D. The bidder shall bid on each alternate specified as part of the specifications. Alternates not specifically requested will not be considered unless prior approval has been granted by the Engineer.
- E. Description of Alternate Bids:
  - 1. Provide flexible frame system integrated into dasher board framework on ends, radius and 24 feet down the sides and ice dam.
  - 2. Provide sufficient quantity of dashers board storage carts to store dashers on each end and radius of the rink.

## PART 2 - PRODUCTS

### 2.1 APPROVED MANUFACTURERS OF DASHER BOARD SYSTEM

- A. Becker Arena Products/Sports Systems/Athletica/Cascadia, or others by prior owner approval.

### 2.2 FRAME

- A. All dasher panels whether straight, curved or gated shall have the same design and similar construction. Panels shall be all welded construction.

- B. Standard Sizes:

P	S	H	L	W
Straight		41"	96"	6"
Curved		41"	88"	6"
Back of Players Boxes		See plan	96"	6"

- C. Materials:
  - 1. Aluminum: Shall be structural alloy 6005A-T6. Architectural alloy is not acceptable. Shall meet ASTM B221 and Federal Specifications QQA200-9.
  - 2. Systems shall be constructed with either aluminum or steel materials, not a combination of the two.
  - 3. Height of systems shall be modified if ice retainers is used.
- D. Components: See drawings.
- E. Connections: Panels shall be fastened together through end plates at a minimum of three (3) locations with 1/2" diameter (minimum) bolts.
- F. Other Supports: Provide additional supports where required and to accommodate systems such as quick release backer panels, gap closures, material, taller panels, etc.
- G. All holes used in the framing system shall be pre-punched with slotted holes to allow for expansion and contraction in the polyethylene materials.
- H. Systems that require external support posts on the back side of the dasher panel section are not acceptable unless specified or noted on the drawings.

- I. Lift Out Panels
  - 1. Modify dasher board framework to provide lift out panels in locations shown on the drawings. All materials and construction to meet the requirement of these specifications.
  - 2. Provide one (1) aluminum stair and railing section for each floor access lift out panel.
  - 3. Verify threshold height with adjacent bleacher or concrete sections.
- J. **ALTERNATE BID 1** Flexible Frame System
  - 1. Approved Manufacturers: Checkflex by Athletica or equal.
  - 2. Frame: As required in this article with the addition of a heavy-duty spring assembly at the base of the dasher board frame.
  - 3. Performance Criteria: 3" impact absorption, 42" above the ice surface.
  - 4. Shielding Clips: Shall be specially designed for extra movement of system.
  - 5. Ice Retainer: A steel ice retainer system is required for this system. See separate article in the Section for the ice retainer.
- K. Conversion Friendly Base
  - 1. Dasher base shall feature a solid aluminum angle with anchor holes in based drilled on site to align with ice damn anchor locations.

**2.3 SHIELDING**

- A. Shielding shall be as specified herein and shown on the drawings.
- B. Acrylic Material: Shall be cell cast acrylic sheeting as manufactured by Rink Shield, CrystaPlex 590 or equal. All sheets shall be clear and colorless. Material shall conform to ASTM D4802-88.
- C. Dimensions:
  - 1. Height of shielding: As shown on the drawings. Specified height of shielding shall be measured from top of top sill to top of shielding.
  - 2. Thickness of shielding in inches: As shown in table below with nominal dimensions shown in ( ):

T ( ) ( )	S ( ) ( ) ( )	E ( ) ( ) ( )	R ( ) ( ) ( ) ( )
Acrylic	0.545-0.620	0.545-0.620	0.545-0.620

- 3. All shielding shall be equal widths wherever possible, so the panels are interchangeable.
- 4. The top two corners of each piece of shielding shall be rounded to 1/2" radius.
- D. Other:
  - 1. Provide one (1) 2.5" diameter speaker hole(s) in shielding in front of scorer's box. All edges of hole shall be routed smooth.
  - 2. Provide transition (angled top edge to match height of adjacent shielding pieces of shielding) where two different height shielding meet as shown on the plans.
  - 3. Provide extra pieces of shielding as stated below. Thickness to match specifications for specified area.

L ( ) ( ) ( ) ( ) ( ) ( )	H ( ) ( ) ( ) ( ) ( ) ( ) ( )	M ( ) ( ) ( ) ( ) ( ) ( ) ( )	N. ( ) ( ) P ( ) ( ) ( ) ( ) ( )
Ends and Radii	99	Acrylic	5
Straight Sections	72	Acrylic	4
30" Access gate	72	Acrylic	1
36" Access Gate	72	Acrylic	1
36' Access gate	99	Acrylic	1
Equipment gate	99	Acrylic	1
<b>TOTAL</b>			<b>13</b>

- 4. Custom Camera Holes and Covers. Provide custom camera holes in shielding at locations noted on the drawings. Holes shall be rectangular and approximately 4" high x 6" long with rounded corners. Holes shall be covered by a 1/2" acrylic shielding cover fastened to the

shielding with heavy duty Velcro fastening system and braided nylon safety string. The bottom of the hole should be located 5" above the caprail per NHL standards.

- E. Curved Acrylic Safety/Termination Sections. Provide four (2) one (1) extra NHL approved curved acrylic safety/termination shielding sections for termination points at each end of player's boxes. Shall be same material and height as adjacent shielding.

## 2.4 SHIELDING SUPPORTS

- A. Acrylic shielding shall be supported by clear, flexible, polycarbonate H sleeves by HDM Divider Sleeves by Athletica.
- B. Gaskets: Continuous polyethylene gasket to hold shielding in place. Thickness of gasket shall vary for varying thickness of shielding to provide snug fit between the shielding and the support.
- C. Hardware: All hardware shall be made of extruded aluminum alloy 6005A or 6351-T-6. All fasteners shall be recessed flush with surface of support. All fasteners and hardware shall be removable for easy replacement of shielding and disassembling for removal and reinstallation.
- D. Height: As indicated on the drawings or 1" max. distance below top of shielding if not indicated on the drawings.
- E. Spacing: Nominally 8'-0" on center on sides of rink. Nominally 4'-0" on ends and raddi.
- F. Other: Eye bolts shall be provided on each support on ends and radius for connection of netting.
- G. Provide 3 extra Polycarbonate H sleeves for each different height of shielding.

## 2.5 SUPPORTLESS SHIELDING SUPPORT CHANNEL

- A. Material:
  - 1. Aluminum: Material shall meet ASTM B221, Federal Specification QQA200-9 and alloy 6005A or alloy 6351-T-6.
  - 2. Polyethylene: Material shall be requirements of Section 2.3.
- B. Construction: Continuous aluminum channel(s) to support glass welded into frame. The bottom 3 -1/2" minimum of tempered glass shall be covered with U-shaped gaskets inserted in channels. A continuous block of polyethylene may be substituted for the aluminum channel.
- C. Gaskets: Continuous polyethylene or equal gasket to hold shield in place. Gaskets shall be mounted to glass with adhesive tape.
- D. Hardware: All hardware shall be made of extruded aluminum alloy 6005A or 6351-T-6. All fasteners shall be recessed flush with surface of support. All fasteners and hardware shall be removable for easy replacement of shielding and disassembling for removal and reinstallation.
- E. Other:
  - 1. Provide system to continuously support netting below top of shielding.
  - 2. The gap between the glass shielding pieces, where there are no gates, shall be 1/4" to 3/8".
  - 3. Furnish and install spring-loaded Lexan clip assemblies at the top of the shielding to connect shielding sections together. Provide poly protection covers for each bolt on back of each assembly. Provide eight (8) extra clips and twenty (20) extra covers for the Owner's use.
  - 4. Furnish and install plastic spacers between the shielding panels for proper spacing.
  - 5. Furnish and install shielding supports as specified in Article 2.8 at doors and 90-degree corners.

**2.6 FLEXIBLE GLASS SYSTEM**

1. Approved Manufacturers: GlassFlex as manufactured by Athletica or equal.
2. Description: 3 ½" extruded U channel shall be mechanically fastened to the dasher framing. Systems which are not mechanically fastened, spring loaded and adjustable are not acceptable. System shall have a minimum movement of ½" measured at top sill area. System shall be constructed completely of welded structural aluminum. Systems with angles or flat bar will not be accepted.
3. Provide gaskets to cover the gap between the shielding and the caprail during movement. The gaskets shall be the same color as the caprail material.
4. Manufacturer must have at least 3 installations completed in the past 5 years.

**2.7 POLYETHYLENE**

- A. Material: High impact, high density, stress relieved, virgin polyethylene. Reprocessed polyethylene is not acceptable.
- B. Dimensions: See drawings.
- C. Colors:
  1. As stated in material schedules on drawings. "Owner" means color shall be selected by Owner from the standard colors of white, black, royal blue, red, gold, yellow. It does not include the premium colors of light blue, green, navy blue, and some shades of grey or custom colors.
  2. All like colors shall match.
  3. White: Shall be Bright white in color. Natural white is not acceptable.
- D. Fasteners: See Article 2.07 in this section.

**2.8 FLEXIBLE CAPRAIL**

- A. Approved Manufacturers: Soft Cap by Athletica or equal.
- B. Description: Replace specified material with 1" thick flexible-plastic elastomer material, shall be installed on the ice side and the standard specified top sill material. ¾" thick shall be installed on the bleacher side of the system and routed to ¼" radius. Provide H clamps of same color.
- C. Color: Selected by Owner from standard red or blue colors
- D. Extra Pieces: Provide the following additional material
  1. 5 extra pieces of Softcap for in front of benches.
  2. 5 extra pieces of H clamps.

**2.9 KICK PLATE**

- A. Shall be inlaid or flush mounted with facing of dasher board system and shall interlock with ice dam. Provide additional stringer to dasher board framing system.

**2.10 FACING PANELS**

1. Shall be one piece, cut to match dimension of frame.
- B. Line Markings:
  - a. Shall be installed at locations shown on the drawings and shall be installed flush with dasher board facing.





- A. Dimensions: As shown on the drawings.
- B. Framing Systems: Shall be constructed of same material as the dasher frame, conforming to material requirements of Article 2.02, and as shown on the drawings.
  - 1. Components: See drawings.
  - 2. Benches shall be constructed so that they can be easily removed including tube supports built into flooring to support the bench supports.
- C. Flooring. Shall be constructed with 3/4" fire treated plywood screwed to framing. Provide coaches walk as shown in the drawings for the full length of the player's benches. All exposed surfaces shall be covered with 1/2" black resilient flooring material as manufactured by Humane or equal.
- D. Scorers Box Table(s) and Benches:
  - 1. Provide table(s) and benches with dimensions shown on the drawings.
  - 2. Framing material as specified in this article.
- E. Fasteners: Fasteners that come in contact with pressure treated or fire-retardant treated wood shall be hot-dipped galvanized steel with a minimum rating of G-185 (1.85 oz. of zinc/sq.ft. of metal) meeting ASTM A153, stainless steel, or silicon bronze as required by the International Building Code Section 2303.1.8.5. Plain finish elsewhere. Electroplated galvanized fasteners shall not be used for exterior applications. Fasteners for benches shall be 3/8" carriage bolts.
- F. Backing: Specified in Article 2.07 of these specifications.
- G. Other: Incorporate a water bottle shelf in player's boxes as shown on the drawings. Shelf shall run full length of player's box. Material thickness as shown on the drawings. Color of shelf material shall be white to match color of backer.

**2.16 PLAYERS AND ACCESS GATES**

- A. Provide access and players gates with openings as shown on the drawings.
- B. Gates shall be integrated into the standard 8' long panel sections and shall be Left or right swing as directed by the Owner.
- C. Gate panel framing shall be similar construction as dasher framing.
- D. Gate Latches: Shall be solid, steel welded construction, with a single 3/8" thick x 2" wide steel flat bar, easily opens with glove hand. Fastened to framing with 3/8" x 1 1/4" hex head bold and 3/8" nylon locking nut. Shall latch by gravity and latch on their own when gate is closed.
- E. Gate Hinges: Shall be two lift off type hinges welded. All hinge assemblies shall have grease fittings for easy lubrication or use nylon bushings. Piano type hinges, 10 GA, non greasable, bolted to frame, are acceptable where shielding is not used. Hinges shall be adjustable.
- F. Doorstop: All gates shall have a steel door stop welded to the frame with minimum dimensions of 3/8" x 3 1/2" x 4 1/2" long".
- G. Ice Side Release Devices: All players and access gates with shielding shall have push button releases located on in the top sill, on the ice side, so that the gate can be opened from the ice side.
- H. Finger hold: Route a 3/8" deep x 3/4" wide area in top sill at all access gates with glass shielding to be used as a finger hold to close doors from the ice side of the board system.
- I. Gate shall be constructed so top of threshold is located as follows:

<b>T</b> □ □ □ □ <b>G</b> □ □ □ □	<b>D</b> □ □ □ □ □ □ <b>A</b> □ □ □ □ <b>F</b> □ □ □ □ □ □ <b>F</b> □ □ □ □ (□)
Players	9
Access	3
Equipment	2

- J. Casters: For gates over 42" wide, provide 5" diameter, spring loaded, adjustable, zinc plated framing, polyurethane tires. Provide casters on each leaf.

### 2.17 EQUIPMENT GATES (STANDARD)

- A. Shall be double leaf gates with opening sizes as shown on the drawings.
- B. Materials: Framing materials to meet requirements of Article 2.02 of this specification and be of similar construction.
- C. Latch: Shall be the sliding steel tube with minimum dimensions of 2 ¼" x 2 ¼" x 12 gauge or 2" diameter solid steel rod with large handle (push down). Zinc plated all components. Provide two (2) latches per gate.
- D. Lock: Each leaf of gate shall lock into concrete perimeter slab with ¾" diameter x 12" long solid steel, zinc plated cane bolts.
- E. Hinges: Zinc plated, heavy duty, manufactured using 3/8" thick steel components and ¾" minimum diameter hinge pins, adjustable, lift off type welded to frame. Shall have grease fittings for easy lubrication. Two hinges per door.
- F. Casters: 5" diameter, spring loaded, adjustable, zinc plated framing, polyurethane tires. Provide casters on each leaf.
- G. Fasteners: Shall be zinc plated and color to match where necessary.

### 2.18 GAP CLOSURES

- A. Furnish and install material to fill the gap between the back of the dasher board panel and the bleachers, stairs, ramps, and all other raised structures.
- B. Material:
  - 1. Polyethylene: ½" thick x width shown on drawings. Length of each piece shall be minimum of 8 feet or longest possible for area of application. Material shall be high impact, high density, stress relieved, virgin polyethylene. Reprocessed polyethylene is not acceptable. Router top edge on opposite side of the bleachers to provide a radius. Furnish and install all additional framing and supports required for fastening to dasher framing and for solid support over gap length. Framing and support material shall match dasher panel framing material. Color selected by Owner from standard colors of white, gold, dark blue, light blue, red, green and yellow. The color of all material shall match.
- C. Fasteners: See Article 2.07 in this section.
- D. Construction: Gap closure system shall be mounted to the dasher board system only and not to the adjacent structure.

### 2.19 FLOOR ANCHORS AND INSERTS

- A. Anchors components include bolts, inserts, washers, threaded rod, and hold down plate as shown on the drawings and as follows:
  - 1. Where dasher board system is located on the perimeter concrete: New holes shall be drilled for each anchor. Anchors shall be 5/8" x 3" zinc plated inserts by Hilti-HFA 200, Hilti HY 150, or equal. Expansion anchors are not acceptable.
  - 2. Where the dasher board system is located on the ice rink slab: Anchor assembly shall be as detailed on the drawings or equal and shall be cast in place into the concrete ice rink floor. If material type is not shown on the drawings, then insert material shall be:
    - a. For permanent panels: All materials shall be zinc plated.

- b. For removable panels: Anchor inserts, and washers shall be 303 stainless steel, base plate may be 303 Stainless steel or carbon steel and bolts shall be zinc plated material.
    3. Where an ice retainer is used, provide 5" anchors of material stated herein.
  - B. Bolts shall be 5/8" diameter. Material shall be as stated herein.
  - C. Hold down plate shall be sized as shown on the drawings.
  - D. Anchoring Adhesive (for drilled in anchors)
    1. Approved Manufacturers: Hilti HIT Doweling Adhesive HIT HY-150 MAX, Red Head A7 Adhesive, Simpson Strong-Tie AT-High Strength or equal.
    2. Properties:
      - a. ASTM C881 Type IV, Grade 3, Class A, B, C.
      - b. Bond Strength: ASTM C 882: 2900 psi min. at 2 days.
      - c. Compressive Strength: ASTM D 695: 9200 psi min. at 7 days.
      - d. Water Absorption: ASTM D 570: 0.23% (24 hours).
  - E. Plug Materials: Furnish and install threaded plugs for each insert. Stainless steel for the circus inserts and brass for the dasher board inserts.

## 2.20 ADA PLATFORMS AND RAMPS

- A. All ramps and platforms shall be constructed with the same materials as Player's, Penalty and Scorer's boxes. All ramps shall be covered with rubber flooring as specified for the Player's Penalty and Scorer's boxes.
- B. All ramps and platforms shall be easily removable and storable.
- C. Coordinate railing requirements with architectural details.

## 2.21 ICE DAM

- A. Materials:
  1. Steel as specified in Article 2.02. Primed and painted with rust inhibitor paint per paint manufacturer's requirements, galvanized or powder coated.
  2. Polyethylene as specified in Article 2.07.
  3. Insulation shall be extruded polystyrene, 25 psi.
- B. Construction:
  1. Dimensions as detailed on the drawings. Section lengths shall be 96".
  2. Anchoring System:
    - a. Anchor plates: Ice retainer section shall have two (2) 1/2" x 4" anchor plates welded to the underside of the channel. Ice retainer shall be secured to concrete floor using 5/8" x 1 1/2" hex head cap screws. Anchors shall be located at approximately 4 feet on center.
    - b. Inserts: Each ice retainer section shall have four (4) 5/8" threaded inserts welded to the underside of the channel. Two will be used for anchoring dasher board system and two for spares.
  3. Fasteners: Polyethylene kickplate shall be fastened with 1/4" diameter nylon nails 9" on center.
  4. Insulation: Insulation shall be cut to fit snugly in the steel channel and bonded in place with construction adhesive. All voids around anchor locations shall be filled with expanding urethane foam.
  5. Coating: Steel channel shall be coated with two coats of rust inhibiting paint prior to installation.

**2.22 PROTECTIVE SPECTATOR NETTING SYSTEM**

- A. Size and Location: Netting shall be installed where shown on the drawings. The netting shall extend from 6" below the top of the shielding supports to the height specified on the drawings. The net shall be custom made to fit the exact length and height required.
- B. Material:
1. Kevlar, No. 12 twisted (1.2 mm twine) x 3" stretched mesh, 292 lb minimum tensile strength, knotted net, fire retardant, urethane coated, black in color. Netting border (all sides) shall be No. 72 twisted (4 mm) polyester, 590 minimum tensile strength, color to match netting. Net supports shall be installed at a maximum of 18" on center. Hanging twine shall be same size as netting.
- C. Support System:
1. The top of the netting shall be supported with a continuous rigid conduit or rigid bar system (10-foot minimum length sections) formed to the radius dimensions of the rink. Rigid supports shall be installed at the bottom of the netting at all equipment and access gates. Conduit supports shall be galvanized steel.
  2. Support Cables: 3/16" galvanized steel cable to roof structure.
  3. Fasteners: Netting shall be attached to top of shielding with cable system and metal clips or nylon tie straps. Every 4' o.c., centered on each sheet of shielding, cable shall be attached to shielding with suction cups if supportless shielding, fasteners shall be attached to poly clips at top of shielding. Nylon ties shall be 1/8" wide, UL recognized and a minimum tensile strength of 100 lbs.
  4. Provide all other cables, clamps, turnbuckles, eyebolts, suction cups, plastic ties, etc. as required for a complete, clean and neat installation.
- D. Motorized Retractable Netting System:
1. Furnish and install an electric winch connected to single control point described in the manual netting system above with a 1/4" diameter aircraft cable. Winch shall raise and lower netting in no more than 8 minutes.
  2. Each winch should be located in an approved location by the Engineer.
  3. System shall raise and lower each netting support bar for the full height of the net and be cable of dropping to the floor and be removed as required.
  4. Furnish and install all cable hoist system, pulleys, hardware, and other material specified in manual system and all other materials required for a complete operating system.
  5. Furnish and install all electrical wiring, conduit, power supply cords, controllers, and controls required for the system. Provide mobile storage case with caster wheels for controller. All wiring shall be installed in conduit.
  6. Netting: As specified in this Section.
  7. Manufacturer to verify all existing or potential obstructions to the hoist system prior to designing the system. Notify Engineer of all concerns.

**2.23 ACCESSORIES**

- A. Glass Handler Suction Cups.
1. Furnish one (1) pair of suction cup devices for glass handling to aid in removal of tempered glass or acrylic shielding, 8" diameter with Lexan handle, 125-pound capacity as manufactured by Wood's Power Grip or equal.
- B. Glass and Acrylic Cleaning Kits as manufactured by Novus ([www.novuspolish.com](http://www.novuspolish.com), 800.548.6872) or equal:
1. Furnish one (1) cleaning starter kit that includes the following:
    - a. One (1) 8 oz. bottle of Polish 1 - Clean and Shine.
    - b. One (1) 8 oz. bottle of Polish 2 - Fine Scratch Remover.
    - c. One (1) 8 oz. bottle of Polish 3 - Heavy Scratch Remover.

- d. Two (2) NOVUS Polish Mates
  2. Furnish one (1) package of ten (10) polish mates:
    - a. Size: 13" W x 13" L each.
    - b. Re-usable and washable.
    - c. Microfilament, highly absorbent, extra durable.
    - d. soft and abrasion resistant.
  3. Furnish one (1) buffing kit that includes the following:
    - a. One (1) wool applicator pad.
    - b. One (1) wool buffing pad.
    - c. One (1) back plate adapter.
    - d. One (1) ¼" spindle adapter.
    - e. One (1) Instruction sheet.
- C. Glass Storage Carts
1. Provide sufficient quantity of glass shielding storage cart(s) and for one (1) cart for the curved acrylic pieces and two (2) for the HDM posts for entire dasherboard system.
  2. Size: Large cart (52-inch-wide x 94 inches high x 102-inch-long)
  3. Construction: 4,800 lb minimum, steel "A"-frame, heavy duty construction, two rigid and two swivel wheels, and towing tongue and pull handle on each end of cart. Assemble cart(s) for Owner.
  4. Accessories: Provide two (2) ratchet strap assemblies with each cart.
- D. Ice Cover Storage Carts
1. Provide sufficient quantity of cart(s), 66" wide x 65" high x 96" long for entire ice floor cover system.
  2. Construction: 4,000 lb minimum, steel frame, heavy duty construction, end rails, plywood deck, two rigid and two swivel wheels. Shall have 6" diameter wheels rated for 2,000 lb load each. Carts shall be stackable. Assemble cart(s) for Owner.
  3. Finish: One coat of primer and two coats of finish paint.
  4. Accessories: Provide two (2) ratchet strap assemblies with each cart.
- E. Board Storage Carts – **ALTERNATE BID 2**
1. Provide sufficient quantity of board storage cart(s), 60" wide x 60" high x 94" long to store dashers on each end and radius of rink.
  2. Construction: 4,000 lb minimum, steel frame, heavy duty construction, end rails, plywood deck, two rigid and two swivel wheels. Shall have 5" diameter wheels rated for 2,000 lb load each. Carts shall be stackable. Assemble cart(s) for Owner.
  3. Finish: One coat of primer and two coats of finish paint.
  4. Accessories: Provide two (2) ratchet strap assemblies with each cart.
- F. Poly Ramps
1. 24" x 6' long x 2" thick poly ramp four (4) locations. Ramps shall be anchored to concrete in such a manner that they are easily removable. Ramps shall match radius where located in corners.
- G. Shielding Pads.
1. Furnish and install shielding pads at all exposed ends of shielding or supports, corners, and termination of shielding.
  2. Pads shall full length of shielding or supports and shall be constructed with heavy duty 18 oz. reinforced fabric sleeve with impact-absorbing foam core sealed inside. Pads shall be secured in place with 2" wide Velcro fastening system.
  3. Color and Lettering: Color and Lettering: Owner to select custom color and lettering.

## 2.24 ICE COVER

- A. Approved Manufacturers: ArenaDeck XT or equal.

- B. Panel Size: 96" x 48" x 1" thick, 55 lbs each.
- C. Construction: Synthetic material with waffle pattern underside providing an insulated (R-2.84) air pocket. Solid panels shall be used near equipment gates. Allowable compressive strength of 500 psi. Material shall not absorb moisture, warp, swell or stick to the ice.
- D. Coating: FASCOAT coating.
- E. Color: Black
- F. Warranty: 5 Years

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Prior to delivering materials to the site and beginning installation, verify that the rink floor has been released for lift access and that the expansion joint has been installed and inspected.
- B. The manufacturer shall provide all materials and labor for a complete dasher board system and installation. The dasher board system shall be shop fabricated as much as possible prior to delivering to job site.
- C. Installation shall be completed under the direct supervision of an experienced representative from the manufacturer.
- D. Installation shall be performed per the manufacturers recommended requirements and instructions. System shall be securely anchored in place. Provide all trim, shims and other accessories required for a complete, level and plumb, installation.
- E. Any material that is scratched, marked up, chipped, dented or damaged in any way shall be replaced.
- F. All parts of the system shall be thoroughly tested and adjusted, as necessary. Walk through the system with the Owner and make all adjustments necessary for the Owner's satisfaction.
- G. Nylon ties used to attach netting at top of shielding and elsewhere shall be cut off or trimmed in such a manner, and with the appropriate tools, to eliminate all sharp edges.
- H. All supportless shielding systems shall be installed with a maximum 3/8" wide space between any two pieces of shielding.

#### **3.2 ANCHORS AND INSERTS**

- A. The dasher board manufacturer shall be on-site prior to and during the concrete rink floor pour to install, protect and adjust the anchors and inserts when the dasher board system is being installed on the rink floor.
- B. Field verify the location of goal inserts in the concrete floor (if applicable) to assure alignment with the goal line markings on the dasher board system.

#### **3.3 RESILIENT FLOORING IN BOXES**

- A. Cut rubber flooring to fit neatly and tightly around fixed objects and perimeter. Provide flush surfaces at sills and gates. Flooring to be loose laid over plywood substrate on the main box level. Flooring to be securely fastened on coaches raised platform and other raised floor levels within the box areas. All other exposed aluminum or steel to be covered by rubber flooring (horizontal surfaces) or poly (vertical surfaces).

**3.4 CLEANING**

- A. Clean all surfaces thoroughly prior to leaving the job site. The systems shall not be cleaned until all punch list items have been addressed.

**3.5 START-UP SERVICES**

- A. After all the systems have been tested and thoroughly cleaned provide the Owner's operating staff with a minimum of 4 hours of hands-on instructions on the operation and maintenance of the system.

**3.6 COORDINATION OF WORK**

- A. The contractor shall be responsible for coordinating all work specified herein and shall work closely with other subcontractors on the project.

**3.7 PERMITS**

- A. The contractor shall apply for and obtain all permits required to construct the project at no additional cost to the Owner unless specified otherwise.

END OF SECTION





**PROJECT MANUAL  
VOLUME 3**

**FOR**

**MOBILE ARENA  
401 Civic Center Drive  
Mobile, Alabama 36602**

**Project No. AMOB230117**

**BID SET**

December 13, 2024



**City of Mobile  
Architectural Engineering Department  
Government Plaza  
205 Government Street, South Tower, 5th Floor  
Mobile, Alabama 36602**

**Bid Date:** \_\_\_\_\_

**Set Number:** \_\_\_\_\_

## **OWNERSHIP OF DOCUMENTS AND DISCLAIMER**

The Project Manual, Technical Specifications, Drawings, and all other documents relating to this project have been prepared for this individual and particular project, and for the exclusive use of the original Owner, developer or other party so indicated.

Actual project conditions and as-built conditions may vary significantly. Changes made during bidding, negotiations, construction, due to additions or deletions of portions of this project, and/or for other reasons, may not be indicated in these documents.

These documents may not be used or relied upon as a certification of information indicated, or used for any other project, by any third parties or other parties, for any purpose whatsoever, without the prior written consent of Goodwyn Mills Cawood, LLC, or prior to receipt of mutually agreed to compensation paid to Goodwyn Mills Cawood, LLC, therefore.

The ownership, copyrights, and all other rights to these documents, are reserved by Goodwyn Mills Cawood, LLC, including in part, all copies thereof in any form or media. Reproduction of the material contained in these documents or substantial quotation of their provisions without prior written permission of Goodwyn Mills Cawood, LLC, violates the copyright and common laws of the United States and will subject the violator to legal prosecution.

### **Goodwyn Mills Cawood, LLC**

11 N. Water Street

Suite 15250

Mobile, AL 36602

**SECTION 00 01 05 – PROJECT DIRECTORY**

**PROJECT DIRECTORY**

**OWNER:** **City of Mobile Architectural Engineering Department**  
Government Plaza 205 Government Street, South Tower, 5th  
Floor  
Mobile, Alabama 36602  
Phone: (251) 208-7492  
**Carleen Stout, Deputy Director, Real Estate  
and Asset Manager**

**ARCHITECT:** **GOODWYN MILLS CAWOOD, LLC**  
11 North Water Street  
Mobile, Alabama 36602  
Phone: (251) 460-4006  
**James R. Walker, AIA, Project Architect**  
**George Keith Parker, AIA, Project Manager**

**ARCHITECT:** **POPULOUS**  
4800 Main Street, Suite 300  
Kansas City, Missouri 64112  
Phone: (816) 221-1500  
**Aaron Bruckerhoff, AIA, Project Architect**

**CONSTRUCTION  
MANAGER:** **VOLKERT, INC**  
11 N Water Street, Suite 18290  
Mobile, AL 36602  
Phone: (864) 245-1917  
**Sam Matheny, Program Manager**

**STRUCTURAL  
ENGINEERS:** **WALTER P MOORE**  
1301 McKinney Drive, Suite 1100  
Houston, TX 77010  
Phone: (713) 630-7300  
**Erin Kueht, P.E., Structural**

**MECHANICAL/ELECTRICAL  
PLUMBING/ FP ENGINEERS:** **HENDERSON ENGINEERS**  
1801 Main Street, Suite 300  
Kansas City, MO 64108  
Phone: (816) 663-8700  
**Tyler Johnson, P.E., Project Manager**  
**Evan O'Brien, P.E., Lead Mechanical**  
**Mike Fiser, P.E., Lead Electrical**

**CIVIL  
ENGINEERS:**

**DRIVEN ENGINEERING**  
805 Morris Hill Road  
Semmes, AL 36575-6445  
Phone: (251) 649-4011  
**Avalisha Fisher, P.E., Civil**

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

## VOLUME 1

### SECTION 00 01 10 – TABLE OF CONTENTS

#### DIVISION 00 – PROCUREMENT & CONTRACTING REQUIREMENTS

00 01 00	COVER
00 01 05	DIRECTORY
00 01 07	PROFESSIONAL SEALS
00 01 10	TABLE OF CONTENTS
00 10 00	INVITATION TO BID
00 20 00	INSTRUCTIONS TO BIDDERS
00 22 00	SUPPLEMENTARY INSTRUCTIONS TO BIDDERS
00 24 00	PROPOSAL FORM
00 25 00	ATTACHMENT A TO PROPOSAL FORM
00 50 00	STANDARD FORM OF AGREEMENT OWNER/CONTRACTOR AIA A101-2017
00 72 00	GENERAL CONDITIONS OF THE CONTRACT AIA A201-2017
00 73 00	SUPPLEMENTARY PROJECT CONDITIONS

#### DIVISION 01 – GENERAL REQUIREMENTS

01 10 00	SUMMARY
01 23 00	ALTERNATES
01 25 00	SUBSTITUTION PROCEDURES
01 26 00	CONTRACT MODIFICATION PROCEDURES
01 29 00	PAYMENT PROCEDURES
01 31 00	PROJECT MANAGEMENT AND COORDINATION
01 32 00	CONSTRUCTION PROGRESS DOCUMENTATION
01 33 00	SUBMITTAL PROCEDURES
01 35 16	ALTERATION PROJECT PROCEDURES
01 40 00	QUALITY REQUIREMENTS
01 42 00	REFERENCES
01 43 39	MOCKUPS
01 45 29	STRUCTURAL TESTING AND INSPECTIONS
01 50 00	TEMPORARY FACILITIES AND CONTROLS
01 60 00	PRODUCT REQUIREMENTS
01 73 00	EXECUTION
01 77 00	CLOSEOUT PROCEDURES
01 78 23	OPERATION AND MAINTENANCE DATA
01 78 39	PROJECT RECORD DOCUMENTS
01 79 00	DEMONSTRATION AND TRAINING

#### DIVISION 02 – EXISTING CONDITIONS

NOT ISSUED

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 03 – CONCRETE**

03 10 00	CONCRETE FORMING AND ACCESSORIES		
03 20 00	CONCRETE REINFORCING		
03 30 00	CAST IN PLACE CONCRETE		
03 35 43	POLISHED CONCRETE FINISHING		
03 41 34	PRECAST PRETENSIONED CONCRETE SEATING UNITS		
03 45 00	PRECAST ARCHITECTURAL CONCRETE		

**DIVISION 04 – MASONRY**

04 20 00	UNIT MASONRY		
04 21 13.23	ADHERED BRICK VENEER		

**DIVISION 05 – METALS**

05 12 00	STRUCTURAL STEEL FRAMING		
05 31 00	STEEL DECKING		
05 40 00	COLD-FORMED METAL FRAMING		
05 45 00	METAL SUPPORT ASSEMBLIES		
05 50 00	METAL FABRICATIONS		
05 51 13	METAL PAN STAIRS		
05 51 16	METAL FLOOR PLATE STAIRS		
05 51 19	METAL GRATING STAIRS		
05 52 13	PIPE AND TUBE RAILINGS		
05 53 13	BAR GRATINGS		
05 70 00	DECORATIVE METAL		
05 70 10	VISION BARRIERS		
05 73 13	GLAZED DECORATIVE METAL RAILINGS		
05 75 00	DECORATIVE FORMED METAL		

**DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES**

06 10 00	ROUGH CARPENTRY		
06 20 00	FINISH CARPENTRY		
06 40 00	ARCHITECTURAL WOODWORK		
06 42 16	FLUSH WOOD PANELING		
06 65 00	SOLID SURFACE FABRICATIONS		

**DIVISION 07 – MOISTURE PROTECTION**

07 11 13	BITUMINOUS DAMPROOFING		
07 13 26	SHEET WATERPROOFING		
07 18 00	TRAFFIC COATINGS		
07 21 00	THERMAL INSULATION		
07 26 16	BELOW-GRADE VAPOR RETARDERS		
07 27 26	FLUID-APPLIED MEMBRANE AIR BARRIERS		

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
07 42 13	INSULATED METAL WALL PANELS		
07 42 93	SOFFIT PANELS		
07 46 46	FIBER-CEMENT SIDING		
07 54 19	PVC MEMBRANE ROOFING		
07 62 00	SHEET METAL FLASHING AND TRIM		
07 71 00	ROOF SPECIALTIES		
07 72 00	ROOF ACCESSORIES		
07 76 00	ROOF PAVER AND PEDESTAL SYSTEM		
07 81 00	APPLIED FIRE PROTECTION		
07 81 23	INTUMESCENT FIRE PROTECTION		
07 82 00	BOARD FIRE PROTECTION		
07 84 13	PENETRATION FIRESTOPPING		
07 84 43	JOINT FIRESTOPPING		
07 91 00	PREFORMED PRECAST SEATING BOWL JOINT TREATMENTS		
07 92 00	JOINT SEALANTS		
07 95 00	EXPANSION CONTROL		

**DIVISION 08 – OPENINGS**

08 11 13	HOLLOW METAL DOORS AND FRAMES
08 14 16	FLUSH WOOD DOORS
08 31 13	ACCESS DOORS AND FRAMES
08 33 13	COILING COUNTER SHUTTERS
08 33 23	OVERHEAD COILING DOORS
08 41 13	ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
08 44 13	GLAZED ALUMINUM CURTAIN WALLS
08 51 13	ALUMINUM WINDOWS
08 56 53	SECURITY WINDOWS

**VOLUME 2**

08 71 00	DOOR HARDWARE
08 80 00	GLAZING
08 81 13	DECORATIVE GLASS GLAZING
08 83 00	MIRRORS
08 88 53	SECURITY GLAZING
08 91 19	FIXED LOUVERS

**DIVISION 09 – FINISHES**

09 21 16.23	GYPSUM BOARD SHAFT WALL ASSEMBLIES
09 22 16	NON-STRUCTURAL METAL FRAMING
09 29 00	GYPSUM BOARD
09 30 13	TILE
09 51 00	SUSPENDED CEILING SYSTEMS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
09 61 13	FLOOR SEALERS		
09 61 23	HAZARD STRIPING		
09 65 13	RESILIENT BASE AND ACCESSORIES		
09 65 16	RESILIENT SHEET FLOORING		
09 65 19	RESILIENT TILE FLOORING		
09 66 23	RESINOUS MATRIX TERRAZZO FLOORING		
09 67 23	RESINOUS FLOORING		
09 68 00	CARPETING		
09 69 00	ACCESS FLOORING		
09 72 00	WALL COVERINGS		
09 72 19	GRAPHICS WALL COVERINGS		
09 84 33	SOUND-ABSORBING WALL UNITS		
09 84 36	SOUND-ABSORBING CEILING UNITS		
09 91 13	EXTERIOR PAINTING		
09 91 23	INTERIOR PAINTING		
09 93 00	STAINING AND TRANSPARENT FINISHING		
09 96 00	HIGH-PERFORMANCE COATINGS		

**DIVISION 10 – SPECIALTIES**

10 11 00	VISUAL DISPLAY UNITS
10 12 00	DISPLAY CASES
10 14 00	SIGNAGE
10 21 13.14	STAINLESS STEEL TOILET COMPARTMENTS
10 21 16	SHOWER AND DRESSING COMPARTMENTS
10 22 26.13	ACCORDION FOLDING PARTITIONS
10 22 29	UPFOLDING PANEL PARTITIONS
10 22 39	FOLDING PANEL PARTITIONS
10 26 00	WALL AND DOOR PROTECTION
10 28 00	TOILET, BATH, AND LAUNDRY ACCESSORIES
10 28 19	TUB AND SHOWER ENCLOSURES
10 35 00	FLAGPOLES
10 43 13	DEFIBRILLATOR CABINETS
10 43 14	AUTOMATED EXTERNAL DEFIBRILLATORS
10 44 13	FIRE PROTECTION CABINETS
10 44 16	FIRE EXTINGUISHERS
10 51 13	METAL LOCKERS
10 51 19	PHENOLIC LOCKERS
10 51 20	CUSTOM WOOD LOCKERS
10 53 00	WALKWAY COVERS



SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 11 – EQUIPMENT**

11 13 13	LOADING DOCK BUMPERS
11 13 16	LOADING DOCK SEALS AND SHELTERS
11 13 19	STATIONARY LOADING DOCK EQUIPMENT
11 23 00	COMMERCIAL LAUNDRY EQUIPMENT
11 31 00	RESIDENTIAL APPLIANCES
11 40 00	FOOD SERVICE EQUIPMENT
11 47 00	ICE MACHINES
11 61 00	THEATER AND STAGE EQUIPMENT
11 61 43	STAGE CURTAINS
11 61 44	HALF-HOUSE CURTAINS
11 61 53	ARENA CURTAINS
11 82 26	FACILITY WASTE COMPACTORS

**DIVISION 12 – FURNISHINGS**

12 22 00	CURTAINS AND DRAPES
12 36 16	METAL COUNTERTOPS
12 48 13	ENTRANCE FLOOR MATS AND FRAMES
12 63 26	ARENA SEATS
12 66 00	TELESCOPING STANDS
12 66 23	PORTABLE PLATFORMS

**DIVISION 13 – SPECIAL CONSTRUCTION**

13 17 00	HYDROTHERAPY EQUIPMENT, POOLS, AND TUBS
13 18 11	ICE RINK GENERAL REQUIREMENTS
13 18 12	ICE RINK REFRIGERATION SYSTEM
13 18 13	ICE RINK FLOOR SYSTEM
13 18 14	ICE RINK PIPING, VALVES, AND ACCESSORIES
13 18 15	ICE RINK WASTE HEAT RECOVERY SYSTEM
13 18 16	ICE RINK DASHER BOARD SYSTEM AND ACCESSORIES

**VOLUME 3**

13 18 17	ICE RINK CENTRAL CONTROL SYSTEM
13 18 19	ICE RINK WATER TREATMENT SYSTEM
13 28 16	HOCKEY SAFETY NETTING SYSTEM

**DIVISION 14 – CONVEYING SYSTEMS**

14 21 00	GEARLESS MACHINE ROOM LESS TRACTION ELEVATORS
14 22 00	ELECTRIC TRACTION FREIGHT ELEVATORS
14 31 00	ESCALATORS
14 42 00	WHEELCHAIR LIFTS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 21 – FIRE SUPPRESSION**

21 00 00	TABLE OF CONTENTS AND SEAL		
21 00 10	GENERAL FIRE SUPPRESSION REQUIREMENTS		
21 05 00	COMMON WORK RESULTS FOR FIRE SUPPRESSION		
21 05 15	BASIC FIRE SUPPRESSION PIPING METHODS AND MATERIALS		
21 05 53	IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT		
21 11 00	FIRE SUPPRESSION WATER SERVICE PIPING		
21 12 00	FIRE SUPPRESSION STANDPIPES		
21 13 13	WATER BASED FIRE SUPPRESSION SYSTEMS		
21 31 13	ELECTRIC DRIVE CENTRIFUGAL PUMPS		

**DIVISION 22 – PLUMBING**

22 00 00	TABLE OF CONTENTS AND SEAL		
22 00 10	GENERAL PLUMBING REQUIREMENTS		
22 00 15	COORDINATION		
22 05 10	COMMON WORK RESULTS FOR PLUMBING		
22 05 13	COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT		
22 05 15	BASIC PIPING MATERIALS AND METHODS		
22 05 19	METERS AND GAUGES FOR PLUMBING PIPING		
22 05 23	GENERAL DUTY VALVES FOR PLUMBING PIPING		
22 05 29	HANGERS AND SUPPORTS FOR PLUMBING PIPING		
22 05 33	HEAT TRACING FOR PLUMBING PIPING		
22 05 50	VIBRATION ISOLATION FOR PLUMBING PIPING AND EQUIPMENT		
22 05 53	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT		
22 07 00	PLUMBING INSULATION		
22 11 00	WATER DISTRIBUTION PIPING AND SPECIALTIES		
22 11 11	MECHANICALLY JOINED PLUMBING PIPING SYSTEMS		
22 11 14	STAINLESS STEEL WATER DISTRIBUTION PIPING & SPECIALTIES		
22 11 23	DOMESTIC WATER PUMPS		
22 13 00	SANITARY DRAINAGE AND VENT PIPING & SPECIALTIES		
22 13 28	CONDENSATE PUMPS FOR HVAC EQUIPMENT		
22 14 00	STORM DRAINAGE PIPING AND SPECIALTIES		
22 14 89	SUMP PUMPS		
22 34 00	FUEL FIRED DOMESTIC WATER HEATERS		
22 40 00	PLUMBING FIXTURES		
22 70 00	NATURAL GAS SYSTEMS		

**DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING**

23 00 00	TABLE OF CONTENTS AND SEAL		
23 00 10	GENERAL MECHANICAL REQUIREMENTS		
23 00 15	ELECTRICAL COORDINATION FOR MECHANICAL EQUIPMENT		

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

23 05 00	COMMON WORK RESULTS FOR HVAC
23 05 10	BASIC PIPING MATERIALS AND METHODS
23 05 13	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
23 05 14	VARIABLE FREQUENCY DRIVES
23 05 16	EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING
23 05 19	METERS AND GAUGES FOR HVAC PIPING
23 05 23	GENERAL DUTY VALVES FOR HVAC PIPING
23 05 29	HANGERS AND SUPPORTS FOR HVAC PIPING & EQUIPMENT
23 05 50	VIBRATION ISOLATION FOR HVAC
23 05 53	IDENTIFICATION FOR HVAC PIPING & EQUIPMENT
23 05 93	TESTING, ADJUSTING AND BALANCING FOR HVAC
23 07 00	HVAC INSULATION
23 08 00	COMMISSIONING OF HVAC SYSTEMS
23 09 13	INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
23 09 14	REFRIGERANT MONITORING SYSTEMS
23 09 23	DIRECT-DIGITAL CONTROL FOR HVAC
23 21 13	HYDRONIC PIPING
23 21 13.13	BURIED HYDRONIC AND STEAM PIPING
23 21 13.23	MECHANICALLY JOINED HYDRONIC PIPING SYSTEMS
23 21 14	HYDRONIC SPECIALTIES
23 21 23	HYDRONIC PUMPS
23 25 00	HVAC WATER TREATMENT
23 31 13	METAL DUCTS
23 33 00	AIR DUCT ACCESSORIES
23 34 23	HVAC POWER VENTILATORS
23 34 33	AIR CURTAINS
23 36 00	AIR TERMINAL UNITS
23 37 13	DIFFUSERS, REGISTERS AND GRILLES
23 51 00	BREECHES, CHIMNEYS AND STACKS
23 51 13	DRAFT CONTROL DEVICES
23 52 16	CONDENSING BOILERS
23 53 23	BOILER ACCESSORIES
23 64 16	CENTRIFUGAL WATER CHILLERS
23 65 00	COOLING TOWERS
23 72 00	AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

#### **VOLUME 4**

23 73 13	CENTRAL STATION AIR HANDLING UNITS
23 82 00	TERMINAL HEATING AND COOLING UNITS
23 84 14	SELF CONTAINED HUMIDIFIERS
23 84 17	DESICCANT WHEEL UNITS
23 84 19	HYDROTHERAPY AIR HANDLING UNITS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 26 – ELECTRICAL**

26 00 00	TABLE OF CONTENTS AND SEAL
26 00 10	GENERAL ELECTRICAL REQUIREMENTS
26 05 00	COMMON WORK RESULTS FOR ELECTRICAL
26 05 02	EQUIPMENT WIRING SYSTEMS
26 05 04	PROVISIONS FOR ELECTRIC UTILITY SERVICE
26 05 19	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES
26 05 26	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
26 05 33	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
26 05 43	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS
26 05 53	IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 05 73	POWER SYSTEM STUDIES
26 09 10	CENTRALIZED DIMMING SYSTEM
26 09 23	LIGHTING CONTROL DEVICES
26 22 00	LOW-VOLTAGE TRANSFORMERS
26 24 13	SWITCHBOARDS
26 24 16	PANELBOARDS
26 27 26	WIRING DEVICES
26 28 13	FUSES
26 28 16	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
26 32 13	PACKAGED ENGINE-DRIVEN GENERATORS
26 33 53	STATIC UNINTERRUPTIBLE POWER SUPPLIES
26 36 00	TRANSFER SWITCHES
26 41 13	LIGHTNING PROTECTION FOR STRUCTURES
26 43 13	SURGE PROTECTIVE DEVICES
26 51 00	INTERIOR LIGHTING
26 53 00	INDOOR ARENA LIGHTING
26 56 00	EXTERIOR AREA LIGHTING

**DIVISION 27 – COMMUNICATIONS (TECHNOLOGY)**

27 00 00	TABLE OF CONTENTS - COMMUNICATIONS
27 05 00	COMMONWORK RESULTS FOR COMMUNICATIONS
27 05 26	GROUNDING AND BONDING FOR COMMUNICATIONS
27 05 28	PATHWAYS FOR COMMUNICATIONS
27 05 43	UNDERGROUND PATHWAYS & STRUCTURES FOR COMMUNICATIONS SYSTEMS
27 05 53	IDENTIFICATIONS FOR COMMUNICATIONS
27 11 00	COMMUNICATIONS EQUIPMENT ROOM FITTINGS
27 13 00	COMMUNICATIONS BACKBONE CABLING
27 15 00	COMMUNICATIONS HORIZONTAL CABLING
27 31 24	IP TELEPHONE SYSTEM
27 32 44	EMERGENCY RESPONDER TESTING

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
27 35 23	EMERGENCY RESPONDER RADIO COVERAGE		
27 60 00	NETWORK ELECTRONICS		
27 62 00	WIRELESS NETWORK SYSTEMS		

**DIVISION 27 – COMMUNICATIONS (AUDIO – VIDEO)**

27 00 01	TABLE OF CONTENTS AND SEAL – AUDIO-VIDEO
27 00 11	GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO - VIDEO
27 05 01	COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO - VIDEO
27 41 00	AUDIO VIDEO SYSTEMS
27 41 16	AUDIO VIDEO SYSTEMS EQUIPMENT
27 41 22	LARGE FORMAT DISPLAY SYSTEMS
27 41 33	TELEVISION DISTRIBUTION SYSTEM
27 41 51	BROADCAST SYSTEMS PRE-WIRE

**DIVISION 28 – ELECTRONIC SAFETY AND SECURITY**

28 00 00	TABLE OF CONTENTS (SECURITY)
28 05 00	BASIC SECURITY REQUIREMENTS
28 05 20	BASIC SECURITY MATERIALS AND METHODS
28 05 26	GROUNDING AND BONDING FOR SECURITY SYSTEMS
28 05 28	SECURITY SYSTEMS PATHWAYS AND SUPPORT EQUIPMENT
28 13 00	ACCESS CONTROL SOFTWARE AND DATABASE MANAGEMENT
28 15 00	ACCESS CONTROL HARDWARE DEVICES
28 15 23	INTERCOM ENTRY SYSTEM
28 23 00	VIDEO SURVEILLANCE CAMERA SYSTEMS
28 41 10	SECURITY CONTROL ROOM EQUIPMENT
28 45 00	TABLE OF CONTENTS AND SEAL (FIRE ALARM)
28 46 00	FIRE DETECTION AND ALARM

**VOLUME 5****DIVISION 31 – EARTHWORK**

02 06 13	GEOTECHNICAL REPORT - SEE APPENDIX
31 00 00	TABLE OF CONTENTS AND SEAL
31 00 00	EARTHWORK
31 11 00	CLEARING, GRUBBING AND DEMOLITION
31 22 00	SITE GRADING
31 23 23 23	SOIL COMPACTION CONTROL
31 40 00	SHORING AND UNDERPINNING
31 63 29	DRILL DISPLACEMENT CAST-IN-PLACE PILES
32 12 16	ASPHALT PAVING
32 13 13	CONCRETE PAVING, CURBS, AND WALKS
32 90 00	PLANTING
33 14 11	WATER SERVICE PIPING
33 30 00	SANITARY SEWERAGE

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
33 31 00	SANITARY SEWER COLLECTION SYSTEM		
33 40 00	STORMWATER UTILITIES		

**DIVISION 32 – EXTERIOR IMPROVEMENTS**

32 00 00	TABLE OF CONTENTS AND SEAL
32 13 13	CONCRETE PAVING
32 13 16	DECORATIVE CONCRETE PAVING
32 13 73	CONCRETE PAVING JOINT SEALANTS
32 14 00	UNIT PAVING
32 17 26	TACTILE WARNING SURFACING
32 31 16	WELDED WIRE FENCES AND GATES
32 31 19	DECORATIVE METAL FENCES AND GATES
32 31 19.53	DECORATIVE METAL SECURITY FENCES AND GATES
32 32 23	SEGMENTAL RETAINING WALLS
32 33 00	SITE FURNISHINGS
32 84 00	PLANTING IRRIGATION
32 84 23	IRRIGATION WORK
32 90 00	PLANTING (LANDSCAPE WORK)
32 90 05	LANDSCAPE MAINTENANCE
32 91 13	SOIL PREPARATION
32 92 00	TURF AND GRASSES
32 92 23	SODDING
32 93 00	PLANTS

**DIVISION 33 – UTILITIES**

REFER TO DIVISION 31 ABOVE

**APPENDIX**

GEOTECHNICAL REPORT DATED AUGUST 16, 2024 (from Geotechnical Engineering Testing, Inc.)  
AVAILABLE UPON REQUEST

END OF SECTION

**SECTION 13 18 17 - ICE RINK CENTRAL CONTROL SYSTEM****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. This section includes labor, materials, equipment, skills and related services necessary to furnish and install an ice rink control system (IRCS) for the ice rink refrigeration system.
- B. General Requirements
- C. General System Description and Design Criteria
- D. References
- E. Submittals
- F. Warranty
- G. Products, Delivery, Storage and Handling Requirements
- H. Products
- I. Execution / Performance

**1.2 RELATED SECTIONS**

- A. Division 0, Division 1, General and Supplemental Conditions
- B. Section 131811 – Ice Rink General Requirements
- C. Section 131812 – Ice Rink Refrigeration System
- D. Section 131815 – Ice Rink Waste Heat Recovery Systems
- E. Drawing Sheets show locations and quantities of equipment for the refrigeration system.

**1.3 GENERAL REQUIREMENTS**

- A. All work of this Division shall be coordinated and provided by the single Ice Rink Control System (IRCS) Contractor.
- B. The work of this Division shall be scheduled, coordinated and interfaced with the associated work of other trades. Reference the other Division 13 Sections for details.
- C. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.
- D. If the IRCS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the Engineer.
- E. Provide connection points to collect and manipulate data from power monitoring device specified in Section 13 18 12 Ice Rink Refrigeration System.
- F. The IRCS Contractor is responsible for the design of the control system.
- G. The refrigeration system shall have sufficient manual controls to allow the system to operate without the computer control system if the computer control system fails.

**1.4 GENERAL SYSTEM DESCRIPTION AND DESIGN CRITERIA**

- A. The Ice Rink Control System (IRCS) shall be a complete system to operate the ice rink refrigeration system and all its functions and monitoring requirements and include the following:

1. An 18" (minimum size) touch screen microprocessor control system to control and manage the refrigeration system and all its components, functions and alarms.
  2. The capability of remote access through an Owner provided data/phone circuit. Contractor to supply phone line to unit. Owner will supply any data lines required for connection with building management, energy management or IT systems.
  3. Provide all control and monitoring points and alarms to the Building Management System (BMS) or Energy Management System (EMS) as specified elsewhere.
- B. The work of the single IRCS Contractor shall be as defined individually and collectively in all Sections of Division 13 of these specifications together with the Drawings.
- C. The IRCS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned IRCS.
- D. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.
- E. The IRCS shall be integrated with the refrigeration system's specified motor control center (MCC) and shall be located in a wall mounted, NEMA rated, steel enclosure.

## 1.5 REFERENCES

- A. In addition to the references listed in Section 131811 - Ice Rink General, all work shall conform to the following Codes and Standards, as applicable:
1. National Fire Protection Association (NFPA) Standards.
  2. National Electric Code (NEC) and applicable local Electric Code
  3. Underwriters Laboratories (UL) listing and labels.
  4. UL 864 UUKL Smoke Control
  5. UL 268 Smoke Detectors.
  6. UL 916 Energy Management
  7. NFPA 70 - National Electrical Code.
  8. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
  9. NFPA 92A and 92B Smoke Purge/Control Equipment. Factory Mutual (FM).
  10. American National Standards Institute (ANSI).
  11. National Electric Manufacturer's Association (NEMA).
  12. American Society of Mechanical Engineers (ASME).
  13. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) user note: add ASHRAE 62 IAQ as applicable .
  14. Air Movement and Control Association (AMCA).
  15. Institute of Electrical and Electronic Engineers (IEEE).
  16. American Standard Code for Information Interchange (ASCII).
  17. Electronics Industries Association (EIA).
  18. Occupational Safety and Health Administration (OSHA).
  19. American Society for Testing and Materials (ASTM).
  20. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
  21. Americans Disability Act (ADA)
  22. ANSI/EIA 909.1-A-1999 (LonWorks)
  23. ANSI/ASHRAE Standard 195-2004 (BACnet)
- B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.



- C. All work shall meet the approval of the authorities having jurisdiction at the project site.
- D. Definitions:
  - 1. EMS – Energy Management System
  - 2. BMS – Building Management System
  - 3. DDC – Direct Digital Control
  - 4. IRCS – Ice Rink Control System

## 1.6 SUBMITTALS

- A. Shop Drawings. All submittals shall conform to the requirements of General Conditions and Section 131811 - Ice Rink General Requirements.
- B. The IRCS contractor shall submit a list of all shop drawings with submittals dates within 45 days of contract award from City to Ice Rink Contractor.
- C. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Engineer for Contract compliance.
- D. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the IRCS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.
- E. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
- F. The IRCS Contractor shall correct any errors or omissions noted in the first review.
- G. At a minimum, submit the following:
  - 1. IRCS network architecture diagrams including all nodes and interconnections. Include future/existing BMS/EMS connection.
  - 2. Systems schematics, sequences and flow diagrams.
  - 3. Points schedule for each point in the IRCS, including Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
  - 4. Samples of screen menus.
  - 5. Details of all IRCS interfaces and connections.
  - 6. Product data sheets or marked catalog pages including part number, photo and description for all products including software.

## 1.7 RECORD DOCUMENTATION

- A. Provide the following information in addition to the requirements of Section 131811 - Ice Rink General Requirements.
  - 1. Operation and Maintenance Manuals
    - a. One (1) hard copy and three (3) electronic copies on compact disc (CD) format of the entire Operation and Maintenance Manuals shall be provided to the Engineer upon completion of the Project. Include the following for the IRCS:
      - 1) Table of contents.
      - 2) As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
      - 3) Manufacturer's product data sheets or catalog pages for all products including software.
      - 4) System and Software Operator's manuals.
      - 5) Archive copy of all site-specific databases and sequences.
      - 6) IRCS and BMS network diagrams.
      - 7) Interfaces to all third-party products and work by other trades.

- 8) Operating license for all software.
- b. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

### **1.8 WARRANTY GUARANTY**

- A. As required in Section 131811 - Ice Rink General Requirements.
- B. Provide as-built drawings to include a board and points list for the system.
- C. The Ice Rink Control Contractor must furnish 8 hours of checkout and walk through time at refrigeration start up with the Owners personnel.
- D. Contractor shall ensure all warranties and extended warranties are properly filed for all systems and equipment. A copy of all warranties shall be inserted in the Operation and Maintenance Manuals.

### **1.9 PRODUCT DELIVERY STORAGE AND HANDLING REQUIREMENTS**

- A. As required in Section 131811 - Ice Rink General Requirements.

### **1.10 QUALIFICATIONS**

- A. As evidence and assurance of the contractor's controls subcontractor's ability to construct the project, the control subcontractor must have successfully completed the design, programming and installation of five (5) ice rink control systems similar to this project within the past five (5) years.

## **PART 2 - PRODUCTS**

### **2.1 APPROVED MANUFACTURERS**

- A. Control systems by Alerton by NAC (651.490.9869, [www.nac-hvac.com](http://www.nac-hvac.com)), Tridium-Vykon by Total Mechanical Services, Inc. (651.768.9367, [www.totalmech.com](http://www.totalmech.com)) Cimco SmartHub and Distech, WAGO, or equal manufacturer.

### **2.2 GENERAL**

- A. Furnish and install a complete ice rink control system (IRCS) including all controllers, alarm devices, enclosures, transformers, sensors, transducers, boards required for a complete monitoring system.
- B. Provide an uninterruptible power supply (UPS) that provides 20-minute run time during a power failure. The purpose of this system is to allow the system to run long enough to send out alarms.

### **2.3 CONTROLLERS**

- A. Alerton Visual Logic Controller (VLC) or equal. Furnish and install all cards and boards required.
- B. Provide remote monitoring capabilities.
- C. All panels and devices must utilize BACnet ANSI/ASHRAE Standards 135-2004, as required to interact with the existing/future BMS/EMS, on a single building level network.
- D. Provide web accessible graphic monitoring and control system. All system access shall be compatible with standard, current web browsers.

**2.4 GRAPHICAL USER INTERFACE (GUI)**

- A. The Graphical User Interface shall allow the operator to view, configure, and edit values from multiple controllers. The GUI shall be completely programmable and shall be wall mounted.
- B. Operator interface shall be via a wall mounted touch screen display with ASHRAE standard user definable graphical icons associated with any displayed variable.
- C. Variables such as alarms, trends, set points, analog and digital values may be displayed and/or edited using the GUI.
- D. The GUI shall be menu based displaying a minimum of 16 menus. Menus shall be arranged logically.
- E. The graphics shall provide a visual representation of the ice rink, refrigeration system and equipment with associated hardware point's locations displayed symbolically and monitoring inputs shown.

**2.5 OTHER SYSTEMS**

- A. ICRS shall communicate with the refrigerant gas monitoring system, power monitoring device, ventilation system, building management system and fire alarm system. See Section 131813 – Ice Rink Refrigeration System.

**2.6 ENCLOSURES**

- A. Furnish and install all required enclosures. Furnish and install weatherproof enclosures for exterior equipment such as the condenser. Seal all unused knockout holes with silicon sealant. Label enclosure.

**2.7 SENSORS AND TRANSDUCERS**

- A. Approved Manufacturers: Rochester Gauges, Inc., Computer Process Controls, Inc., Ashcroft Inc., Kele Inc., Omega, JW Instruments, ACI, SETRA, or equal.
- B. Furnish and install all sensors, transducers and all other devices required to control and monitor systems.
- C. Scale on sensors shall be as specified in the contract drawings for monitoring devices. If not specified, shall be typical of similar systems.
- D. Temperature Sensor Accuracy. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

P POINT	A ACCURACY
Glycol/Brine (warm or cold)	.5°F
Ice/Subfloor Temperature	.5°F
All Others	.5°F

- E. Resistance Temperature Detectors (RTD) Assemblies:
  - 1. RTD: Single Element, platinum, 3 wire, Tolerance Class A, 316 stainless steel sheath. Length to be at approximately 10% longer than radius of pipe.
  - 2. Temperature Ranges:
    - a. Return brine/glycol: 0-50F.
    - b. Others: As required.
  - 3. Spring loaded.
  - 4. NPT stainless steel hex nipple.

5. Aluminum screw cover head – NEMA 4X rated.
- F. Thermowell:
  1. Shall be standard duty threaded (NPT), 304 stainless steel, NPT size as required to accommodate RTD or other devices.
  2. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
  3. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.

## 2.8 INFRARED SENSORS

- A. Approved manufacturers: Raytek M13 sensors and boxes or approved equal.
- B. Furnish and install one complete infrared temperature sensor system with (2) sensors and shall include all equipment, wiring, configuration, programming, setup, hangers, supports and all related work.
- C. Terminate wiring in ice system control panel. Program and configure controller to control start/stop function on packaged refrigeration systems based on user adjustable set-point and IR sensor input as an option to controlling packaged refrigeration systems on return glycol.
- D. Provide visibility of IR Sensors Ice Temperature on control system.
- E. Install above the ice rink floor where shown on the drawings. Field verify sensor wire and conduit routing.

## 2.9 LOW VOLTAGE CABLE

- A. Cable: Shall be level-4, twisted pair, stranded and shielded.
- B. Wire: Shall be 22 AWG, 0.65 mm diameter.
- C. Loop Resistance: 106 ohms/km
- D. Capacitance: 49 nf/km

## 2.10 CABLE FOR SENSORS TRANSDUCERS AND CONTROL RELAY

- A. Temperature Sensors and 2 Wire Inputs Sensors: (Dry contact, 4-20 ma, and low voltage): 2-wire input sensor cable shall be 2 conductor, stranded, shielded, twisted, PVC jacketed 22 AWG, (Belden #8761 or equiv.). Cable runs over 800 feet shall be a minimum of 18 AWG.
- B. Control Relays (low voltage or dry contact only): Cable shall be 2 conductors, stranded, twisted, PVC jacketed 18 AWG cable, (Belden #8461 or equiv.).
- C. Pressure Transducers: Cable shall be 3 conductors, stranded, shielded, twisted, PVC jacketed 22 AWG, (Belden #8771 or equiv.). Cable runs over 800 feet shall be a minimum of 18 AWG.

## 2.11 CONDUIT

- A. Cable: General: Conduit for all high voltage, low voltage, and communication connections must be run and connected in accordance to meet current electrical code standards.
- B. High Voltage Connections:
  1. Separate conduit shall be run from each refrigeration/HVAC controller, IRLDS-II panels, Input/output boards, and control boards to each respective enclosure or panel housing their source of power. Conduit will not be necessary if equipment is mounted directly to enclosure housing source of power providing electrical couplings are fitted to link enclosures permitting enough room to supply power wires to equipment.

- C. Low Voltage Connections:
1. Controllers: Separate conduit will be run to connect any Alerton VLC, or equal controllers where by the units are separated from each other in different rooms. Conduit will be labeled at each end as "echelon net and/or 485 com" and to what controller opposite end of conduit leads to.
  2. Input / output boards: Separate conduit will be run to connect any enclosures housing I/O and/or controller boards where communication wires are needed to link each other through an area outside of the building structure ensuring no communication wires are left exposed to outside air. Conduit will be labeled at each end as to what I/O board and/or controller the opposite end of conduit leads to.
  3. Sensors: Separate conduit per island or dual-temp case shall be run in slabs from equipment enclosure housing respective I/O boards of each case to enclosed area of case. Conduit shall be labeled with case or I/O board number on each end of conduit.

## 2.12 LABELS

- A. All components, devices and cables shall be identified with printed labels. Labels shall include name of equipment, unit numbers, identify associated equipment and devices.
- B. Cables shall have labels at each end.
- C. Input and Output relays, digitals controls shall be labeled with control description.
- D. Alarms shall be labeled as "out alarms" or "in alarms".

## 2.13 ALARM LIGHT AND STROBE

- A. Furnish one (1) alarm strobe light with time delay button.

## 2.14 INFRARED SENSORS

- A. Approved manufacturers: Raytek M13 sensors and boxes or approved equal.
- B. Furnish and install one complete infrared temperature sensor system with (2) sensors and shall include all equipment, wiring, configuration, programming, setup, hangers, supports and all related work.
- C. Terminate wiring in ice system control panel. Program and configure controller to control start/stop function on packaged refrigeration systems based on user adjustable set-point and IR sensor input as an option to controlling packaged refrigeration systems on return glycol.
- D. Provide visibility of IR Sensors Ice Temperature on control system.
- E. Install above the ice rink floor in owner directed location. Field verify and coordinate conduit and wire routing.

## PART 3 - EXECUTION PERFORMANCE

### 3.1 GENERAL INSTALLATION

- A. Installation shall be in accordance with manufacturers' recommendations.

### 3.2 SENSOR AND TRANSDUCER INSTALLATION

- A. All sensors and transducers are to be mounted in an appropriate location. All pressure transducers must be mounted in an upward vertical position and accessible for adjustment. All sensors and transducers are to be properly set up through software and hardware.

**3.3 WIRE INSTALLATION**

- A. No cable will be run in the same conduit as line voltage wiring.
- B. All cables can be run exposed whenever permitted by code and shall be secured in such a manner so that they are not visible from the floor.
- C. Communications cables connecting boards shall be run from board to board in a logical daisy chained fashion with no breaks, or star configurations.

**3.4 GAS MONITORING SYSTEM CONNECTIONS**

- A. Connect gas monitoring system unit outputs to IRCS for alarming and monitoring functions.
- B. An alarm strobe light and bell with time delay button shall be mounted by the controller.
- C. Furnish and install one dry contact pushbutton. Mount switches to the outside of alarm panel. Label one switch as "Sign Override".
- D. Settings shall enable alarms to stay "on" if system fails.
- E. Program all necessary set points, parameters, and alarm settings for proper operation.

**3.5 ALARMS**

- A. All alarm parameters must be programmed and fine-tuned at time of product delivery.
- B. Owner must be notified of all alarms through email and text messages.
- C. Connect ice system controls to automatic dialer system, specified in Section 131812 – Ice Rink Refrigeration System, for alarm notifications.
- D. Outside alarms must be tested in the present of Owner's representative.
- E. All alarms and settings identified herein are recommended guidelines for initial system setup. These settings shall be fully adjustable.
- F. The following alarms and Set Points shall be established.
  - 1. Compressor high discharge pressure - 200 psi
  - 2. Compressor high discharge temperature - 300°F
  - 3. Compressor low suction pressure - 10 psi
  - 4. Compressor high oil temperature - 150°F
  - 5. Compressor low oil temperature - 90°F
  - 6. Compressor low oil net pressure - 15 psi (net oil pressure – suction pressure)
  - 7. Brine/glycol return high temperature - 24°F.
  - 8. Heat recovery water heater high water temperature - 150°F
  - 9. Emergency bypass/crossover solenoid valve activation - 235psi
  - 10. Refrigeration system power failure.
- G. The following equipment shall be monitored for status/current after a start command has been given. Alarms shall be recorded and require manual user reset when the current monitoring has identified that the equipment is not operating.
  - 1. Compressors
  - 2. Brine/glycol pumps
  - 3. Condenser Fan and Water Pump
  - 4. Snowmelt pump
  - 5. Subfloor pump
- H. The following alarms shall be recorded and automatically de-energize the associated compressor. When the alarms are cleared, the user must manually reset alarms through on-site access or remote access to bring associated compressors back into operation.
  - 1. Compressor high discharge pressure.

- 2. Compressor low suction pressure.
  - 3. Compressor high discharge temperature.
  - 4. Compressor high oil temperature.
  - 5. Compressor low oil pressure (net).
  - 6. Start failure (MCC failure for motor overload, phase loss, etc.)
- I. The following alarms shall be recorded and automatically de-energize all compressors. When the alarm condition is cleared, the compressor shall automatically reset. The alarm shall remain in a latched state for operator to identify that alarm occurred.
- 1. Chiller flow switch
  - 2. Emergency stop activated.
  - 3. Refrigerant leak detection activation

**3.6 CABLE FOR SENSOR TRANSDUCERS AND CONTROL RELAY INSTALLATION**

- A. No cable will be run in the same conduit as line voltage wiring.
- B. All cables can be run exposed whenever permitted by code and shall be secured in such a manner so that they are not visible from the floor.
- C. Cables with multiple conductors to accommodate more than one sensor can be utilized for island and dual-temp cases only, providing all limitations are met through specifications for each sensor connected.
- D. Cables for input sensors shall be run with no breaks or splices from the I/O board to sensors wires. Use wire butt connector. Do not use wire nuts.
- E. Cables for control relays shall be run with no breaks or splices from the I/O board to termination on points of relay.

**3.7 PENETRATIONS**

- A. Provide fire stopping for all penetrations used by dedicated BMS/EMS conduits and raceways.
- B. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
- C. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
- D. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

**3.8 GENERAL POINTS LIST**

- A. The IRCS shall, at minimum, monitor the following system points and points necessary for a complete control system as described in this section.
- B. Points Type Legend:
  - 1. AI – Analog Input
  - 2. AO – Analog Output
  - 3. BI – Binary Input
  - 4. BO – Binary Output

GENERAL				
D□□□□□□□□	F□□□□□□□	U□□□	I□□□□ O□□□□□	T□□□
Outdoor Air Temperature	Monitor	Degree F	Input	AI
Outdoor Relative Humidity	Monitor	%	Input	AI

Refrigeration System Power Status	Monitor	On/Off	Input	BI
Power Usage (Electric Submeter)	Monitor/Logging	KWH	Input	
System Enable Switch	Monitor	On/Off	Input	
Spare				
Spare				
<b>ALARMS AND SAFETIES</b>				
<b>D</b> □□□□□□□□	<b>F</b> □□□□□□	<b>U</b> □□□	<b>I</b> □□□□ <b>O</b> □□□□□	<b>T</b> □□□
Refrigeration System Emergency Stop	Control	On/Off	Input	BI
Leak Detection Refrigerant Level	Monitor	PPM	Input	AI
Leak Detection Alarm Level 1	Monitor		Input	BI
Leak Detection Alarm Level 2	Monitor		Input	BI
Leak Detection Alarm Level 3	Monitor		Input	BI
Leak Detection Alarm Level 4	Monitor		Input	BI
Chiller Flow Switch	Monitor		Input	BI
Condenser fan fails to run	Monitor		Input	BI
Spare				
<b>SOLENOID VALVES</b>				
<b>D</b> □□□□□□□□	<b>F</b> □□□□□□	<b>U</b> □□□	<b>I</b> □□□□ <b>O</b> □□□□□	<b>T</b> □□□
Chiller King Solenoid Valve	Control	Open/Closed	Output	BO
Bypass/Crossover Solenoid Valve	Control	Open/Closed	Output	BO
Compressor Only Enabled Solenoid Valves	Control	Open/Closed	Output	BO
Water Preheat System Solenoid Valve	Control	Open/Closed	Output	BO
<b>CCOMPRESSORS (VERIFY ALL POINTS WITH COMPRESSOR PACKAGE MANUFACTRE)</b>				
<b>D</b> □□□□□□□□	<b>F</b> □□□□□□	<b>U</b> □□□	<b>I</b> □□□□ <b>O</b> □□□□□	<b>T</b> □□□
Common Discharge Pressure (Pre-Regulator)	Monitor	PSI	Input	AI
Common Discharge Pressure (Post-Regulator)	Monitor	PSI	Input	AI
Compressor 1 Oil Temperature	Monitor	Degree F	Input	AI
Compressor 1 Oil Pressure	Monitor	PSI	Input	AI
Compressor 1 Discharge Pressure	Monitor	PSI	Input	AI
Compressor 1 Discharge Temperature	Monitor	Degree F	Input	AI
Compressor 1 Suction Pressure	Monitor	PSI	Input	AI
Compressor 1 Suction Temperature	Monitor	Degree F	Input	AI
Compressor 1 Command	Control	On/Off	Output	BO
Compressor 1 Status	Monitor	Amps	Input	AI
Compressor 1 Stage 1 Loading	Control	On/Off	Output	BO
Compressor 1 Stage 2 Loading	Control	On/Off	Output	BO
Compressor 1 Oil Return Valves	Control	On/Off	Output	BO
Compressor 2 Oil Temperature	Monitor	Degree F	Input	AI
Compressor 2 Oil Pressure	Monitor	PSI	Input	AI
Compressor 2 Discharge Pressure	Monitor	PSI	Input	AI
Compressor 2 Discharge Temperature	Monitor	Degree F	Input	AI



Compressor 2 Suction Pressure	Monitor	PSI	Input	AI
Compressor 2 Suction Temperature	Monitor	Degree F	Input	AI
Compressor 2 Command	Control	On/Off	Output	BO
Compressor 2 Status	Monitor	Amps	Input	AI
Compressor 2 Stage 1 Loading	Control	On/Off	Output	BO
Compressor 2 Stage 2 Loading	Control	On/Off	Output	BO
Compressor 2 Oil Return Valves	Control	On/Off	Output	BO
Compressor 3 Oil Temperature	Monitor	Degree F	Input	AI
Compressor 3 Oil Pressure	Monitor	PSI	Input	AI
Compressor 3 Discharge Pressure	Monitor	PSI	Input	AI
Compressor 3 Discharge Temperature	Monitor	Degree F	Input	AI
Compressor 3 Suction Pressure	Monitor	PSI	Input	AI
Compressor 3 Suction Temperature	Monitor	Degree F	Input	AI
Compressor 3 Command	Control	On/Off	Output	BO
Compressor 3 Status	Monitor	Amps	Input	AI
Compressor 3 Stage 1 Loading	Control	On/Off	Output	BO
Compressor 3 Stage 2 Loading	Control	On/Off	Output	BO
Compressor 3 Oil Return Valves	Control	On/Off	Output	BO
Oil Separator Level	Monitor	-	Input	AI
Oil Separator Temperature	Monitor	Degree F	Input	AI
Oil Separator Heaters	Control	On/Off	Output	BO
5 Spare				
<b>EVAPORATIVE CONDENSER</b>				
Fan Command	Control	On/Off	Output	BO
Fan Status	Monitor	Amps	Input	AI
Fan Speed Control (VFD)	Control		Output	AO
Water Pump Command	Control	On/Off	Output	BO
Water Pump Status	Monitor	Amps	Input	AI
3 Spare				
<b>ICE RINK</b>				
<b>D</b> □□□□□□□□	<b>F</b> □□□□□□	<b>U</b> □□□	<b>I</b> □□□□ <b>O</b> □□□□□	<b>T</b> □□□
Glycol Supply Temperature	Monitor	Degrees F	Input	AI
Glycol Return Temperature	Monitor	Degrees F	Input	AI
Rink Floor Temperature 1	Monitor	Degrees F	Input	AI
Rink Floor Temperature 2	Monitor	Degrees F	Input	AI
Rink Floor Temperature 3	Monitor	Degrees F	Input	AI
Rink Floor Temperature 4	Monitor	Degrees F	Input	AI
Subfloor Temperature 1	Monitor	Degrees F	Input	AI
Subfloor Temperature 2	Monitor	Degrees F	Input	AI
Subfloor Temperature 3	Monitor	Degrees F	Input	AI
Subfloor Temperature 4	Monitor	Degrees F	Input	AI
IR Sensor 1	Monitor	Degrees F	Input	AI

IR Sensor 2	Monitor	Degrees F	Input	AI
<b>RINK PUMPS</b>				
D□□□□□□□□	F□□□□□□□	U□□□□	I□□□□ O□□□□□	T□□□□
Rink Pump 1 Command	Control	On/Off	Output	BO
Rink Pump 1 Status	Monitor	Amps	Input	AI
Rink Pump 1 Speed Control (VFD)	Control		Output	AO
Rink Pump 2 Command	Control	On/Off	Output	BO
Rink Pump 2 Status	Monitor	Amps	Input	AI
Rink Pump 2 Speed Control (VFD)	Control		Output	AO
<b>HEAT RECOVERY SYSTEMS</b>				
D□□□□□□□□	F□□□□□□□	U□□□□	I□□□□ O□□□□□	T□□□□
Snowmelt Pump Command	Control	On/Off	Output	BO
Snowmelt Pump Status	Monitor	Amps	Input	AI
Snowmelt Return Temperature	Monitor	Degrees F	Input	AI
Snowmelt Supply Temperature	Monitor	Degrees F	Input	AI
Subfloor Pump 1 Command	Control	On/Off	Output	BO
Subfloor Pump 1 Status	Monitor	Amps	Input	AI
Subfloor Supply Temperature 1	Monitor	Degrees F	Input	AI
Subfloor 3-Way Valve 1	Control		Output	AO
Ice Debonding Supply Temperature	Monitor	Degrees F	Input	AI
Ice Debonding Return Temperature	Monitor	Degrees F	Input	AI
Water Preheat Temperature 1	Monitor	Degrees F	Input	AI
Water Preheat Temperature 2	Monitor	Degrees F	Input	AI

**3.9 SEQUENCE OF OPERATION**

- A. The following is a general sequence of operation to familiarize the control system developer/supplier with the functions and controls of the ice system. It may not be comprehensive sequence or list and may be modified throughout the project.
- B. All temperatures and pressure settings identified herein are recommended guidelines for initial system setup. These settings should be adjusted during system operation to achieve optimum system performance.
- C. Compressors
  - 1. Compressor Lead/Lag.
    - a. The three (3) compressors shall rotate lead / lag positions based on operator sequence selection to rotate order of operation. The following compressor sequences shall be used.

<i>Lead Position</i>	<i>Lag Position</i>	<i>Standby Position</i>
1	2	3
2	3	1
3	1	2

- 2. Compressor Operation
  - a. Compressor operation is controlled by secondary refrigerant temperature returning from rink floor based on operator adjustable Set Point (SP).

- b. Lead / Lag compressors shall be energized in accordance with the SP offsets in the table below. SP offsets shall be operator adjustable.

<b>Compressor</b>	<b>ON (°F)</b>	<b>OFF (°F)</b>
Lead	SP 1□	SP - 1□
Lag	SP 2□	SP - 1□

- c. Lag compressors shall not be energized until the SP offset has been reached and the lead compressor has been operating fully loaded for 10-minutes.
- d. If the lead compressor fails to start, the lag compressor shall be energized within 2-minutes of the failure.
- e. The standby compressor shall be automatically enabled if the lead or lag compressor are locked out on start fail or can be enabled manually in an emergency once the lead and lag compressors are enabled.
3. Compressor loading shall be fully adjustable with initial settings as follows:
- Stage 1 loading will occur 1-minute after compressor start.
  - Stage 2 loading will occur 2-minutes after compressor start.
- D. Heat Reclaim System
- Snow Melting
    - Pump on and solenoid valve open when compressors are running.
  - Subfloor Heating
    - With subsoil temperature sensors: Pump on when compressors are running and subsoil temperature is less than 40□(F). If glycol temperature is less than 55□(F), the three-way valve shall modulate warmer glycol from the snow melt piping loop into the subfloor heat loop. Pump shall turn off when subsoil temperature reaches 45□(F).
  - Preheat Domestic and Resurfacers Water
    - Solenoid valve opens when compressors are running and water temperature inside heat recovery water heater is less than 140°F.

E. Condenser

- Controlled by compressor discharge head pressure downstream of the pressure regulating valve. Condensing pressure shall be controlled by a combination of the fan and water pump to maintain the specified condensing temperature. Add ambient air sensor to assure water pump does not operate at very low air temperatures (0F, etc.) to avoid freeze up of unit. Typical set points are as follows. The fan speed is regulated by VFD. Initial fan and water pump set points are as follows:

<b>Operation</b>	<b>Discharge Pressure (psi)</b>
Fan ON @ min. speed	145
Fan ON @ max. speed	165
Water Pump ON	175
Water Pump OFF	150
Fan OFF	135

- Provide two modes of operation.
  - Winter mode: Condenser fan leads and water pump follows.
  - Summer mode: Water pumps leads and condenser fan follows. Fans to shut off first as pressure decreases.
  - Provide an automatic switchover mode between winter and summer modes. When this mode is enabled, if the temperature falls below the User setpoint, the control switches to winter mode.

F. Chiller

- The level of refrigerant in the chiller vessel is controlled by:
  - A solenoid valve (king valve) as described below.

- b. An automatic expansion valve regulated by the specified adjustable level controller that is mounted on the liquid refrigerant column.
  - c. A high-level float switch shall be wired in series with the solenoid valve (king valve) to close the solenoid valve if the maximum set level in the chiller is reached.
- G. Rink Pumps
  - 1. Continuously running. Pump speed regulated by VFD based on operator adjustable Set Point (SP) for the ice rink floor temperature as measured by the rink floor sensors. One pump should always operate at 100%.
- H. Solenoid Valves:
  - 1. Chiller Vessel:
    - a. This valve allows refrigerant to pass from the high-pressure receiver to the chiller vessel.
    - b. This valve shall be enabled with any one or more compressors are running.
    - c. This valve shall be wired in series with the chiller high level float switch to close the solenoid valve if the maximum set level in the chiller is reached.
  - 2. Emergency Bypass/Crossover Solenoid Valve: This valve allows high and low-pressure refrigerant to equalize if high discharge pressures are reached. Valve opens if compressor discharge pressure reaches 235 psi (adj.) Compressors shall be locked out when valve is open. Valve shall be controlled by a dedicated mechanical pressure safety switch.
  - 3. Compressor Only Enabled Solenoid Valve: These valves control refrigerant hot gas flow to heat exchangers. Valves are open when compressors are running.
  - 4. Water Preheat System Solenoid Valve: This valve controls refrigerant hot gas flow to the heat recovery water heaters. Valve is open when compressors are running and the water temperature inside the heat recovery water heaters is less than 140°F.
- I. King Valve
  - 1. This valve allow refrigerant to pass from the high-pressure receiver to the chiller vessel and is a manually operated isolation valve.
- J. The following programming shall be included in the control system.
  - 1. Modes of Operation. The following modes of operation shall be programmed into the control system. The modes of operation shall be fully programmable and adjustable per the Owner's requirements and direction.
    - a. IRC Mode: The rink is controlled based on the temperature from the Infrared sensor.
    - b. Slab Mode: The rink is controlled based on the average temperature of the slab sensors.
    - c. Return Mode: The rink is controlled based on the return glycol temperature.
    - d. Day Mode: This indicates the rink is in day mode and control will be based on the day mode targets.
    - e. Night Mode: This indicates the rink is in night mode and control will be based on the night mode targets.
    - f. Game Mode: This indicates the rink is in Game mode and control will be based on the Game mode targets. Under "Game Mode", the system shall always operate with a minimum of (1) compressor and (1) rink pump. System shall operate based on the in-floor slab sensors.
    - g. Cover Mode: Under "Cover Mode", the system shall operate based secondary refrigerant temperature returning from rink floor based on operator adjustable Set Point (SP).
    - h. Ice Refresh Mode: Under "Refresh Mode", the system shall automatically bring down the rink slab temperature based on in-floor slab sensors to a user defined set-point at a user defined rate per hour. The system shall automatically bring up the rink slab temperature based on in-floor slab sensors to a user defined set-point at a user defined rate per hour.

2. Calendar. Provide a programmable daily calendar that allows different modes of operation to be incorporated in the calendar. The calendar shall be fully adjustable and programmable by the Owner.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 13 18 19 - ICE RINK WATER TREATMENT SYSTEM****PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. General system description and design criteria.
- B. Reverse Osmosis Equipment and Materials.
- C. Valves Piping and Accessories.
- D. Waterline connections.

**1.02 GENERAL SYSTEM DESCRIPTION AND DESIGN CRITERIA**

- A. Furnish and install all materials, equipment and controls necessary for a fully functional demineralization system. In general, the treatment system shall include:
  - 1. Water Softener System.
  - 2. Carbon Filter System.
  - 3. Demineralizer System.
  - 4. Storage Tank.
  - 5. Circulation Pump and Distribution System.
  - 6. Water Heating System.
  - 7. Ice Quality System.
- B. The system shall be capable of providing a continuous supply of treated and heated water for the purpose of ice making, at a rate of seven (7) gallons per minute to the storage reservoir.
- C. Work shall include all design, engineering, supply, installation and startup of equipment and training for a complete operating demineralization water treatment system.
- D. Work shall include furnishing and installing 4" high concrete equipment pads for entire system.

**1.03 RELATED SECTIONS**

- A. Section 007200 - General Conditions.
- B. Section 007300 – Supplementary Conditions.
- C. Section 131811 - Ice Rink General.
- D. Section 131814 - Ice Rink Piping, Valves and Accessories.

**1.04 REFERENCES**

- A. AWWA, ANSI, ASME, FDA, NSF, TSS, UL related sections.

**1.05 SUBMITTALS**

- A. Shop Drawings. All submittals shall conform to the requirements of General Conditions and Division 0 and 1 Specifications and shall also include schematic drawings of the systems, detail description of the treatment and control systems
- B. Operational and Maintenance manuals – Provide three (3) copies of the manuals prior to start-up and as required by the General Conditions and Division 0 and 1 specifications.

**1.06 WARRANTY GUARANTY**

- A. The water treatment system and all its components shall be warranted against defects in equipment, materials and workmanship for a period of one (1) year from substantial completion of system and as required by the general conditions.

#### **1.07 PRODUCT DELIVERY STORAGE AND HANDLING REQUIREMENTS**

- A. As required in the General Conditions and Division 0 and 1 specifications.

### **PART 2 - PRODUCTS**

#### **2.01 APPROVED MANUFACTURERS OF WATER TREATMENT SYSTEM**

- A. Approved Manufacturers: Jet Ice Limited, Newmarket, Ontario, Canada (905-853-4204) or equal.
- B. Model: PS-Mach 6.
- C. All components of the demineralization treatment system shall be manufactured from new, unused materials, free from defects and of the highest quality possible.
- D. The material shall be of the configuration, quantity, quality and design elements as described herein.
- E. Furnish and install all piping, valves, controls and electrical for each system component(s) whether or not stated in this section.

#### **2.02 PRE-TREATMENT EQUIPMENT AND SYSTEMS**

- A. Water Softener System: System shall include a duplex (two vessels), 16" diameter water softener unit with a capacity of 180,000 grains of hardness, alternating tank design, and meter-initiated regeneration. Tanks shall be glass fiber reinforced polyester with a working pressure of 120 psi and a hydrostatic test pressure of 300 psi.
- B. Carbon Filter System: System shall include a duplex (two vessels), 16" diameter carbon filter system with premium coconut carbon media. System shall provide an uninterrupted supply of water flowrate of 20 gpm. Tanks shall be glass fiber reinforced polyester with a working pressure of 120 psi and a hydrostatic test pressure of 300 psi.
- C. Prefilter System: System shall include a replacement type element filter for the demineralization system. Filter elements shall be rated at five (5) micron nominal size removal.

#### **2.03 PURIFICATION (DEMINERALIZATION) EQUIPMENT AND SYSTEMS**

- A. Pro Ice Unit: System shall include a Pro Ice Demineralizer unit designed to provide a continuous supply of treated water to meet the resurfacing and ice making rates of the facility.
- B. Circulating Pump: Shall be a stainless steel, multi-stage, pump with a direct coupled, premium efficiency motor. Pump shall boost operating pressure to 200 psig. A thermal overload relay shall be provided to protect the pump motor from overheating.
- C. Pro Ice Module: Module assembly shall consist of six (6) – 4" diameter by 40" long high flow elements. Elements shall be polyamide thin film composite membrane type elements in a spiral-wound modular configuration. Elements material and configuration shall be capable of producing water at least 95% free of dissolved solids based on standard conditions of feed water at 77°F containing 1500 ppm NaCl and an operating pressure of 200 psi. The element housings shall be constructed of stainless steel. Modules shall be connected in a series, multi-stage arrangement to deliver the design capacity by using a waste recycle system to minimize waste flow requirements.
- D. Electrical and Control System Enclosure and Framework: Shall be open type mounted on a freestanding welded steel frame with a durable powder coating finish. Pressure gauges, flow



indicators and waste flow control valve shall be mounted on a protective metal frame below the control panel.

- E. Protection Features: A pressure switch shall be installed after the inlet water solenoid to protect the pump from cavitating by shutting down the inlet solenoid valve and pump should the inlet pressure fall below 20 psi for more than five (5) seconds. A 'low pressure event' readout shall be displayed on the LED panel to warn the operator of the condition. For membrane protection, the unit shall be equipped with time delay startup.
- F. Auto Flush: Unit shall automatically flush debris from membrane.
- G. Controls:
  - 1. All controls required for the system; including mechanical, hydraulic and electrical controls shall be provided for a complete, self-contained unit. Operation of the unit shall be controlled by an 'on / off' button located on the front of the cabinet. The panel LED shall include the following readouts:
    - a. System running
    - b. Low pressure event
    - c. Storage full
  - 2. Connections shall be for liquid level control, which will shut down the unit and prevent overflow of the product water storage tank.
  - 3. Two (2) liquid filled pressure gauges shall be installed to indicate the feed and module pressure of the unit and to notify the operator when a replacement cartridge is required. A third pressure gauge to monitor system pressure shall be included.
  - 4. Two (2) clear rotameter flow indicators shall be mounted on the front of the cabinet to show the rate of production flow and the rate of waste flow.
  - 5. The unit shall be equipped with LCD Total Dissolved Solids meter for monitoring quality of product water at all times.
- H. Waste Water Line: Shall include piping and stainless-steel throttling valve to permit adjustment of the waste flow. An adjusting handle shall be located on the front of the cabinet for operator convenience.
- I. Recycle Line: Shall include a stainless-steel throttling valve to permit the recycle of wastewater through the membranes to minimize the discharge of wastewater.

#### **2.04 STORAGE TANK AND DELIVERY PUMP**

- A. Storage Tank: The demineralized water shall be fed to a polyethylene closed top storage tank with capacity of 850 gallons tank measuring 48" diameter by 120" tall. Level controls in the tank will control feed to the tank. Owner may require tank dimensions to change to fit allocated space within existing resurfacer room. Tank shall be a rotationally molded polyethylene storage tank. The tank shall have an integral factory manufactured vent in the manway cover. Bulkhead fittings shall be provided to allow for 2"-3" drain/outlet, 1"-1.5" inlet, level control.
- B. Distribution Pump: The water distribution pump shall be of stainless steel construction capable of producing up to 15 gallons per minute of flow at 50 psi pressure with a premium efficiency, inverter duty motor. A variable frequency drive shall be provided with pump to maintain 50 psi system pressure. Accessories shall include a liquid filled pressure gauge, and a pressured well tank.

#### **2.05 HEATING PACKAGE**

- A. Heating Package: Shall consist of two (2) natural gas fired, glass lined, water heaters with a holding capacity of 85 gallons each and a recovery rate of 442 gallons per hour each at 80 degrees F temperature rise. Input rating shall be 365,000 BTU's. Minimum efficiency rating shall be 80%.
- B. Approved water heater manufacturer: A.O. Smith BTR365(A) or equal.

**2.06 ELECTRICAL SYSTEMS**

- A. The water treatment system shall be prewired, and CSA approved. A disconnect panel will be included. The electrical subcontractor on the project will provide the following electrical systems for the system (see electrical drawings):
  - 1. One (1) 30-amp 208/230/240-volt electrical service for the main panel.
  - 2. Two (2) 120-volt connections for the two water heaters.
  - 3. One (1) 110-volt quad receptacle to power the controllers for the pretreatment package.

**2.07 PLUMBING SYSTEMS**

- A. Thermostatic mixing valve: Furnish and install a Symmons 6-500 thermomixing valve on the 1" domestic hot and cold-water supply lines. The 1" supply line supplied by the mechanical subcontractor (see mechanical drawings). RO feed water is to be maintained at 77°F to ensure the system achieves maximum performance. The valve shall have union connectors on each side for service accessibility.
- B. Drain line: Drains lines for the carbon tanks, softener and RO waste shall be schedule 40 PVC, 3"-4" in diameter. Pipe to floor drain provided by mechanical subcontractor (see mechanical drawings) or existing floor drain.

**2.08 LABELING**

- A. All system components shall be clearly labeled.

**2.09 PIPE**

- A. Low pressure piping: upstream of the RO high pressure pump or downstream of the concentrate and recycle valves, shall be schedule 80 CPVC, to insure freedom from corrosion and chemical degradation. Connections shall be flanged, glued, threaded or grooved mechanical couplings.
- B. High pressure piping shall be schedule 40, 304 stainless steel. Connections shall be flanged, butt welded, threaded or grooved mechanical couplings. Mechanical couplings shall be galvanized. High-pressure thermoplastic tubing shall be utilized for gauges and pneumatic lines.
- C. Piping to domestic water supply: See Plumbing Drawings.
- D. Pipe Markers: All exposed piping shall be marked with name of fluid be conveyed and direction of flow. Markers shall be clearly visible and shall conform to ANSI and OSHA requirements for marker size, marker color, legend size, and legend color. Install at least three (3) markers for each pipe in each room.

**PART 3 - EXECUTION****3.01 GENERAL**

- A. Installation contractor shall follow manufactures instructions for installing equipment.
- B. Furnish and install all supports, anchors and all other materials required to install system equipment and materials.
- C. Installation contractor shall meet with the manufacturer before commencing installation to discuss any questions that may have arisen. Contractor shall contact manufacturer regarding any questions that develop during installation.

**3.02 PIPE INSTALLATION**

- A. Support all piping in such a manner as to prevent all vibration and vertical or horizontal movement.

### **3.03 PUMP INSTALLATION**

- A. The pumps shall be mounted and balanced to prevent vibration.

### **3.04 VALVES AND ACCESSORIES**

- A. Install valves at the locations shown on the drawings, described in the specifications, as required for system operation and maintenance, and as required by the manufacturer.
- B. Install all valves so that they can be easily replaced in the future including installing unions and allowing adequate clearance.
- C. Install all valves with adequate clearance around the valve for maintenance.
- D. Install valves for system drainage at all exposed low points in the system whether or not shown on the drawings.
- E. Provide all power and electrical systems as necessary for operation.

### **3.05 GAUGES AND INSTRUMENTATION**

- A. All gauges and instrumentation shall be installed at eye level wherever possible unless specified otherwise and shall be positioned for ease of reading by operation and maintenance staff.

### **3.06 START UP**

- A. Provide written verification to the Engineer/Architect, Owner and Equipment Manufacturer that the equipment is ready for start-up. Coordinate training and scheduling with all parties.
- B. Provide one (1) day (8 hours) of combined on-site start-up and operator training. Equipment manufacturer representative and professional ice maker shall review installation, place the equipment in service, optimize operating parameters, and confirm that the equipment is operating properly. Training shall be completed with operation and maintenance manuals in hand.

**END OF SECTION**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 13 28 16 – HOCKEY SAFETY NETTING SYSTEM****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes design, fabrication, and installation of hockey safety netting system, including netting and rigging accessories, for the protection of spectators.
- B. Related Requirements:
  - 1. Division 05 Section "Metal Fabrications" for steel framing and supports for netting systems.
  - 2. Division 13 Section "Ice Rink Dasher System" for dasher boards and glass shields.
  - 3. Division 26 Sections for electrical wiring and connections and for installation of remote-control switches for lift motors.

**1.2 SCOPE OF WORK**

- A. The work of this Section consists of furnishing equipment and appliances, materials, and labor required to perform all operations in connection with the installation of two complete winch rigging and netting systems as hereinafter specified.
  - 1. Netting Equipment:
    - a. Net.
    - b. Two (2) 1000 pound capacity winch systems with (7) beam mounted loft blocks for the protective netting.
  - 2. Control Equipment and Cabinet.
    - a. Remotely located control cabinet to contain control switches for all motorized winch systems.
  - 3. All electrical connections for winch motors and controls.
  - 4. All conduit and wiring.
  - 5. Auxiliary steel to support netting system.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design rigging, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Engineer must be licensed in the State where the project is located.
- B. Structural Performance: System shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Design Loads: Weight of netting and the design loads indicated in the General Notes of the Structural Drawings.
- C. National Hockey League (NHL) Approval: Design netting system of height, type, and hung in a manner approved by the NHL. Provide documentation to the NHL for approval.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for exposed rigging accessories. For lift motors, include rated capacities, operating characteristics, and electrical characteristics.

- B. Shop Drawings: Show fabrication and installation details for netting system. Include plans, elevations, sections, details, attachments to other work, and the following:
  - 1. Operating clearances.
  - 2. Requirements for supporting netting, rigging accessories, and equipment. Verify capacity of each rigging component to support loads.
  - 3. Locations of equipment components, switches, and controls. Differentiate between manufacturer-installed and field-installed wiring.
  - 4. Wiring Diagrams: For power, signal, and control wiring.
- C. Final Shop Drawings: Following approval of preliminary drawings and prior to the beginning of fabrication, submit four sets of complete shop drawings of the rigging components including, but not limited to, the following:
  - 1. Mechanical assembly drawings.
  - 2. Mechanical detail drawings.
  - 3. Mechanical general layout.
  - 4. Component equipment drawings.
  - 5. Erection plans and diagrams.
  - 6. Miscellaneous details and assembly drawings.
- D. Delegated-Design Submittal: For rigging indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Qualification Data: For qualified Installer and professional engineer.
- F. Product Certificates: For the following, from manufacturer:
  - 1. Netting: Provide name of flame-retardant chemical used, identification of applicator, treatment method, application date, allowable life span for treatment, and details of any restrictions and limitations.
- G. Field Quality Control reports as specified in Part 3 of this Section.
- H. Operation and Maintenance Data: For netting system to include in operation and maintenance manuals.
- I. Warranty: Sample of special warranty.
- J. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed netting systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in netting installations with a record of successful in-service performance.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of rigging systems that are similar to those indicated for this Project in material, design, and extent.
- C. Fire-Test-Response Characteristics: Provide netting with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or a testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Flame-Resistance Ratings: Passes NFPA 701.
    - a. Permanently attach label to each panel of the netting system indicating whether netting is inherently and permanently flame resistant or treated with flame-retardant chemicals, and whether it requires retreatment after designated time period or cleaning.

- D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Preinstallation Conference: Conduct conference at Project site.

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with netting system by field measurements before fabrication.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Deliver products in original unopened packaging with legible manufacturer's identification.
- B. Storage and Protection: Comply with manufacturer's recommendations.
  - 1. Store in a cool, dry place out of direct sunlight.
  - 2. Protect from damage by the elements and construction procedures.
  - 3. Store at temperature above 40 degrees F.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of rigging equipment that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, faulty operation of rigging equipment.
  - 2. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering safety netting systems that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Athletic and Performance Rigging.
  - 2. Chicago Spotlight.
  - 3. Atlanta Rigging Systems.
  - 4. Sport Systems Unlimited Corp. (d/b/a Athletica).

### 2.2 MATERIALS

- A. Protective Netting. Provide safety netting approved by the NHL for spectator protection.
  - 1. Mesh, maximum opening size of 1-1/2 inch (37 mm) square.
  - 2. Dyneema or "Kevlar" Twine Diameter: 1.2 mm; knotted netting.
  - 3. Rope binding.
  - 4. Color: Black.
- B. Cable: Steel cable for winch systems shall be 3/32 inch (2.4 mm) diameter 7 x 19 galvanized aircraft quality.
- C. Trusses: Aluminum trusses shall be manufactured by Applied Electronics or approved equal. All connections to such units to be by manufacturers recommendations.

- D. Electrical Hoisting Machines:
1. Machines shall incorporate helical worm gear reduction units rated by AGMA (American Gear Manufacturers Association) for Class I service. Attach metal name tag to unit indicating name of manufacturer.
  2. Power Requirements: Provide 208 V three (3) phase power. No 110 V motors power will be acceptable.
  3. Include the following in each machine assembly:
    - a. A control switch plus three-pole fused disconnect switch to protect the motor against short circuit or prolonged locked rotor conditions.
    - b. A reversing motor starter with three (3) overload heater coils. Starter shall be sized to motor requirements.
    - c. A safety load control device to stop motor if over load is detected in netting travel.
  4. Machine shall be internally wired to a labeled terminal strip to require a minimum of field connections.
  5. Electrical diagrams for field connecting shall be included for all electrical equipment furnished under this contract.
- E. Control Cabinet and Equipment:
1. The control cabinet shall be a NEMA-1 enclosure for wall mounting with hinged locking door and removable panel.
    - a. Provide labeled terminal strips equal to Allen-Bradley Bulletin 1492 Type F8 for all conductors entering or leaving the cabinet. Mark each conductor to correspond to the wiring diagram.
    - b. Cabinet Depth: Approximately 6 inches (150 mm) deep and of necessary height and width to accommodate the required control equipment.
  2. Thirty (30) ampere 3-phase source shall be used for 208 volt power. Control power at 120 volts shall be connected to the fused circuit terminals at the control cabinet.
  3. Provide two (2) control devices for each machine to permit exclusive operation of each machine at the following positions:
    - a. At the machine.
    - b. At the control cabinet.
  4. Control at the machines shall consist of a three (3) push button switch. This control shall be operable only when the main control switch at the control cabinet is turned to the "SERVICE" position. A name plate on the switch shall indicate direction of travel.
- F. Equipment common to system by system provider.
1. Miscellaneous auxiliary steel to connect to building steel.
  2. All miscellaneous hardware and equipment either inferred or implied to allow full design-build project.

## 2.3 FINISHES

- A. Exposed Finishes: Apply manufacturer's standard black finish to all exposed rigging components.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.



**3.2 INSTALLATION**

- A. Install netting system in accordance with approved Shop Drawings.

**3.3 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Services: Technical representative from manufacturer shall provide the following field services during installation:
  - 1. Perform pre-installation examination and acceptance of site preparation for each stage. Issue report.
  - 2. Be present at initial start-up for each process. Confirm application rates and techniques. Issue report.
  - 3. Issue a summary report at completion of installation indicating manufacturer's acceptance of installed system and warranty conditions.

**3.4 DEMONSTRATION**

- A. Startup Services: Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
  - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 2. Review data in maintenance manuals. Refer to Division 01 Section "Operation and Maintenance Data."
  - 3. Provide at least 8 hours of on-site training for Owner's maintenance personnel.

**3.5 ADJUSTING**

- A. Adjust moving parts to function smoothly.

**3.6 CLEANING AND PROTECTION**

- A. Touchup Painting: Clean and touchup field welds, bolted connections, and abraded areas of shop paint as specified in Division 09 Section "Painting."

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 14 21 00 - GEARLESS MACHINE ROOM LESS TRACTION ELEVATORS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Gearless Machine Room Less (MRL) Traction elevators as follows:
  - 1. Passenger Elevators, Cars PE 1 & 2, PE 3 and PE 4
  - 2. One Service Elevator, Car SE 5
  
- B. Related Requirements: Including but not limited to the following:
  - 1. Division 05 Section "Structural Steel Framing" for the following:
    - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
    - b. Divider beams.
    - c. Hoist beams.
    - d. Structural-steel shapes for subsills.
  - 2. Division 05 Section "Metal Fabrications" for the following:
    - a. Pit ladders

**1.2 PRODUCT VARIATIONS AND ADJUSTMENTS**

- A. Product Variations: In the event of differences between products and systems of acceptable or available manufacturer/fabricators, Contractor shall notify Architect of such differences and resolve conflicts prior to awarding Contract. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.
  
- B. Adjustments: Proposed deviations shall include a detailed analysis of impact to adjacent substrates, structural, mechanical, electrical or other building systems, including related design or construction cost impacts. Deviations causing changes in materials, constructability, substrates, systems or conditions shall be included in the Work at no additional cost to Owner.

**1.3 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Include capacities, sizes, performance data, operation, control, signal systems operation, safety features, finishes, and similar information.
  - 2. Include product data for car enclosures and hoistway entrances.
  - 3. Include product data for signal fixtures, lights, graphics, Tactile marking plates, and details of mounting.
  
- B. Shop Drawings:
  - 1. Provide scaled shop drawings of the following:
    - a. Plan and section layouts of hoistways, pits, overheads, machinery spaces and openings at each landing, to include the following:
      - 1) Location of all equipment.
      - 2) Static and dynamic loads imposed on building structure.
      - 3) Details of equipment isolation.
      - 4) Required clearances around equipment.
      - 5) Control room and machine heat release.
        - a) Provide heat loads based on a regenerative emergency power operation.
      - 6) Power requirements:

- a) motor horsepower, code letter, starting current, full load running current, and demand factor.
  - b) Provide engineered power consumptions based on 80 starts per hour.
  - c) Provide maximum and average power consumption.
- 7) Service connections.
- 8) Running Clearances.
- 9) Location of fixtures.
- b. Elevation section of hoistways:
  - 1) Overhead, pits: clearances, and runby.
  - 2) Entrance details.
  - 3) Sill support detail.
- c. Pit Equipment:
  - 1) Buffers.
  - 2) Counterweight guards.
  - 3) Pit reactions.
  - 4) Service ladder, platform.
  - 5) Stop switches.
  - 6) Compensation equipment.
- d. Elevator cabs:
  - 1) Car shell fabrication.
  - 2) Ventilation.
  - 3) Ceiling construction details.
  - 4) Wall construction details.
  - 5) Lighting details.
  - 6) Handrail mounting details.
  - 7) Transom, entrance returns.
- e. Fixtures:
  - 1) Car operating panel.
  - 2) Hall stations.
  - 3) Destination / landing input stations.
  - 4) Hall Lanterns.
  - 5) Position indicators.
  - 6) Access key switches.
  - 7) Remote fixtures.
    - a) Group Status Panel.
    - b) Emergency Power selector switches.
  - 8) Two-way communication device at all master stations.

C. Submittals:

1. All submittals are delivered via Portable Document Format (.pdf)
2. All submittals are clearly marked and identified with project name and appropriate device identification.
3. All submittals are subject to approval.
4. Corrections requested are incorporated onto the submittals.

D. Samples for Verification:

1. For exposed car, hoistway door and frame, and signal equipment finishes.
2. Samples of sheet materials: 3" (75 mm) square.
3. Running trim members: 4" (100 mm) lengths.
4. Include full component samples, if requested:
  - a. Signal fixtures
  - b. Lighting
  - c. Graphics
  - d. Tactile markings

**1.4 CLOSEOUT SUBMITTALS**

- A. Continuing Maintenance Proposal:
1. Submit executed Installer's standard five-year maintenance agreement, starting at the end of the warranty maintenance period.
  2. State services, obligations, conditions, and terms for agreement period and for future renewal options.
- B. Record Documents:
1. The following record documents are furnished upon completion and before final payment and delivered via Portable Document Format (.pdf):
    - a. Shop Drawings:
      - 1) Complete sets of as installed plan and section layouts of hoistways, pits, overheads, and equipment spaces, to include the following:
        - a) Static and dynamic loads imposed on building structure.
        - b) Details of equipment isolation.
        - c) Required clearances around equipment.
        - d) Control room heat release.
        - e) Power requirements.
      - 2) Elevation section of hoistways:
        - a) Overhead, pits and entrance details.
      - 3) Elevator cabs.
      - 4) Fixtures:
        - a) Car fixtures.
        - b) Hall fixtures.
        - c) Remote fixtures.
      - 5) Control room heat release and power requirements.
    - b. Wiring Diagrams:
      - 1) Complete sets of as installed straight-line wiring diagrams, showing the electrical connections of all altered vertical transportation equipment, are furnished upon completion.
      - 2) A legend sheet is furnished with each set of drawings containing the following information:
        - a) Name and symbol of each relay, switch and other electrical or solid-state apparatus.
        - b) Location on drawings, drawing sheets, number and area of switches and relays, and location of all contacts.
        - c) Location of apparatus whether on controller, in hoistway or on elevator cab.
    - c. Maintenance and Operating Manuals:
      - 1) Description and sequence of operation of all equipment installed, including operating use for Building Personnel and tenants, as well as system troubleshooting manuals for technicians.
      - 2) Maintenance instructions and procedures of all vertical transportation equipment installed, including parts lists, for each elevator system.
      - 3) Lubrication charts indicating all lubricating points and type of lubricant recommended for all equipment.
      - 4) Complete parts catalogs for all replaceable parts.
- C. Tools:
1. The following equipment is furnished upon completion and before final payment:
    - a. The Elevator Contractor provides all the necessary tools, including laptop, hand-held devices, required software and manuals, required to troubleshoot, adjust, synchronize, calibrate, repair, and maintain the vertical transportation systems, as well as perform all necessary procedures to perform all safety tests as required by code and local governing authority.

- b. Owner's equipment and software is updated regularly to properly troubleshoot, adjust, synchronize, calibrate, repair, maintain and test the vertical transportation systems. All equipment and/or software is of the same version as issued to technicians maintaining the vertical transportation systems.
  - c. The Elevator Contractor provides a backup copy of any software that resides on the troubleshooting tool.
  - d. Upon cancellation of service agreement, the Elevator Contractor provides all updates indicated above.
- D. Keys:
- 1. Four sets of keys to operate all keyed switches and locks are furnished upon completion.
  - 2. Keys properly tagged.
  - 3. All keying arranged with the Contractor.

### 1.5 PERMITS TESTS & CERTIFICATES

- A. Permits:
- 1. The Elevator Contractor secures the permits required for work to be performed, including work of sub-contractors.
  - 2. The Elevator Contractor obtains and pays for all municipal and state permits necessary for execution of the elevator work, including fees for renewing permits.
  - 3. The Elevator Contractor is responsible for posting all permits as required by the AHJ.
  - 4. The Elevator Contractor is responsible for obtaining final sign-off and approval for each permit.
- B. Tests and Inspections:
- 1. The Elevator Contractor performs all necessary tests as required by ASME A17.1 and recommended by A17.2.
  - 2. The Elevator Contractor is responsible for scheduling the necessary tests as required by the local authorities.
    - a. Any fees associated with a missed appointment, or for expediting of test or overtime tests due to delays caused by the Elevator Contractor are the responsibility of the Elevator Contractor.
- C. Certificates:
- 1. Elevator Contractor is responsible for obtaining and providing Contractor with all temporary and final inspection certificates of the proper governing authorities and provides the Contractor with such certificates.
  - 2. The Elevator Contractor pays for all fees necessary for obtaining temporary and final inspection certificates.

### 1.6 QUALITY ASSURANCE

- A. Compliance with Regulatory Agencies:
- 1. Comply with most stringent provisions of codes, laws, and/or authorities, including revisions and changes in effect.
- B. Progress Reviews:
- 1. The Elevator Contractor is subject to reviews by the Consultant and/or Contractor at any time throughout the project.
  - 2. Contractor to assist without additional cost.

### 1.7 DELIVERY STORAGE AND HOISTING

- A. General:

1. The protection of all equipment and exposed finishes is the responsibility of the Elevator Contractor during delivery, handling, and installation until final acceptance of elevator equipment.
  2. The Elevator Contractor replaces damaged materials with new, at no additional cost for material and labor.
- B. Delivery and Storage:
1. It is the responsibility of the Elevator Contractor to properly store and protect all materials in space provided or designated by the Contractor against damage, stains, scratches, corrosion, weather, construction debris and environmental conditions.
  2. Deliver materials to the site in the manufacturer's original and unopened containers and packaging, bearing labels as to type of material, brand name and manufacturer's name.
  3. Store materials under cover in a dry and clean location, off the ground. Remove delivered materials that are damaged or not suitable for installation from the job site and replace with acceptable materials.
- C. Hoisting:
1. All required hoisting and movement of equipment is the responsibility of the Elevator Contractor.

## 1.8 COORDINATION

- A. General:
1. Coordinate the following requirements with the other trades.
- B. Cast-in-Place Concrete:
1. Elevator Contractor to provide guide rail bracket inserts and the locations for the General Contractor to install.
  2. Provide other hoistway and pit requirements, including location of sump pits.
- C. Masonry Penetrations:
1. Provide locations in elevator control room/hoistway walls where conduit, ropes, and wiring penetrate walls and slabs.
  2. Coordinate installation of sleeves, block outs, inserts, and items that are embedded in concrete or masonry for elevator equipment.
  3. Furnish inserts, templates and installation instructions and deliver to Project site in time for installation.
- D. Structural Steel:
1. Including, but not limited to, elevator control rooms, hoistways and pits, sill supports, rail supports.
- E. Miscellaneous Steel:
1. Pit ladders, working platforms, inspection platforms, guard rails, divider beams.
- F. Electric:
1. Electrical service, mainline disconnects, 110 VAC disconnects, outlets, lights, switches in elevator control rooms and pits.
- G. Sprinklers:
1. Including installation of sprinkler systems in the elevator pits or shaft as per NFPA 13.
- H. HVAC:
1. Provide necessary information to General Contractor and coordinate installation of equipment for elevator control rooms.

- I. Finishes:
  - 1. Cab interiors, hoistway entrances, fixtures.
  
- J. Elevator Cab Flooring:
  - 1. Material and finish as specified.
  - 2. Flooring installation must be coordinated to ensure car sill is installed level with finished floor.
  
- K. Security Equipment:
  - 1. Coordinate locations in elevator control rooms and cabs where cables, conduit, and other components for CCTV and/or security equipment must be installed.

## 1.9 WARRANTY

- A. Manufacturer's Warranty:
  - 1. Manufacturer agrees to repair, restore, or replace elevator equipment that fails due to defective materials or poor workmanship within specified warranty period.
  
- B. Warranty Period: 12 months from date of Substantial Completion:
  - 1. The Elevator Contractor guarantees that the materials and workmanship of the apparatus installed by them and any subcontractor, under this contract, is first class in every respect and that they will make good on any defects not due to ordinary wear and tear or improper use, which may develop within one year from the date of final acceptance of all equipment.
  - 2. Manufacturer's warranty to repair or replace defective products or their components in the event of defects within a specified period.
  - 3. Neither the final payment nor any provisions of the contract documents relieve the Elevator Contractor of any obligation provided by law. They shall remedy any defects and pay all expenses for any damage to other work.
  - 4. The warranty as outlined above, for all devices, starts from the date of final acceptance of each device, by the Consultant and the Owner, of all work specified and intended under these contract documents.

## 1.10 MAINTENANCE

- A. General:
  - 1. All maintenance is performed according to the guidelines stated in manufacturer's Maintenance and Operations manuals.
  - 2. Maintenance records for each device, including lubrication logs, check charts, are provided in each control room.
  
- B. Construction Maintenance:
  - 1. Upon substantial completion of a device, after receiving sign-off from the governing authorities and acceptance from Consultant and/or Contractor, the device may be accepted for service before completion of the entire project.
  - 2. During the Construction Maintenance period, the necessary preventive maintenance is performed on a scheduled basis.
  - 3. Provide the necessary protection of the hoistway entrances and sills, hoistway fixtures, cab interiors and fixtures and car door sills.
  - 4. Replacement or repair of components, due to misuse by others, is the responsibility of the Contractor/Owner.
  - 5. Perform emergency callback service during normal working hours
  - 6. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of sixty minutes or less.



- C. Warranty Maintenance:
1. Upon final acceptance of each device, subsequent to receiving acceptance and sign-off from the governing authorities and final acceptance, each device is accepted for full operation.
  2. The warranty maintenance period begins for each device when all conditions in the above paragraph are met and will continue for a specified period.
    - a. Warranty Maintenance Period may begin at different times for each elevator.
  3. The warranty maintenance program includes the following:
    - a. Monthly examinations, including adjustments, cleaning, and lubrication of equipment.
    - b. 24-hour Emergency Call back service is provided at no additional cost to Owner.
    - c. Replacement of components as required, using only components produced by the original manufacturer.
      - 1) Each control room is equipped with a lockable storage cabinet to contain the necessary spare parts.
- D. Maintenance Specification:
1. Upon completion of the Warranty Maintenance period, the Elevator Contractor will provide the personnel to service the vertical transportation equipment.
    - a. Full-Service Maintenance commences upon the completion of the warranty maintenance period for a term of five (5) years:
      - 1) Contractor provides a proposal for a full-service agreement which covers the following:
        - a) All required inspections and tests.
        - b) 24-hour emergency call service at no additional cost to Owner.

## PART 2 - PRODUCTS

### 2.1 REFERENCES

- A. Definitions:
1. Terms used are defined in the latest edition of the Safety Code for Elevators and Escalators, ASME A17.1.
- B. American Society of Mechanical Engineers:
1. ASME A17.1 - Safety Code for Elevators and Escalators.
  2. ASME A17.2 – Guide for Inspection of Elevators, Escalators, and Moving Walks.
  3. ASME A17.5 – Elevator and Escalator Electrical Equipment.
  4. ASME A17.6 – Standard for Elevator Suspension, Compensation, and Governor Systems.
- C. International Building Code (IBC)
- D. National Fire Protection Association (NFPA):
1. NFPA 13 – Installation of Sprinkler Systems.
  2. NFPA 70 – National Electric Code.
  3. NFPA 80 – Fire Doors and Windows.
  4. NFPA 101 – Life Safety Code.
- E. Accessibility:
1. American National Standard Institute (ANSI):
    - a. A117.1 - Accessible and Usable Buildings and Facilities.
  2. ADAAG – Americans with Disabilities Act Accessibility Guidelines.

## 2.2 MANUFACTURERS

- A. Subject to compliance with project requirements, provide products by one of the following:
  - 1. MRL Systems:
    - a. KONE Elevator.
    - b. Schindler Elevator
    - c. TK Elevator
    - d. Otis Elevator
  - 2. Fixtures vandal resistant

## 2.3 PERFORMANCE REQUIREMENTS

- A. Car Speed:
  - 1.  3% of contract speed under any loading condition.
- B. Car Capacity:
  - 1. Safely lower, stop and hold 125% of rated load.
- C. Car Stopping Zone:
  - 1.  1/4" under any loading condition.
- D. Door Times:
  - 1. Seconds from start to fully open or fully closed:
    - a. Car PE 1-4: Door open 2.0 seconds, door close 2.6 seconds.
    - b. Car SE 5: Door open 2.5 seconds, door close 4.0 seconds.
- E. Car Floor-to-Floor Performance Time:
  - 1. Seconds from start of doors closing until doors are 1/2 open for side opening doors, and car level and stopped at next successive floor under any loading condition or travel direction:
    - a. Car PE 1-4: 15.0 seconds.
    - b. Car SE 5: 16.5 seconds
- F. Car Ride Quality:
  - 1. Acceleration and Deceleration:
    - a. Smooth, constant, and not less than 2.5 feet/second  with an initial ramp between 0.5 and 0.75 second.
  - 2. Sustained Jerk:
    - a. Not more than 6 feet/second  or twice the rate of acceleration.
  - 3. Horizontal and vertical acceleration within car during all riding and door operating conditions.
    - a. Not more than 15 mg peak to peak (adjacent peaks).
  - 4. Measurement Standards:
    - a. Measure and evaluate ride quality consistent with ISO 18738, using low pass cutoff frequency of 10 Hz and A95 peak-to-peak average calculations.
- G. Noise and Vibration Control:
  - 1. Airborne Noise:
    - a. Measured noise level of elevator equipment and its operation does not exceed 55 dBA inside car under any condition including door operation and car ventilation exhaust blower on its highest speed.
    - b. Limit noise level in the control room and control space relating to elevator equipment and its operation to no more than 80 dBA.
    - c. All dBA readings to be taken 3'-0" off the floor and 3'-0" from the equipment using the "A" weighted scale.

2. Vibration Control:
  - a. All elevator equipment is mechanically isolated from the building structure and other components to minimize noise and vibrations being transmitted to occupied areas of the building.

## 2.4 ELEVATORS

### A. Passenger Elevator Description:

1. Elevator Identification: Cars PE 1-2.
2. Capacity: 3,500 pounds
3. Class of Loading: Class A.
4. Contract Speed: 200 fpm.
5. Roping: 2:1
6. Machine: Gearless.
7. Machine Location: Overhead in Hoistway
8. Control System: Collective microprocessor-based: Duplex selective collective
9. Floors Served, Front: 01, 02, 03.
10. Openings: Front 3.
11. Minimum Clear Height to underside of canopy: 8'-0" High.
12. Entrance Size: 3'-6" Wide X 7'-0" High.
13. Entrance Type: Single-speed, center-opening.

### B. Passenger Elevator Description:

1. Elevator Identification: Cars PE 3
2. Capacity: 3,500 pounds
3. Class of Loading: Class A.
4. Contract Speed: 200 fpm.
5. Roping: 2:1
6. Machine: Gearless.
7. Machine Location: Overhead in Hoistway
8. Control System: Collective microprocessor-based: Simplex selective collective
9. Floors Served, Front: 01, 02, 03.
10. Openings: Front 3.
11. Minimum Clear Height to underside of canopy: 8'-0" High.
12. Entrance Size: 3'-6" Wide X 7'-0" High.
13. Entrance Type: Single-speed, center-opening.

### C. Passenger Elevator Description:

1. Elevator Identification: Cars PE 4.
2. Capacity: 3,500 pounds
3. Class of Loading: Class A.
4. Contract Speed: 200 fpm.
5. Roping: 2:1
6. Machine: Gearless.
7. Machine Location: Overhead in Hoistway
8. Control System: Collective microprocessor-based: Simplex selective collective
9. Floors Served, Front: 01, 02, 03.
10. Openings: Front 3.
11. Minimum Clear Height to underside of canopy: 8'-0" High.
12. Entrance Size: 3'-6" Wide X 7'-0" High.
13. Entrance Type: Single-speed, center-opening.

### D. Service Elevator Description:

1. Elevator Identification: Car SE 5.
2. Capacity: 5000 pounds. Service Shaped

3. Class of Loading: Class C3.
4. Contract Speed: 200 fpm.
5. Roping: 2:1 Overslung
6. Machine: Gearless.
7. Machine Location: Overhead in Hoistway
8. Control System: Collective microprocessor-based: Simplex selective collective
9. Floors Served, Front: 01, 02, 03.
10. Openings: Front 3.
11. Minimum Clear Height to underside of canopy: 8'-0" High.
12. Entrance Size: 4'-6" Wide X 7'-0" High.
13. Entrance Type: Two-speed, side-opening

## 2.5 MATERIALS

### A. Steel:

1. Sheet Steel (Furniture Steel for Exposed Work): Stretcher-leveled, cold-rolled, commercial quality carbon steel, complying with ASTM A366, matte finish.
2. Sheet Steel (for Unexposed Work): Hot-rolled, commercial quality carbon steel, pickled and oiled, complying with ASTM A568/A568M-03.
3. Structural Steel Shapes and Plates: ASTM A36.

### B. Stainless-steel:

1. Type 302 or 304 series complying with ASTM A240, with standard tempers and hardness required for fabrication, strength, and durability.
2. Apply mechanical finish on fabricated work in the locations shown or specified, Federal Standard and NAAMM nomenclature, with texture and reflectivity required to match Architect's sample. Protect with adhesive paper covering.
  - a. No. 4 Satin:
    - 1) Directional polish finish.
    - 2) Graining directions as shown or, if not shown, in longest dimension.
  - b. Textured:
    - 1) .050 inches mean pattern depth with bright directional polish (No. 4 satin finish).
    - 2) 5WL as manufactured by Rigidized Metals.
    - 3) Windsor pattern as manufactured by Rimex Metals.
    - 4) Scottish Quad finish.
3. Extruded stainless-steel:
  - a. 304 stainless-steel per ASTM A276.
  - b. Hot finished and stretched straightened.
  - c. Polished finish.

### C. Aluminum:

1. Extrusions per ASTM B221; sheet and plate per ASTM B209.
2. Die Cast Aluminum – ASTM B108, Alloy 356.0, T6.
3. Extruded Aluminum – FS QQ-A 200/8, Alloy 6061, T6.

### D. Nickel-Silver:

1. Extruded nickel-silver:
  - a. C77600 nickel-silver
  - b. Hot extruded, temper code M30

### E. Plastic Laminate:

1. ASTM E84 Class A and NEMA LD3.1, Fire-Rated Grade (GP-50), Type 7, 0.050" ±0.005" thick.
2. Exposed Surfaces: Color and texture selected by Architect.

3. Concealed Surfaces: Manufacturer's standard color and finish.
- F. Fire-Retardant Treated Particle Board Panels:
1. Minimum 3/4" thick backup for natural finished wood and plastic laminate veneered panels, edged and faced as shown, provided with suitable anti-warp backing.
  2. Meet ASTM E84 with a flame-spread rating of 75 or less, and smoke development rating of 450 or less.
- G. Paint Finishes:
1. General:
    - a. Clean exposed metal parts and assemblies of oil, grease, scale, and other foreign matter and factory paint one shop coat of standard rust-resistant primer.
    - b. Galvanized metal need not be painted.
  2. Prime Finish:
    - a. Apply one coat of rust-resistant primer followed by a filler coat over uneven surfaces.
    - b. Sand smooth and apply final coat of primer.
  3. All equipment and metal work installed under this contract, which does not have a baked enamel or special architectural finish, and which is exposed in the hoistway, is cleaned, and painted one field coat of enamel.
  4. All control room equipment is painted upon completion of the installation with the manufacturer's standard machinery enamel.
  5. Elevator designation (number and/or letter) is prominently indicated on all control room and machinery space equipment, top of car crosshead and pit equipment.
- H. Baked Enamel Finish:
1. Prime finish per above.
  2. Unless specified "prime finish" only, apply and bake three additional coats of enamel in the selected solid color.

## 2.6 OPERATION

- A. General:
1. Cars automatically slow down and stop level at floors in response to car and landing calls with stops made in sequence in the established direction of travel, regardless of order in which buttons are pressed.
  2. Landing calls are canceled when the assigned car arrives at the landing.
  3. Automatic Dispatch Failure: Provide auxiliary dispatch system to automatically dispatch elevators in the event of failure of the primary control system.
  4. Hall Call Button Failure: Should failure of hall call button system occur, initiate operation providing predetermined service to all landings; elevators respond normally to car calls.
  5. Automatic Leveling:
    - a. When arriving at a floor cars level to within 1/8" above or below the landing sill prior to opening doors, without travelling past the landing during leveling
    - b. Maintain leveling accuracy regardless of carload, direction of travel, rope slippage or stretch.
  6. Power Conservation: P1, S1
    - a. Shut off car interior illumination after adjustable period (60-180 seconds) of no elevator demand.
    - b. Turn on prior to opening car doors when elevator demand returns.
- B. Door Operation:
1. Automatically open doors when car arrives at a floor.
  2. Stop and reopen doors or hold doors in open position upon activation of "door open" button.

3. At expiration of normal dwell time, or upon activation of "door close" button, close doors:
    - a. Prevent doors from closing and reverse doors at normal opening speed if door reopening device beams are obstructed while doors are closing, except during nudging operation.
    - b. In event of door reopening device failure, provide for automatic shutdown of car at floor level with doors open.
    - c. Close cycle does not begin upon activation of "door close" button until normal door dwell time for a car or hall call has expired, except firefighters' operation.
  4. Nudging Operation:
    - a. After beams of door reopening device are obstructed for a predetermined time interval (minimum 20.0-25.0 seconds), sound warning signal, and attempt to close doors with maximum of 2.5 foot-pounds kinetic energy.
    - b. Activation of the door open button overrides nudging operation and reopens doors.
  5. Interrupted Beam Time:
    - a. When beams are interrupted during initial door opening, hold door open a minimum of 3.0 seconds.
    - b. When beams are interrupted after the initial 3.0 second hold open time, reduce time doors remain open to an adjustable time of approximately 1.0-1.5 seconds after beams are reestablished.
  6. Differential Door Time:
    - a. Field adjustable time that doors remain open after stopping in response to calls.
    - b. Car Call: Hold open time adjustable between 3.0 and 5.0 seconds.
    - c. Hall Call:
      - 1) Hold open time adjustable between 5.0 and 8.0 seconds.
      - 2) Use hall call time when car responds to coincidental calls.
- C. Independent Service:
1. When feature is activated from within the car, allow control of car from buttons and controls inside the car.
  2. Close doors by constant pressure on desired destination floor button or door close button.
  3. Open doors automatically upon arrival at selected floor.
- D. Load Weighing:
1. Provide cars with adjustable load weighing device which monitors cable tension.
  2. Control system to provide dispatching at main floor in advance of normal intervals when car fills to a field adjustable, 10%-100%, percentage of rated capacity.
  3. Provide hall call by-pass when car is filled to a field adjustable, 10%-100%, percentage of rated capacity.
  4. Audible overload signaling device inside elevator cab shall be activated upon load weighing device sensing carload has reached or exceeded a pre-determined percentage of capacity.
  5. Doors will not close when overload signaling device is active.
- E. Duplex Selective Collective Operation, Cars PE 1 & PE 2:
1. Elevators operate via momentary pressure buttons to:
    - a. place hall call by selecting direction of travel at each hall landing (up and down buttons at each intermediate landing, single buttons at each terminal landing).
    - b. place car call by selecting destination floor from inside the car (individual buttons for each floor served).
  2. Hall calls, other than calls placed at the landing at which car is standing, start car and cause the car to stop at first landing for which a call is registered in the direction of travel.
  3. Car calls cause the car to stop at the floors registered in the order the car arrives at each selected floor in its current direction of travel.
  4. Free Car:

- a. When there are no calls in the system, one car is automatically dispatched to the elevator discharge level (home car), park other car (free car) at its last stop above elevator discharge level.
  - b. An idle free car answers call above or below it, except calls at main or Basement landings (where applicable).
  - c. When free car travels to main landing in response to a car call, it becomes home car and former home car travels to a middle floor above main landing and becomes the free car.
  - d. When free car is responding to calls, home car shall respond to the following:
    - 1) Up calls below UP traveling free car.
    - 2) All Up and Down calls behind DOWN traveling free car.
    - 3) Any hall calls registered when free car is delayed in its normal operation for a predetermined period.
  - e. When both cars are responding to registered car and hall calls, the first car to complete its calls becomes the assigned home car and is dispatched automatically to the Main Landing.
  - f. Only one car responds to each hall call.
5. If either car is removed from service, the other car responds to all registered hall calls and its own car calls.
6. Car and Hall Lanterns:
- a. Lanterns provide audio and visual signal upon each stop, regardless of responding to car or hall call.
  - b. Visual signal remains active from commencement of door opening until doors are completely closed.
- F. Simplex Selective Collective Operation, Car PE 3, PE 4 and SE 5:
- 1. Elevators operate via momentary pressure buttons to:
    - a. Place hall call by selecting direction of travel at each hall landing (up and down buttons at each intermediate landing, single buttons at each terminal landing).
    - b. Place car call by selecting destination floor from inside the car (individual buttons for each floor served).
  - 2. Hall calls, other than calls placed at the landing at which car is standing, start car, and cause the car to stop at first landing for which a call is registered in the direction of travel.
  - 3. Stops are made in order in which landings are reached, irrespective of sequence in which calls are registered.
  - 4. Parked Car (No Demand):
    - a. When feature is enabled, elevator remains at landing of last assignment (if no further demand) with doors closed, for a predetermined amount of time (programmable for any amount of time). Upon expiration of time, the elevator returns to the main egress landing with the doors closed.
    - b. If feature is disabled, if no further demand, the elevator remains at landing of last assignment with the doors closed until a hall call is registered.
  - 5. Car and Hall Lanterns:
    - a. Lanterns provide audio and visual signal upon each stop, regardless of responding to car or hall call.
- G. Standby or Emergency Power Operation:
- 1. The terms Standby Power and Emergency Power are both referred to as Emergency Power in this Section. Elevator operation is the same when either is provided.
  - 2. Where emergency power is provided to the elevator main disconnects and required by the Building Code the elevator installation shall comply with the Emergency Power Operation requirements of ASME A17.1 as modified by any superseding Building Code requirements.
  - 3. Operation is activated by a signal from an Automatic Transfer Switch (ATS) to elevator controls indicating the Emergency power source is operational.

- a. Start and run one elevator per group or single elevator at contract car speed and capacity.
  - b. Illuminate "ELEVATOR EMERGENCY POWER" signals.
- 4. Restoration of Normal Power:
  - a. At least 20 seconds prior to transfer from emergency power to normal power at the ATS, a pre-transfer signal is supplied to the elevator control system from the ATS.
  - b. Elevators operating on emergency power stop at the next available landing and remain there until normal power is restored.
- H. Firefighters' Emergency Operation:
  - 1. Provide equipment and operation in accordance with code requirements.
- I. Car-to-Lobby Operation, All Cars:
  - 1. Activated and deactivated for each elevator or group of elevators:
    - a. Remotely via Elevator Management System.
    - b. Remotely via keyswitch activation.
  - 2. Return car nonstop after answering pre-registered car calls, and park with doors open for an adjustable time of 60-90 seconds.
- J. Interface to Building Management Systems:
  - 1. The elevator monitoring system shall be capable of interfacing and exchanging data with third-party building management systems including Siemens, Landis AND Staefa, Johnson Controls, SCADA.
  - 2. Information shall be exchanged by Modbus protocol, open protocol or other suitable methods as required.
- K. Motion Control:
  - 1. Microprocessor-based AC variable-voltage, variable frequency with digitally encoded closed-loop velocity feedback suitable for operation specified and capable of providing smooth, comfortable car acceleration, retardation, and dynamic braking.
  - 2. Limit the difference in car speed between full load and no load to not more than  $\pm 3\%$  of the contract speed.
- L. Emergency Lighting, Communication, and Alarm:
  - 1. Car mounted battery unit with solid-state charger to operate alarm bell, car emergency lighting, and communication system.
  - 2. Car lighting and communication shall be provided with a minimum of 4 hours of operation on back-up power during a loss of normal power, and a minimum of 1 hour of operation for car-mounted alarm.
  - 3. Battery to be rechargeable with minimum five-year life expectancy.
  - 4. Provide constant pressure light test button in service compartment of car operating panel.
  - 5. Provide lighting integral with normal car lighting system.

## 2.7 EQUIPMENT SPACE EQUIPMENT

- A. Arrange equipment in spaces shown on drawings.
- B. Solid State Power Conversion and Regulation Unit:
  - 1. Provide solid-state, alternating current, variable voltage, variable frequency (ACV $\square$ F), IGBT converter/inverter regenerative drive.
  - 2. Design unit to limit current, suppress noise, and prevent transient voltage spikes into building power supply.
    - a. Provide internal heat sink cooling fans for the power drive portion of the converter panels.
    - b. Mechanically isolate unit to minimize noise and vibration transmission.



3. Conform to IEEE standard 519-2014 for line harmonics and switching noise.
  4. Provide isolation transformers, filter networks, and choke inductors.
  5. Suppress solid-state converter noises, radio frequency interference, and eliminate regenerative transients induced into the mainline feeders or the building standby power generator.
  6. Supplemental direct-current power for the operation of hoist machine brake, door operator, dispatch processor, signal fixtures, from separate static power supply.
  7. ACVF Drives are regenerative and utilize IGBT converter/inverter and dynamic braking during overhauling condition.
- C. Resistor Load Bank:
1. Provide means of diverting regenerated power during emergency power operation and restoring regenerated power delivery back to the electrical distribution system following emergency power operation termination.
  2. Provide resistor load bank to discharge regenerative power during emergency power operation.
  3. Load bank is installed on the load side of the mainline disconnect.
- D. Encoder:
1. Direct drive, solid-state, digital type. Update car position at each floor and automatically restore after power loss.
- E. Controller:
1. UL/CSA labeled.
  2. Compartment:
    - a. Securely mount all assemblies, power supplies, chassis switches, relays, on a substantial, self-supporting steel frame.
    - b. Completely enclose equipment with covers.
    - c. Provide means to prevent overheating.
  3. Relay Design:
    - a. Magnet operated with contacts of design and material to insure maximum conductivity, long life, and reliable operation without overheating or excessive wear.
    - b. Provide wiping action and means to prevent sticking due to fusion.
    - c. Contacts carrying high inductive currents are provided with arc deflectors or suppressors.
  4. Microprocessor Hardware:
    - a. Provide built-in noise suppression devices that provide a high level of noise immunity on all solid-state hardware and devices.
    - b. Provide power supplies with noise suppression devices.
    - c. Isolate inputs from external devices (such as pushbuttons) with opto-isolation modules.
    - d. Design control circuits with one leg of power supply grounded.
    - e. Safety circuits are not affected by accidental grounding of any part of the system.
    - f. System automatically restarts when power is restored.
    - g. System memory is retained in the event of power failure or disturbance.
    - h. Equipment is provided with Electro Magnetic Interference (EMI) shielding within FCC guidelines.
  5. Wiring:
    - a. CSA labeled copper for factory wiring.
    - b. Neatly route all wiring interconnections and securely attach wiring connections to studs or terminals.
    - c. Provide labels for all extra or spare wires, neatly organized at base of controller cabinet.
  6. Data Monitoring:

- a. Provide an onboard monitor or screen, either inside the controller or in a stand-alone PC station, to display an easily understood format.
  - b. Upon command, the current operating parameters, individual car status, floor positions or other selected operational features will be displayed.
  - c. Display a minimum of 20 previous errors, which will be logged for statistical evaluation.
  - d. Provide means for hard copy printouts.
  - e. Diagnostic display will support monitoring of elevator motion, velocity, door operation parameters and timing functions.
  - f. Non-volatile memory is required to store group operation data with provisions for data logging and hard copy reporting.
  - g. Network connectivity provision is incorporated in the basic dispatching control system.
    - 1) This provision may be employed for traffic analysis, hard copy computation and/or remote monitoring of status conditions utilizing an isolated PC and compatible printer for reports or graphs.
    - 2) All reports are time and date stamped to confirm reporting period.
  - h. Monitor employs color video displays for the following information:
    - 1) Display screen (group operations statistics).
    - 2) Monitoring screen (diagnostics, system status).
    - 3) Performance screen (traffic analysis).
  - i. Features required regarding remote and additional location monitoring, as indicated in other applicable sections, apply.
7. Permanently mark components with symbols shown on wiring diagrams.
8. Provide control panel compliant with UL 508A SB.SCCR of 5000A required.

F. Electrical Wiring and Wiring Connections:

- 1. Conductors and Connections:
  - a. Copper throughout with individual wires coded and connections on identified studs or terminal blocks.
- 2. The use of splices or similar connections in wiring except at terminal blocks, control compartments, or junction boxes is prohibited. Conduit:
  - a. Galvanized steel conduit, EMT, or duct.
  - b. Flexible conduit length not to exceed 3'-0".
- 3. Traveling Cables:
  - a. Tag spares in equipment space.
  - b. Provide cables from controller to car top.
- 4. Auxiliary Disconnect:
  - a. Provide controller or machine mounted auxiliary, lockable "open" disconnect.
- 5. Auxiliary Wiring:
  - a. Provide dedicated equipment space junction boxes for the following:
    - 1) Fire alarm initiating devices.
    - 2) Emergency two-way communication system.
    - 3) Network connectivity.
    - 4) Paging speaker.
    - 5) CCTV.
    - 6) Digital video display.
    - 7) Intercom, announcement speaker and/or background music.
  - b. Provide conduit, wiring and connections from controller space junction box to each controller in the equipment space for the following:
    - 1) Fire alarm initiating devices.
    - 2) Emergency two-way communication system.
    - 3) Network connectivity.
    - 4) CCTV.
    - 5) Digital video display.
    - 6) Intercom, announcement speaker and/or background music.

## 2.8 HOISTWAY EQUIPMENT

- A. Gearless Traction Hoist Machine:
1. AC induction or P.M.S.M. ACVIF gearless traction motor with brakes, drive sheave, and deflector sheave mounted in proper alignment.
  2. Provide hoist machine mounted direct drive, digital, closed-loop velocity encoder.
  3. Provide machine with an electromechanical brake.
    - a. The brake is spring applied and electrically released.
    - b. Brake shoes are applied to the braking surface simultaneously and with equal pressure.
  4. Provide means to prevent ascending car over-speed and unintended car movement via dual modular redundant braking system.
  5. Provide ladders and platforms with handrails and toe boards for overhead sheave and governor access within the bounds of the equipment space.
- B. Machine and Equipment Support Beams:
1. Provide structural steel beams required for direct support of and attachment to building structure of hoist machine, deflector sheaves, overhead sheaves, governor, and hoist rope dead-end hitch assemblies.
  2. Provide bearing plates, anchors, shelf angles, blocking, embedment, for support and fastening of machine beams or equipment to the building structure.
  3. Isolate machine and overhead sheave beams to prevent noise and vibration transmission to building structure.
- C. Governor:
1. Centrifugal-type, car driven mounted with pull-through jaws and bi-directional shutdown switches.
  2. Provide required bracketing and supports for attachment to building structure.
  3. Provide ladders and platforms with handrails and toe boards for governor access.
  4. Provide manual remote reset capability at controller.
- D. Guide Rails:
1. Planed steel T-sections for car and counterweight of suitable size and weight for the application, including brackets for attachment to building structure.
  2. No additional structural points of attachment other than those shown on the Contract Documents will be provided.
  3. Provide rail backing and intermediate counterweight tie brackets.
  4. Provide bracketing, at top and bottom of floor beams.
- E. Sheaves:
1. Machined grooves and sealed bearings.
  2. Provide mounting to machine beams, car, and counterweight structural members, or building structure.
- F. Counterweight:
1. Steel frame with metal filler weights.
- G. Counterweight Guides:
1. Spring dampened roller guides.
- H. Governor Rope and Encoder Tape Tensioning Sheaves:
1. Mount sheaves and support frame on pit floor or guide rail.
  2. Provide frame with guides or pivot point to enable free vertical movement and proper tension of rope and tape.

- I. Suspension Means:
  - 1. 8 x 19 or 8 x 25 Seale construction, traction steel.
    - a. Fasten with staggered length, adjustable, spring isolated wedge shackles.
  - 2. Noncircular elastomeric-coated steel belt comprising of several steel cords arranged in parallel and molded within a coating.
  - 3. Approved governor rope.
  
- J. Terminal Stopping:
  - 1. Provide normal and final devices.
  
- K. Electrical Wiring and Wiring Connections:
  - 1. Conductors and Connections:
    - a. Copper throughout with individual wires coded and connections on identified studs or terminal blocks.
    - b. The use of splices or similar connections in wiring except at terminal blocks, control compartments, or junction boxes is prohibited.
    - c. Provide 20% spare conductors for each wire type.
    - d. Run spare wires from car connection points to individual elevator controllers in the equipment space.
  - 2. Conduit:
    - a. Galvanized steel conduit, EMT, or duct.
    - b. Flexible conduit between isolated equipment, length not to exceed 3'-0".
    - c. Flexible heavy-duty service cord may be used between fixed car wiring and car door switches for door protective devices.
    - d. Provide conduit from the closest hoistway of each elevator group or single elevator to the group control console. Provide wiring
  - 3. Traveling Cables:
    - a. Flame and moisture-resistant outer cover.
    - b. Prevent traveling cable from rubbing or chafing against hoistway or equipment within hoistway.
    - c. Provide the following minimum composition, which are not considered spares:
      - 1) Two pair of shielded 18-gauge wire for CCTV, from car controller to car top junction box, plus 3'-0" excess loop at both ends.
      - 2) Two pair of 18-gauge wire for CCTV power.
      - 3) Two pair of 18-gauge wire for emergency communication system power.
      - 4) Two pair of 18-gauge wire for network connectivity power.
    - d. Provide eight pair of spare shielded communication wires in addition to those required to connect specified items.
    - e. Tag spares in control room or equipment space. Provide cables from controller to car top.
    - f. Support traveling cable by suspending from supports by means that automatically tighten around the cable when tension is increased
  - 4. Auxiliary Wiring:
    - a. Provide conduit, wiring and connections for systems specified.
  
- L. Entrance Equipment:
  - 1. Two-point hanger roller with non-metallic roller surface and suspension with eccentric upthrust roller adjustment.
  - 2. Bar or formed, cold-drawn removable steel door tracks with smooth roller contact surface.
  - 3. Door Interlocks:
    - a. Operable door locks without retiring cam.
  - 4. Door Closers:
    - a. Spring, spirator, weighted, or jamb/strut mounted.
    - b. Design and adjust to ensure a smooth and quiet mechanical close of doors.
  
- M. Floor Numbers:

1. Stencil paint 4" high floor designations in contrasting color on inside face of hoistway doors and hoistway fascia. Must be visible from within car.

## 2.9 HOISTWAY ENTRANCES

### A. Entrance Assemblies:

1. Complete entrances bearing fire labels from a certified testing laboratory approved by authority having jurisdiction.
2. Provide entrance assemblies bearing 1-1/2hr label.

### B. Frames:

1. Provide Arabic floor designation/Tactile marking plates:
  - a. Centered at 60" above finished floor.
  - b. Located on both side jambs of all entrances.
  - c. Minimum 4" in height.
  - d. Tactile indications below Arabic floor designation.
  - e. Permanently fastened.
2. Provide car identification label:
  - a. Mounted directly below floor designation/Tactile marking plates.
  - b. Located on both side jambs at the following levels:
    - 1) Designated Level.
    - 2) Alternate Level.
  - c. Finish and design to match floor designation/Tactile marking plates.
  - d. Permanently fastened.
3. Provide plates at main egress landing with "Star" designation.
4. For designated emergency car, provide "Star of Life" cast designation plates at height of 78"-84" above finished floor on both side jambs at all floors.

### C. Door Panels:

1. Sandwich construction without binder angles.
2. Provide one leading edge of doors with rubber astragals.
3. Provide a minimum of two gibs per panel, one at leading and one at trailing edge with gibs in the sill groove entire length of door travel.
4. Provide one separate 4" steel reinforcement safety gib mounted between door gibs, where not integrated with door gibs.
5. Architectural metal cladding wraps around leading and trailing edge of panel and return a minimum of 1/2" on rear side of leading edge of panel at all floors.

### D. Sight Guards:

1. Same material, finish, and height as hoistway entrance door panels.
2. Construct without sharp edges.

### E. Sills:

1. Extruded aluminum.

### F. Sill Supports:

1. Structural or formed steel designed to support sill load.
2. Design to eliminate need for grout under the sill.

### G. Fascia, Platform Guards and Hanger Covers:

1. 16-gauge furniture steel with Contractor's standard finish.

### H. Struts and Headers:

1. Provide support of all entrances to building structure including connections to building structure.

2. Provide door open bumpers on entrances equipped with vertical struts.
- I. Finish of Frames and Doors:
    1. Satin finish stainless-steel.
  - J. Hoistway Access:
    1. Hoistway Door Unlocking Device:
      - a. Provide unlocking device escutcheon in door panel at all floors, with finish to match adjacent surface.
    2. Hoistway Access Switches:
      - a. Mount in entrance frame side jamb at top floor.
      - b. Provide switch with faceplate.

## 2.10 PIT EQUIPMENT

- A. Buffers:
  1. Provide Spring type with blocking and support channels.
  2. Stencil car number on buffer.
- B. Pit Access:
  1. Hoistway Access Key Switch:
    - a. Provide key switch at lowest terminal landing.
    - b. Mount in entrance frame side jamb.
    - c. Provide switch with faceplate.
  2. Provide pit stop switches.
- C. Counterweight Guard:
  1. Metal guard in pit in front of counterweight where no compensation is provided or where there is no space greater than 20 inches between the compensation means, suspension means, counterweight rails, or guards.
- D. Compensation: (If required by design)
  1. Encapsulated chain with pit guide assembly.
    - a. Pit mounted guide assembly:
      - 1) Provide quiet, effective restraint without excessive wear of components.
      - 2) Inhibit rubbing or chafing against hoistway or equipment within hoistway or pit.
    - b. Application must meet performance/noise level requirement of specification.

## 2.11 CAR EQUIPMENT

- A. Frame:
  1. Welded or bolted formed steel channel construction to meet load classification specified.
- B. Safety Device:
  1. Type "B," flexible guide clamp.
- C. Platform:
  1. Design and construct to accommodate load classification requirements.
    - a. Provide Class "A" construction for passenger elevators, Class "C3" for service elevators.
    - b. Provide 1" recess to accommodate floor and subfloor thickness.
    - c. Allow 500 lbs. for floor weight.
  2. The car platform consists of a steel frame with necessary steel stringers, all securely welded together.

3. Provide platform with two layers of 3/4" marine grade plywood.
  4. Cover the underside of the car platform with sheet steel.
  5. Isolate the passenger elevator platform.
    - a. The support frame includes rubber pads on which the platform rests.
    - b. No mechanical connections between platform and frame.
  6. Work Light Fixtures & AC Receptacles:
    - a. Provide permanent mounted work light fixtures below platform, complete with proper lamp guards.
- D. Platform Guard:
1. Minimum 48" high, reinforced and braced to car platform front with Manufacturer's standard finish
- E. Cartop Guard Rail:
1. Provide a railing system provided on the outside perimeter of the car top on all sides where the horizontal distance between the edges of the car top and the adjacent hoistway enclosure exceeds 12 inches.
- F. Car Guides:
1. Roller type with three or more spring dampened, sound-deadening rollers per shoe. Minimum 6" outside diameter.
- G. Cab Steadying Plates:
1. Provide and install top of car steadying plates.
  2. Emphasis is placed on proper tension to car styles allowing minimal lateral movement of the cab.
  3. Steadying plates are isolated using non-metallic guides or rollers.
- H. Sills:
1. One-piece extrusion with extension between car entrance columns to face of car front return.
  2. Extruded extension to match finish of sill.
  3. Aluminum.
- I. Door Panels:
1. Sandwich construction without binder angles.
  2. Provide one leading edges of doors with rubber astragals.
  3. Provide a minimum of two gibs per panel, one at leading and one at trailing edge with gibs in the sill groove entire length of door travel.
  4. Construct door panels with interlocking, stiffening ribs.
  5. Architectural metal cladding wraps around leading and trailing edge of panel and return a minimum of 1/2" on rear side of leading edge of panel.
- J. Door Hangers:
1. Two-point suspension.
  2. Hanger roller with non-metallic surface and eccentric roller adjustment.
- K. Door Track:
1. Bar or formed, cold-drawn removable steel track with smooth roller contact surface.
- L. Door Header:
1. Construct of minimum 12-gauge steel, shape to provide stiffening flanges.
- M. Door Electrical Contact:
1. Prohibit car operation unless car door is closed.

- N. Door Clutch:
1. Heavy-duty clutch, linkage arms, vane assembly and pickup rollers or cams to provide positive, smooth, quiet door operation.
  2. Design clutch so car doors can be closed while hoistway doors remain open.
- O. Restricted Opening Device:
1. Provide mechanical car-door restrictor to prevent opening of doors when outside unlocking zone.
  2. Plunger type restrictors are not applicable.
  3. Utilize mechanical angle to prevent door opening
- P. Door Operator:
1. High speed, heavy-duty door operator capable of opening doors at no less than 2.5 fps.
  2. Accomplish reversal within 2" of door movement.
  3. Provide solid-state door control with closed loop circuitry to constantly monitor and automatically adjust door operation based upon velocity, position, and motor current.
  4. Provide a minimum of four controller-based motion profiles, per floor, per door, to maintain consistent, smooth, and quiet door operation at all floors, regardless of door weight or varying air pressure.
- Q. Door Reversing Device:
1. Infrared Reopening Device:
    - a. Black fully enclosed device with full screen infrared matrix or multiple beams extending vertically along leading edge of each door panel to minimum height of 74" above finished floor.
    - b. 3D beam device to detect approach from elevator lobby.
    - c. Reverse doors at normal opening speed if beams are obstructed while doors are closing, except during nudging operation.
    - d. In event of device failure, provide for automatic shutdown of car at floor level with doors open.
  2. Nudging Operation:
    - a. After door close is obstructed for a predetermined time interval (minimum 20.0-25.0 seconds), warning signal sounds, and doors close with a maximum of 2.5 foot-pounds kinetic energy.
    - b. Door open button overrides nudging operation and reopen doors.
  3. Interrupted Beam Time:
    - a. When beams are interrupted during initial door opening, hold door open a minimum of 3.0 seconds.
    - b. When beams are interrupted after the initial 3.0 second hold open time, reduce remaining adjustable open time to 1.0-1.5 seconds after beams are reestablished.
  4. Differential Door Time:
    - a. Provide separate adjustable timers to vary door dwell time after stopping in response to calls.
    - b. Car Call:
      - 1) Hold open time adjustable between 3.0 and 5.0 seconds.
    - c. Hall Call:
      - 1) Hold open time adjustable between 5.0 and 8.0 seconds.
      - 2) Use hall call time when car responds to coincidental calls.
- R. Car Operating Panel:
1. Elevator:
    - a. One car operating panel without faceplates:
      - 1) Consisting of a metal box containing the vandal resistant operating fixtures, mounted behind the car swing front return panels.
      - 2) Faceplates are hinged and constructed of satin finish stainless-steel.



- b. Suitably identify floor buttons, alarm button, door open button, door close button and emergency push-to-call button with cast stainless tactile symbols rear mounted.
  - c. Pushbuttons:
    - 1) Provide minimum 3/4" diameter raised floor pushbuttons which illuminate to indicate call registration.
  - d. Locate operating controls no higher than 48" above the car floor; no lower than 35" for emergency push-to-call button and alarm button.
  - e. Locked Firefighters Operation Panel:
    - 1) For fire officer use and independent service only.
    - 2) Openable by the same key which operates the Fire Operation switch.
    - 3) Including the following features:
      - a) Phase II fire access switch.
      - b) Firefighters' visual indication.
      - c) Call cancel button.
      - d) Stop switch, manually operated.
      - e) Door open button.
      - f) Door close button.
      - g) Floors served.
  - f. Provide "door open" button to stop and reopen doors or hold doors in open position.
  - g. Provide "door close" button to activate door close cycle.
    - 1) Cycle does not begin until normal door dwell time for a car or hall call has expired, except firefighters' operation.
2. Service Compartment:
- a. Provide lockable service compartment with recessed flush door.
  - b. Door material and finish matches car return panel or car operating panel faceplate.
  - c. Include the following controls in lockable service cabinet with function and operating positions identified by permanent signage or engraved legend:
    - 1) Access switch.
    - 2) Light switch.
    - 3) 4-position Exhaust blower switch.
    - 4) Independent service switch.
    - 5) Constant pressure test button for battery pack emergency lighting.
    - 6) 120-volt, AC, GFCI protected electrical convenience duplex outlet.
    - 7) Card reader override switch.
    - 8) Keyed stop switch.
3. Provide black filled, engraved, or approved etched signage as follows with approved size and font:
- a. Phase II firefighters' operating instructions on inside face of firefighters' compartment door.
  - b. Red filled engraved firefighters' operation on outside face of compartment door.
  - c. Building identification car number over main car operating panel.
  - d. Car capacity in pounds on service compartment door.
  - e. "No Smoking" over main car operating panel.
- S. Car Top Control Station:
- 1. Mount to provide safe access and utilization while standing on car top.
  - 2. Operating device contains Up and Down direction buttons, a Run button, an Inspection/Automatic switch and Emergency Stop switch.
  - 3. Operating device contains an audible and visible indicator that fire recall has been initiated.
  - 4. This station is fixed to the car crosshead or may be portable provided the extension cord and housing are permanently attached to the car crosshead.
  - 5. The car will be operated by constant pressure on the appropriate direction button and the Run button simultaneously.

6. Normal operating devices will be inoperative while this device is in use.
- T. Emergency Audible Signaling:
1. Provide on top of each elevator.
  2. Activation of the Alarm Button or Emergency Stop switch will cause Emergency Audible Signal.
  3. Provide auxiliary power supply to provide 1hr power in the event of normal power loss.
- U. Work Light and Duplex Plug Receptacles:
1. GFCI protected outlet at top and bottom of car.
  2. Include on/off switch and lamp guard.
  3. Provide additional GFCI protected circuit and dedicated junction box on car top for installation of car CCTV
  4. Provide additional GFCI protected circuit and dedicated junction box on car top for installation of car digital video display.

## 2.12 CAR ENCLOSURE

- A. Elevator: Provide complete as specified herein and detailed on architectural drawings.
1. Shell:
    - a. Reinforced formed furniture steel panels with baked enamel interior finish.
    - b. Apply sound-deadening mastic to exterior.
    - c. Provide concealed ventilation cutouts.
  2. Canopy:
    - a. Reinforced formed furniture steel panels with lockable, contacted, hinged emergency exit.
    - b. Interior finish white reflective baked enamel.
  3. Front Swing Return Panels and Integral Entrance Columns:
    - a. Reinforced furniture steel clad with satin finish stainless-steel No. 4 finish.
    - b. Swing entire unit on substantial pivot points for service access to car operating panels.
    - c. Locate pivot points to provide full swing of return panel without interference with side wall finish or handrail.
    - d. Secure in closed position with concealed three-point latch.
    - e. Provide firefighters' and service compartments with recessed flush cover and cutouts for operating switches.
  4. Transom:
    - a. Reinforced furniture steel clad with satin finish stainless-steel full width of enclosure.
  5. Base:
    - a. Stainless-steel with concealed ventilation cutouts.
  6. Finish Floor Covering:
    - a. Furnished under other sections.
    - b. Accommodate floor and subfloor thickness.
  7. Interior Wall Finish:
    - a. SE 5: Removable panels faced and edged, with textured finish stainless-steel
    - b. PE 1-4: provide 25,000 allowance per elevator for wall finish
  8. Ventilation:
    - a. Forced Ventilation
      - 1) 3-speed blower mounted to car canopy.
      - 2) Exhaust blower meets noise and vibration criteria.
  9. Lighting:
    - a. Provide LED fixtures with wiring and hookup.
  10. Suspended Ceiling:
    - a. Six-section for PE 1-4; Nine-section for SE 5 Satin finish stainless-steel panels with lighting cutouts in each panel.

11. Handrails:
  - a. Minimum 1-1/2" stainless-steel flat grab bar with backing plates and captive nuts across rear wall walls.
  - b. Bolt rails through car walls from back and mount on 1-1/2" deep solid round stainless-steel standoff spacers no more than 18" O.C.
  - c. Provide at 32 in. above finished floor, as indicated on Architectural drawings.
  - d. Additionally for the Service Elevator: Lower guardrail line 4" x 3/8" solid stainless-steel flat stock bars mounted on both sides and rear of the car.
  - e. Locate bottom guardrail line at 8" above car floor and handrail line at 32" above the car floor.

## 2.13 HALL CONTROL STATIONS

- A. Pushbuttons:
  1. Provide one riser for each elevator or group.
  2. Provide flush mounted faceplates
  3. Include pushbuttons for each direction of travel that illuminate to indicate call registration.
  4. Include engraved message and pictorial representation prohibiting use of elevator during fire or other emergency as part of faceplate.
  5. Pushbutton design matches car operating panel pushbuttons.
  6. Provide vandal resistant pushbutton and light assemblies.
  7. Provide LED illumination.
  8. Provide Phase I Fire Service key switch, engraved operating instructions and illuminating jewel.
  9. Provide communication check failure indication and silence key switch.
  10. Provide illuminating jewels indicating standby power status.

## 2.14 SIGNALS

- A. Hall Direction Lantern:
  1. Provide at each entrance to indicate travel direction of arriving car.
  2. Illuminate up or down LED lights and sound tone once for up and twice for down direction prior to car arrival at floor.
  3. Illuminate light until the car doors start to close.
  4. Sound level adjustable from 20-80 dBA measured at 5'-0" in front of hall control station and 3'-0" off floor.
  5. Provide advanced hall lantern notification to comply with ADA hall call notification time.
  6. Provide adjustable car door dwell time to comply with ADA requirements relative to hall call notification time.
  7. Hall direction lenses are arrow shaped with faceplates.
  8. Lenses are minimum 2" in their smallest dimension.
  9. Provide vandal resistant lantern and light assemblies consisting of series of dots or lines for maximum visibility.
- B. Hall Position Indicator, All Cars:
  1. Alpha-numeric digital indicator containing floor designations and direction arrows a minimum of 2" high to indicate floor served and direction of car travel.
  2. Mount integral with hall station at the Primary landing.
  3. Provide vandal resistant indicator and light assemblies.
- C. Car Position Indicator:
  1. Alpha-numeric digital indicator screens containing floor designations and direction arrows a minimum of 2" high to indicate floor served and direction of car travel.
  2. Locate fixture in each car operating panel.

3. When a car leaves or passes a floor, illuminate indication representing position of car in hoistway.
  4. Illuminate proper direction arrow to indicate direction of travel.
- D. Fixture Faceplate Material and Finish:
1. Satin finish stainless-steel for all fixtures.
  2. Tamper resistant fasteners for all public facing fastenings.
- E. Voice Synthesizer:
1. Provide electronic device with easily reprogrammable message and female voice to announce car direction, floor, emergency exiting instructions.

## 2.15 COMMUNICATION

- A. Car Communication System:
1. Hands-Free Phone System:
    - a. Two-way communication instrument in car with automatic dialing, tracking, and recall features, with shielded wiring to car controller in control room or equipment space.
    - b. Provide dialer with automatic rollover capability with minimum two numbers:
      - 1) Actuate two-way communication via "Help" button.
      - 2) Adjacent light jewel illuminates and flash when call is acknowledged.
      - 3) Button matches car operating panel pushbutton design.
      - 4) Provide "Help" button tactile symbol, engraved signage, and Tactile marking adjacent to button mounted integral with car front return panel.
  2. Emergency Personnel Communication:
    - a. Communication system is provided allowing emergency personnel to establish communications with each elevator individually.
    - b. Emergency Personnel Communication overrides any existing connection outside of building.
    - c. Adjacent light jewel illuminates and flashes when call is acknowledged.
    - d. Provide operating instructions.
    - e. On the same car operating panel as the phone push button, provide capability to communicate with and obtain responses from passengers.
    - f. Provide display video capability for entrapment assessment.
  3. Communication for deaf, hearing and speech impaired:
    - a. On the same car operating panel as the phone push button, provide capability to communicate visually with and obtain responses from passengers, including those passengers who cannot communicate verbally or hear.
    - b. Provide shielded twisted pair wiring to communicate to control room or equipment space network box.
    - c. Device shall be capable of being monitored by any entity as selected by the owner. All software, hardware, and training cost associated with the device shall be included within this project. Associated monthly monitoring costs will not be accepted.
- B. Remote Monitoring:
1. Provide system to capture faults or system shutdowns in real-time occurrence.
  2. Communicate faults or shutdowns to reception system, enabling automatic dispatch of technicians.
  3. System monitors faults 24-hours per day, 7-days per week.
- C. Firefighters' Key Box:
1. Flush-mounted box with lockable hinged cover.
  2. Engrave instructions for use on cover per Local Fire Authority requirements.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Prior to beginning installation of equipment examine hoistway and control room and equipment space areas.
- B. Verify no irregularities exist that affect execution of work specified.
- C. Verify electrical power location and characteristics in coordination with equipment requirements.
- D. Do not proceed with installation until work in place conforms to project requirements.

**3.2 INSTALLATION**

- A. Install all equipment in accordance with Contractor's instructions, referenced codes, specification, and approved submittals.
- B. Install control room and equipment space equipment with clearances in accordance with referenced codes and specification.
- C. Install all equipment so it may be easily removed for maintenance and repair.
- D. Provide any required hoisting/safety beams.
- E. Install all equipment to afford maximum accessibility, safety, and continuity of operation.
- F. Remove oil, grease, scale, and other foreign matter from the following equipment and apply one coat of field-applied machinery enamel.
  - 1. All exposed equipment and metal work installed as part of this work which does not have architectural finish.
  - 2. Control room equipment, hoistway equipment including guide rails, guide rail brackets, and pit equipment.
  - 3. Neatly touch up damaged factory-painted surfaces with original paint color. Protect machine-finish surfaces against corrosion.
- G. Fill hoistway door frames, back boxes for hallway stations and signal devices, and sills.
- H. Clean all architectural finishes and replace or restore any surfaces damaged during construction to like new condition.

**3.3 FIELD QUALITY CONTROL**

- A. Acceptance Testing:
  - 1. On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Advise Contractor, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.
- C. Independent Testing by Owner's Consultant.

**3.4 CONSTRUCTION TOLERANCES**

- A. Install rails plumb and align vertically with tolerance of 1/16" in 100'-0".
  - 1. Secure joints without gaps and file any irregularities to a smooth surface.

**3.5 ADJUSTING**

- A. Static balance car to equalize pressure of guide shoes on guide rails.
  - 1. Dynamically balance car and counterweight.
- B. Lubricate all equipment in accordance with Contractor's instructions.
- C. Adjust motors, power conversion units, brakes, controllers, leveling switches, limit switches, stopping switches, door operators, interlocks, and safety devices to achieve specified performance levels.

**3.6 CLEANING**

- A. Keep work areas orderly and free from debris during progress of project.
- B. Remove packaging materials on a daily basis.
- C. Remove all loose materials and filings resulting from work.
- D. Clean Control room and equipment space equipment and floor.
- E. Clean hoistways, car, car enclosure, entrances, operating and signal fixtures.
- F. Clean pit equipment and floor.

**3.7 DEMONSTRATION**

- A. Check operation of each elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period.
  - 1. Determine that operation systems and devices are functioning properly.

**3.8 PROTECTION**

- A. Temporary Use: Comply with the following requirements for each elevator used for construction purposes:
  - 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
  - 2. Provide strippable protective film on entrance and car doors and frames.
  - 3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
  - 4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
  - 5. Do not load elevators beyond their rated weight capacity.
  - 6. Engage elevator Installer to provide full maintenance service.
    - a. Include preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity.
    - b. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
  - 7. Engage Elevator Installer to restore damaged work, if any, so no evidence remains of correction.

- a. Return items which cannot be refinished in the field to the shop, make required repairs, and refinish entire unit, or provide new units as required.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 14 22 00 - ELECTRIC TRACTION FREIGHT ELEVATORS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Traction elevators as follows:
  - 1. One (1) Geared Freight Elevator, Car FR 6.
  
- B. Related Requirements: Including but not limited to the following:
  - 1. Division 05 Section "Structural Steel Framing" for the following:
    - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
    - b. Divider beams.
    - c. Hoist beams.
    - d. Structural-steel shapes for subsills.
  - 2. Division 05 Section "Metal Fabrications" for the following:
    - a. Pit ladders
  
- C. Products Installed but Not Furnished Under This Section:
  - 1. Building announcement speakers.
  - 2. CCTV camera provisions.
  - 3. Elevator security devices, control unit, mounting brackets, wiring materials, logic circuits, security system interface terminals, boxes and relays.
  - 4. Monitoring system interface.

**1.2 PRODUCT VARIATIONS AND ADJUSTMENTS**

- A. Product Variations: In the event of differences between products and systems of acceptable or available manufacturer/fabricators, Contractor shall notify Architect of such differences and resolve conflicts prior to awarding Contract. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.
  
- B. Adjustments: Proposed deviations shall include a detailed analysis of impact to adjacent substrates, structural, mechanical, electrical or other building systems, including related design or construction cost impacts. Deviations causing changes in materials, constructability, substrates, systems or conditions shall be included in the Work at no additional cost to Owner.

**1.3 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Include capacities, sizes, performances, operation, control, signal systems operations, safety features, finishes, and similar information.
  - 2. Include product data for car enclosures and hoistway entrances.
  - 3. Include product data for signal fixtures, lights, graphics, Tactile marking plates, and details of mounting.
  
- B. Shop Drawings:
  - 1. Provide scaled shop drawings and construction drawings of the following:
    - a. Plan and section layouts of hoistways, pits, overheads, machinery spaces and openings at each landing, to include the following:
      - 1) Location of all equipment.

- 2) Static and dynamic loads imposed on building structure.
- 3) Details of equipment isolation.
- 4) Required clearances around equipment.
- 5) Machine room heat release.
  - a) Provide heat loads based on a non-regenerative emergency power operation.
- 6) Power requirements:
  - a) motor horsepower, code letter, starting current, full load running current, and demand factor.
  - b) Provide engineered power consumptions based on 120 starts per hour.
  - c) Provide maximum and average power consumption.
- 7) Service connections.
- 8) Running Clearances.
- 9) Location of fixtures.
- b. Elevation section of hoistways:
  - 1) Overhead, pits (clearance, runby, etc.
  - 2) Entrance details.
  - 3) Sill support detail.
- c. Pit Equipment:
  - 1) Buffers.
  - 2) Compensation equipment and tie-downs.
  - 3) Counterweight guards.
  - 4) Pit reactions.
  - 5) Service ladder, platform.
  - 6) Stop switches.
- d. Elevator cabs:
  - 1) Car shell fabrication.
  - 2) Ventilation.
  - 3) Ceiling construction detail.
  - 4) Wall construction detail.
  - 5) Lighting detail.
  - 6) Handrail mounting detail.
  - 7) Transom, front returns.
- e. Fixtures:
  - 1) Car operating panel.
  - 2) Hall stations.
  - 3) Hall Lanterns.
  - 4) Position indicators.
  - 5) Access key switch.
  - 6) Remote panel:
    - a) Group Status Panel.
    - b) Emergency Power selector switches.
  - 7) Two-way conversation device (all master stations).
2. All submittals shall be clearly marked and identified with project title and appropriate device identification.
3. All submittals are subject to approval.
4. Corrections requested shall be incorporated onto the submittals.
5. All submittals shall also be submitted to Elevator Consultant via Portable Document Format (.pdf).

C. Samples for Verification:

1. For exposed car, hoistway door and frame, and signal equipment finishes.
2. Samples of sheet materials: 3" (75 mm) square.

3. Running trim members: 4" (100 mm) lengths.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Continuing Maintenance Proposal:
  1. Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard five-year maintenance agreement, starting on date initial maintenance service is concluded.
  2. State services, obligations, conditions, and terms for agreement period and future renewal options.
- B. Record Documents
  1. The following record documents shall be furnished upon completion and before final payment:
    - a. Shop Drawings:
      - 1) Complete sets of as installed plan and section layouts of hoistways, pits, overheads and machinery spaces, to include the following:
        - a) Static and dynamic loads imposed on building structure.
        - b) Details of equipment isolation.
        - c) Required clearances around equipment.
        - d) Machine room heat release/diversity factor.
        - e) Power requirements.
      - 2) Elevation section of hoistways:
        - a) Overhead, pits and entrance details.
      - 3) Elevator cabs.
      - 4) Fixtures:
        - a) Car fixtures.
        - b) Hall fixtures.
        - c) Remote fixtures.
      - 5) Machine room heat release/diversity factor and power requirements.
    - b. Wiring Diagrams:
      - 1) Complete sets of as installed straight-line wiring diagrams, showing the electrical connections of all altered vertical transportation equipment, shall be furnished upon completion.
      - 2) A legend sheet shall be furnished with each set of drawings containing the following information:
        - a) Name and symbol of each relay, switch and other electrical or solid-state apparatus.
        - b) Location on drawings, drawing sheets, number and area of switches and relays, etc., and location of all contacts.
        - c) Location of apparatus whether on controller, hoistway or elevator cab.
    - c. Maintenance and Operating Manuals:
      - 1) Description and sequence of operation of all equipment installed, including operating use for Building Personnel and tenants, as well as system troubleshooting manuals for technicians.
      - 2) Maintenance instructions and procedures of all vertical transportation equipment installed, including parts lists, for each elevator system.
      - 3) Lubrication charts indicating all lubricating points and type of lubricant recommended for all equipment.
      - 4) Complete parts catalogs for all replaceable parts.
- C. Tools:
  1. The following equipment shall be furnished upon completion and before final payment:

- a. The Elevator Contractor shall provide all the necessary tools, including laptop, hand-held devices, required software and manuals, required to troubleshoot, adjust, synchronize, calibrate, repair and maintain the vertical transportation systems, as well as perform all necessary procedures to perform all safety tests as required by code and local governing authority.
- b. Owner's equipment and software shall be updated regularly as necessary to properly troubleshoot, adjust, synchronize, calibrate, repair, maintain and test the vertical transportation systems. All equipment and/or software shall be of the same version as issued to technicians maintaining the vertical transportation systems.
- c. The Elevator Contractor shall provide a backup copy of any software that resides on the troubleshooting tool.
- d. Upon cancellation of service agreement, the Elevator Contractor shall provide all upgrades indicated above.

D. Keys:

1. Four sets of keys to operate all keyed switches and locks shall be furnished upon completion.
2. Keys shall be properly tagged.
3. All keying shall be arranged with the Contractor.

## 1.5 PERMITS TESTS AND CERTIFICATES

A. Permits:

1. The Elevator Contractor shall secure the necessary permits required for work to be performed, including work performed by sub-contractors.
2. The Elevator Contractor shall also secure the necessary permits required for the work to be performed to remove any existing devices on the premises.
3. The Elevator Contractor shall obtain and pay for all municipal and state permits necessary for execution of the elevator work, including fees for renewing permits.
4. The Elevator Contractor shall be responsible for posting all permits as required by the AHJ.
5. The Elevator Contractor shall be responsible for obtaining final sign-off for each permit filed by them.

B. Tests and Inspections:

1. The Elevator Contractor shall perform all necessary tests as required by ASME A17.1 and recommended by A17.2.
2. The Elevator Contractor shall be responsible for scheduling the necessary tests as required by the local authorities.
  - a. Any fees associated with a missed appointment, expediting of test or overtime test due to delays caused by the Elevator Contractor shall be the responsibility of the Elevator Contractor.

C. Certificates:

1. Elevator Contractor is responsible for obtaining and providing Contractor with all temporary and final inspection certificates of the proper governing authorities and shall provide the Contractor with such certificates.
2. The Elevator Contractor shall pay for all fees necessary for obtaining temporary and final inspection certificates.

D. Violations:

1. Any violations that exist on devices being removed shall be cleared by the Elevator Contractor prior to final acceptance by the Contractor.

**1.6 QUALITY ASSURANCE**

- A. Compliance with Regulatory Agencies:
  - 1. Comply with most stringent applicable provisions of codes, laws, and/or authorities, including revisions and changes in effect.
- B. Inspections:
  - 1. The Contractor is subject to reviews by the Consultant and/or Contractor at any time throughout the project.

**1.7 DELIVERY STORAGE AND HOISTING**

- A. General:
  - 1. The protection of all equipment and exposed finishes shall be the responsibility of the Elevator Contractor during delivery, handling and installation until completion of project.
  - 2. The Elevator Contractor shall replace damaged materials with new, at no additional cost for material and labor to Contractor.
- B. Delivery and Storage:
  - 1. It is expected that manufacturers' original packing shall adequately protect materials during delivery.
  - 2. Deliver materials to the site ready for use in the accepted manufacturer's original and unopened containers and packaging, bearing labels as to type of material, brand name and manufacturer's name. Delivered materials shall be identical to accepted samples.
  - 3. Store materials under cover in a dry and clean location, off the ground. Remove delivered materials that are damaged or otherwise not suitable for installation from the job site and replace with acceptable materials.
  - 4. It is the responsibility of the Elevator Contractor to properly store and protect all materials in space provided or designated by the Contractor against damage, stains, scratches, corrosion, weather, construction debris and environmental conditions.
- C. Hoisting:
  - 1. All required hoisting and movement of equipment shall be the responsibility of the Elevator Contractor.

**1.8 COORDINATION**

- A. General:
  - 1. Coordinate the following requirements with the other trades.
- B. Cast-in-Place Concrete:
  - 1. Elevator Contractor to provide guide rail bracket inserts and the locations for the General Contractor to install.
  - 2. Elevator Contractor to provide templates for machine room slab penetrations.
  - 3. Provide other hoistway and pit requirements, including location of sump pits.
- C. Masonry Penetrations:
  - 1. Provide locations in elevator machine room/hoistway walls where conduit, ropes, etc. shall penetrate walls and slabs.
  - 2. Coordinate installation of sleeves, block outs, inserts, and items that are embedded in concrete or masonry for elevator equipment.
  - 3. Furnish inserts, templates and installation instructions and deliver to Project site in time for installation.

- D. Structural Steel:
  - 1. Including, but not limited to, elevator machine rooms, hoistways and pits, sill supports, rail supports.
- E. Miscellaneous Steel:
  - 1. Pit ladders, working platforms, inspection platforms, guard rails, divider beams.
- F. Electric:
  - 1. Electrical service, outlets, lights, switches in elevator machine rooms and pits.
- G. Sprinklers:
  - 1. Including installation of sprinkler systems in the elevator pits or shaft per NFPA 13.
- H. HVAC:
  - 1. Provide necessary information to General Contractor and coordinate installation of equipment for elevator machine rooms.
- I. Finishes:
  - 1. Cab interiors, hoistway entrances, fixtures.
- J. Elevator Cab Flooring:
  - 1. Material and finish to be specified in other applicable section.
  - 2. Flooring installation must be coordinated to ensure car saddle is installed at proper height (even with finished floor).
- K. Security Equipment:
  - 1. Coordinate location(s) in elevator machine rooms and cabs where cables, conduit, components, etc. for CCTV and/or secure access interface equipment must be installed.

## **1.9 WARRANTY**

- A. Manufacturer's Warranty:
  - 1. Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
- B. Warranty Period: 12 months from date of Substantial Completion:
  - 1. The Elevator Contractor shall guarantee that the materials and workmanship of the apparatus installed by them and any subcontractor under this contract, shall be first class in every respect and that he will make good on any defects not due to ordinary wear and tear or improper use, which may develop within one year from the date of final acceptance of all equipment.
  - 2. Manufacturer's warranty to repair or replace defective products or their components in the event of defects within a specified period.
  - 3. Neither the final payment nor any provisions of the contract documents shall relieve the Elevator Contractor of the extent and period provided by law and upon written notice he shall remedy any defects due thereto and pay all expenses for any damage to other work resulting there from.
  - 4. The warranty as outlined above, for all devices, shall start from the date of final acceptance of each device, by the Consultant and the Owner, of all work specified and intended under these contract documents.

## **1.10 MAINTENANCE**

- A. General:

1. All maintenance shall be performed according to the guidelines stated in manufacturer's Maintenance and Operations manuals.
  2. Maintenance records for each device, including lubrication logs, check charts, shall be provided in each machine room.
- B. Construction Maintenance:
1. Upon substantial completion of a device, subsequent to receiving sign-off from the governing authorities and acceptance from Consultant and/or Contractor, the device may be accepted for service before completion of the entire project.
  2. During the Construction Maintenance period, the necessary preventive maintenance shall be performed on an as required basis.
  3. Provide the necessary protection of the hoistway entrances and sills, hoistway fixtures, cab interiors and fixtures and car door sills.
  4. Replacement or repair of the aforementioned components, due to abnormal use by others, shall be the responsibility of the Contractor/Owner.
  5. Perform emergency callback service during normal working hours.
  6. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of sixty minutes or less.
- C. Warranty Maintenance:
1. Upon final acceptance of each device, after Construction Maintenance period (if applicable), subsequent to receiving acceptance (sign-off) from the governing authorities and final acceptance, each device shall be accepted for full operation.
  2. The warranty maintenance period shall begin for each device when all conditions in the above paragraph are met and will continue for the specified period.
    - a. Warranty Maintenance Period may begin at different times for each elevator.
  3. The warranty maintenance program shall include the following:
    - a. Monthly examinations, including adjustments, cleaning and lubrication of equipment.
    - b. 24-hour Emergency Call back service shall be provided at no additional cost to Owner.
    - c. Replacement of components as required, using only components produced by the original manufacturer.
      - 1) Each machine room shall be equipped with a lockable storage cabinet to contain the necessary spare parts.
- D. Maintenance Specification:
1. Upon completion of the Warranty Maintenance period, the Elevator Contractor will provide the personnel to service the vertical transportation equipment.
    - a. Full-Service Maintenance Agreement shall commence upon the completion of the warranty maintenance period for a term of five (5) years:
      - 1) Contractor shall provide a proposal for a full-service agreement which covers the following:
        - a) All required inspections and tests.
        - b) 24-hour emergency call service at no additional cost to Owner.

## PART 2 - PRODUCTS

### 2.1 REFERENCES

- A. Definitions:
1. Terms used are defined in the latest edition of the Safety Code for Elevators and Escalators, ASME A17.1.

- B. American National Standard Institute (ANSI):
  1. A117.1 - Accessible and Usable Buildings and Facilities.
- C. American Society of Mechanical Engineers:
  1. ASME A17.1 - Safety Code for Elevators and Escalators.
  2. ASME A17.2 – Guide for Inspection of Elevators, Escalators, and Moving Walks.
  3. ASME A17.5 – Elevator and Escalator Electrical Equipment.
  4. ASME A17.6 – Standard for Elevator Suspension, Compensation, and Governor Systems.
- D. National Fire Protection Association (NFPA):
  1. NFPA 13 – Installation of Sprinkler Systems.
  2. NFPA 70 – National Electric Code.
  3. NFPA 80 – Fire Doors and Windows.
  4. NFPA 101 – Life Safety Code.
- E. Accessibility:
  1. International Building Code (IBC).
  2. American National Standard Institute (ANSI):
    - a. A117.1 - Accessible and Usable Buildings and Facilities.
  3. ADAAG – Americans with Disabilities Act Accessibility Guidelines.

## 2.2 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
  1. Controllers:
    - a. KONE Incorporated.
    - b. Schindler Elevator Corporation.
    - c. TK Elevator.
    - d. Otis Elevator
  2. Freight Vertical Bi-Parting Door:
    - a. Courion.
    - b. EMS.
    - c. Peelle.
  3. Fixtures vandal resistant:
  4. Hoist Machines:
    - a. Hollister Whitney.
    - b. Torin.
    - c. Imperial.
  5. Rope Brakes:
    - a. Hollister Whitney.

## 2.3 PERFORMANCE REQUIREMENTS

- A. Car Speed:
  1.  3% of contract speed under any loading condition.
- B. Car Capacity:
  1. Safely lower, stop and hold 125% of rated load.
- C. Car Stopping Zone:
  1.  1/4" under any loading condition.
- D. Car Ride Quality:



1. Acceleration and Deceleration:
    - a. Smooth, constant, and not less than 3.0 feet/second with an initial ramp between 0.5 and 0.75 second.
  2. Sustained Jerk:
    - a. Not more than 6 feet/second or twice the rate of acceleration.
  3. Horizontal and vertical acceleration within car during all riding and door operating conditions.
    - a. Not more than 20mg peak to peak (adjacent peaks).
  4. Measurement Standards:
    - a. Measure and evaluate ride quality consistent with ISO 18738, using low pass cutoff frequency of 10 Hz and A95 peak-to-peak average calculations.
- E. Noise and Vibration Control:
1. Airborne Noise:
    - a. Measured noise level of elevator equipment and its operation shall not exceed 60 dBA inside car under any condition including door operation and car ventilation exhaust blower on its highest speed.
    - b. Limit noise level in the machine room and control space relating to elevator equipment and its operation to no more than 80 dBA.
    - c. All dBA readings to be taken 3'-0" off the floor and 3'-0" from the equipment using the "A" weighted scale.
  2. Vibration Control:
    - a. All elevator equipment shall be mechanically isolated from the building structure and other components to minimize the possibility of objectionable noise and vibrations being transmitted to occupied areas of the building.

## 2.4 ELEVATORS

- A. Geared Freight Elevators Description:
1. Elevator Identification: Car FR 6.
  2. Capacity: 10,000 lbs.
  3. Class of Loading: Class C 3.
  4. Contract Speed: 200 fpm.
  5. Roping: 2:1 Underslung.
  6. Machine: Geared
  7. Machine Location: Offset.
  8. Control System: Operational Control, Collective microprocessor-based: Selective collective
  9. Floors Served, Front: 01, 02, 03, 04.
  10. Openings: Front 4.
  11. Minimum Clear to underside of canopy: 8'-0" High.
  12. Entrance Size: 10'-0" Wide X 8'-0" High.
  13. Entrance Type: Vertical Bi Parting

## 2.5 MATERIALS

- A. Steel:
1. Sheet Steel (Furniture Steel for Exposed Work): Stretcher-leveled, cold-rolled, commercial quality carbon steel, complying with ASTM A366, matte finish.
  2. Sheet Steel (for Unexposed Work): Hot-rolled, commercial quality carbon steel, pickled and oiled, complying with ASTM A568/A568M-03.
  3. Structural Steel Shapes and Plates: ASTM A36.
- B. Stainless-steel:

1. Type 302 or 304 series complying with ASTM A240, with standard tempers and hardness required for fabrication, strength, and durability.
  2. Apply mechanical finish on fabricated work in the locations shown or specified, Federal Standard and NAAMM nomenclature, with texture and reflectivity required to match Architect's sample. Protect with adhesive paper covering.
    - a. No. 4 Satin:
      - 1) Directional polish finish.
      - 2) Graining directions as shown or, if not shown, in longest dimension.
    - b. Textured:
      - 1) .050 inches mean pattern depth with bright directional polish (No. 4 satin finish).
      - 2) 5WL as manufactured by Rigidized Metals.
      - 3) Windsor pattern as manufactured by Rimex Metals.
- C. Aluminum:
1. Extrusions per ASTM B221; sheet and plate per ASTM B209.
  2. Die Cast Aluminum – ASTM B108, Alloy 356.0, T6.
  3. Extruded Aluminum – FS QQ-A 200/8, Alloy 6061, T6.
- D. Paint Finishes:
1. General:
    - a. Clean exposed metal parts and assemblies of oil, grease, scale, and other foreign matter and factory paint one shop coat of standard rust-resistant primer.
    - b. Galvanized metal need not be painted.
  2. Prime Finish:
    - a. Apply one coat of rust-resistant primer followed by a filler coat over uneven surfaces.
    - b. Sand smooth and apply final coat of primer.
  3. All equipment and metal work installed under this contract, which does not have a baked enamel or special architectural finish, and which is exposed in the hoistway, shall be cleaned and painted one field coat of enamel.
  4. All machine room equipment shall be painted upon completion of the installation with the manufacturer's standard machinery enamel.
  5. Elevator designation (number and/or letter) shall be prominently indicated on all machine room and machinery space equipment, top of car crosshead and pit equipment.
- E. Baked Enamel Finish:
1. Prime finish per above.
  2. Unless specified "prime finish" only, apply and bake three additional coats of enamel in the selected solid color.

## 2.6 OPERATION

- A. General:
1. Cars automatically slow down and stop level at floors in response to car and landing calls with stops made in sequence in the established direction of travel, regardless of order in which buttons are pressed.
  2. Landing calls canceled when answered.
  3. Automatic Dispatch Failure:
    - a. Provide auxiliary dispatch system to automatically dispatch elevators in the event of failure of the primary control system.
  4. Hall Call Button Failure:

- a. Should failure of hall call button system occur, initiate operation providing predetermined service to all landings; elevators to respond normally from car call buttons.
  5. Automatic Leveling:
    - a. An automatic two-way leveling device shall be provided, designed to govern the leveling of the car to within 1/8" above or below the landing sill. The leveling operation shall be effective to avoid overtravel, as well as undertravel of the car and maintain the leveling accuracy regardless of the load in the car, direction of travel, rope slippage or stretch.
  6. Door Control:
    - a. A car without registered car calls arriving at a floor where both up and down hall calls are registered, responds to the call in the direction of car travel. If no car call is registered for further travel in that direction, lantern immediately indicates changed direction without closing and reopening doors.
    - b. Direction lantern to remain illuminated until doors are fully closed.
  7. Coincident Calls:
    - a. The dispatching system shall be designed with a 20 second parameter, whereby an elevator with a car call will receive priority to answer a corresponding corridor call if it can do so within 20 seconds. If that elevator cannot answer the call within the prescribed time, the first available car shall be assigned.
  8. Independent Service:
    - a. Provide controls for operation of each car from its pushbuttons only.
    - b. Close doors by constant pressure on desired destination floor button or door close button.
    - c. Open doors automatically upon arrival at selected floor.
  9. Load Weighing:
    - a. General:
      - 1) Provide cars with adjustable cable tension monitoring load weighing device.
      - 2) Devices must be self-calibrating for the time-dependent effects of compression in any resilient materials in the assemblies, transducers, etc.
      - 3) Control system to provide dispatching at main floor in advance of normal intervals when car fills to capacity.
      - 4) Provide hall call by-pass when the car is filled to preset percentage of rated capacity and traveling in down direction.
      - 5) System shall be provided with field adjustable range, 10 to 100%.
      - 6) Audible overload signaling device inside elevator cab shall be activated upon load weighing device sensing carload has reached or exceeded a predetermined percentage of capacity.
      - 7) Elevator shall not be capable of closing doors and running when Overload signaling device is active.
- B. Simplex Microprocessor, Selective Collective Operation:
1. General:
    - a. Arrange for Simplex Selective Collective automatic operation.
    - b. Elevators shall operate via car and landing buttons.
  2. Operation:
    - a. Momentary pressure of one or more car or landing buttons shall activate the elevator.
    - b. Momentary pressure of calls, other than calls for landing at which car is standing, will start car, and cause car to stop at first landing for which a call is registered corresponding to direction in which car is traveling.
    - c. Stops made in order in which landings are reached, irrespective of sequence in which calls are registered.
  3. Parked Car (No Demand):

- a. Elevator may remain at landing of last assignment (if no further demand) with doors closed, for a predetermined amount of time (programmable for any amount of time) if feature is enabled.
    - b. If this feature is enabled, upon expiration of time, the elevator shall return to the main egress landing with the doors closed.
  4. If this feature is disabled, if no further demand, the elevator shall remain at landing of last assignment with the doors closed until a hall call is registered.
- C. Firefighters' Service:
  1. Provide equipment and operation in accordance with code requirements.
- D. Interface to Building Management Systems:
  1. The elevator monitoring system shall be capable of interfacing and exchanging data with a variety of third party building management systems including Siemens, Landis AND Staefa, Johnson Controls, SCADA.
  2. Information shall be exchanged by Modbus protocol, open protocol or other suitable methods as required.
- E. Motion Control:
  1. Microprocessor-based AC variable-voltage, variable frequency with digitally encoded closed-loop velocity feedback suitable for operation specified and capable of providing smooth, comfortable car acceleration, retardation, and dynamic braking.
  2. Limit the difference in car speed between full load and no load to not more than  $\pm 3\%$  of the contract speed.
- F. Standby Lighting, Communication, and Alarm:
  1. Car mounted battery unit with solid-state charger to operate alarm bell, car emergency lighting, and voice communication system.
  2. Car lighting and communication shall be provided with a minimum of 4 hours of operation on back-up power during a loss of normal power, and a minimum of 1 hour of operation for car-mounted alarm and any remote alarm mounted at the designated level.
  3. Battery to be rechargeable with minimum five-year life expectancy.
  4. Provide constant pressure test button in service compartment of car operating panel.
  5. Provide lighting integral with portion of normal car lighting system.
- G. Power Door Operation:
  1. Open door and gate automatically when car arrives at a floor.
  2. Control door and gate closing by using constant-pressure buttons on car and at each floor.
  3. Provide passenger sequence operation:
    - a. After an adjustable time period between, 30 to 300 seconds, provide audible and visible warning signal and automatically close door and gate.
    - b. Provide dual reversing safety device for car gate.
- H. Attendant Operation:
  1. Include provision for attendant control of door closing, car direction, and calls answered.
  2. Provide two-position key switch in service cabinet to activate Attendant service operation.
  3. Electronic buzzer shall be installed to provide audible signal on registration of hall calls.
  4. Upon activation of Attendant service, DOOR CLOSE, UP, DOWN and NON-STOP buttons become operational for use by Attendant in car. Constant pressure of DOOR CLOSE, UP or DOWN button causes doors to close and car to proceed in direction corresponding to button pushed or assigned call; car to answer car and hall calls in order in which they are reached.

5. Where front and rear entrances are provided, provisions shall be made to allow the Operator to selectively close either the front or rear door.
  6. If direction button or DOOR CLOSE button is released prior to full closure of doors, doors reopen automatically.
  7. Change in direction of travel is accomplished by pushing opposite direction button.
  8. Constant pressure of NON-STOP button until the elevator is in motion shall cause car to bypass registered hall calls until released; hall calls remain registered until answered.
  9. Car calls canceled by pushing UP and DOWN buttons simultaneously or by pushing UP or DOWN button to change direction.
- I. Standby Power Operation:
1. Upon loss of normal power, adequate standby power will be supplied via building electrical feeders to start and run all cars simultaneously at contract car speed and capacity.
  2. Automatically return cars, nonstop to designated floor, open doors for approximately 3.0 seconds, close doors, and park car.
  3. During return operation, car and hall call pushbuttons shall be inoperative.
  4. As cars park, system shall immediately select the next car within the sequence until all cars have returned to the designated floor.
  5. If a car fails to start or return within 30 seconds, system shall automatically select the next car in the sequence to return.
  6. Provide separate group selection key switches in firefighters' control panel.
    - a. Switches shall be labeled "STANDBY POWER OVERRIDE" with positions marked "AUTO" and appropriate car numbers controlled by each respective switch.
    - b. Key shall be keyed differently from the key utilized for firefighters' Phase I and II key switch. Key shall be removable in "AUTO" position only.
    - c. Switch shall override automatic return and automatic selection functions and cause the manually selected car to operate.
    - d. Manual selection shall cause car to start and proceed to designated floor and open and close its doors before standby power is manually transferred to next selected car.
    - e. Provide "STANDBY POWER" indicator lights, one per car, in firefighters' control panel.
    - f. Indicator light illuminates when corresponding car is selected, automatically or manually, to operate on standby power.
  7. Successive Starting: When normal power is restored or there has been a power interruption, individual cars in each bank shall restart at five-second intervals.
- J. Card/Proximity Reader Security System:
1. Provide provisions inside car for reader unit.
  2. Mount reader unit as directed by Architect and make cross connects to card reader terminal interface and relays in machine room.
  3. Provide filler plate to match card slot size or proximity reader size and car return panel finish, including direction of graining, where card slot or proximity reader cutout is not initially utilized.
  4. Elevator control systems shall provide output signal of selected floor to facilitate system tracking of floor access.

## 2.7 MACHINE ROOM EQUIPMENT

- A. Arrange equipment in spaces shown on drawings.
- B. Geared Traction Hoist Machine and Motor:

1. Single worm geared or helical geared traction type with AC induction or P.M.S.M. ACV $\square$ F motor, brakes, gear, drive shaft, deflector sheave, and gear case mounted in proper alignment on an isolated bedplate.
  2. Provide bedplate blocking to elevate secondary or deflector sheave above machine room floor.
  3. Provide hoist machine mounted direct drive, digital, closed-loop velocity encoder.
  4. Provide hoist machine drip pans to collect lubricant seepage.
  5. Provide machine bedplate mounted deflector sheave A-frame or supporting steel beams and fastenings to mount deflector sheaves to building structure.
    - a. Provide 16-gauge removable sound insulated sheet metal closures in hoistway wall opening around machine.
  6. Provide machine with disc brake and secondary emergency brake:
    - a. Provide means to prevent ascending car over speed and unintended car movement.
    - b. Mount emergency brake on geared machine frame bed or suitable structural steel supports.
    - c. Provide drawing showing supports stamped by a Professional Engineer verifying the adequacy of the support provided.
    - d. Acceptable emergency brake devices:
      - 1) BODE Rope Brake.
      - 2) Hollister Whitney Rope Gripper.
      - 3) Draka.
- C. Solid State Power Conversion and Regulation Unit:
1. Provide solid-state, alternating current, variable voltage, variable frequency (ACV $\square$ F), IGBT converter/inverter regenerative drive.
  2. Design unit to limit current, suppress noise, and prevent transient voltage feedback into building power supply:
    - a. Provide internal heat sink cooling fans for the power drive portion of the converter panels.
    - b. Conform to IEEE standards 519-2014 for line harmonics and switching noise.
  3. Mechanically isolate unit to minimize noise and vibration transmission.
  4. Provide isolation transformers, filter networks, and choke inductors.
  5. Suppress solid-state converter noises, radio frequency interference, and eliminate regenerative transients induced into the mainline feeders or the building standby power generator.
  6. Supplemental direct-current power for the operation of hoist machine brake, door operator, dispatch processor, signal fixtures, etc., from separate static power supply.
  7. ACV $\square$ F Drives shall be regenerative and utilize IGBT converter/inverter and dynamic braking during overhauling condition.
- D. Encoder:
1. Direct drive, solid-state, digital type. Update car position at each floor and automatically restore after power loss.
- E. Controller:
1. UL/CSA labeled.
  2. Compartment:
    - a. Securely mount all assemblies, power supplies, chassis switches, relays, etc., on a substantial, self-supporting steel frame.
    - b. Completely enclose equipment with covers.
    - c. Provide means to prevent overheating.
  3. Relay Design:

- a. Magnet operated with contacts of design and material to insure maximum conductivity, long life, and reliable operation without overheating or excessive wear.
- b. Provide wiping action and means to prevent sticking due to fusion.
- c. Contacts carrying high inductive currents shall be provided with arc deflectors or suppressors.
4. Microprocessor Hardware:
  - a. Provide built-in noise suppression devices that provide a high level of noise immunity on all solid-state hardware and devices.
  - b. Provide power supplies with noise suppression devices.
  - c. Isolate inputs from external devices (such as pushbuttons) with opto-isolation modules.
  - d. Design control circuits with one leg of power supply grounded.
  - e. Safety circuits shall not be affected by accidental grounding of any part of the system.
  - f. System shall automatically restart when power is restored.
  - g. System memory shall be retained in the event of power failure or disturbance.
  - h. Equipment shall be provided with Electro Magnetic Interference (EMI) shielding within FCC guidelines.
5. Wiring:
  - a. CSA labeled copper for factory wiring.
  - b. Neatly route all wiring interconnections and securely attach wiring connections to studs or terminals.
  - c. Provide labels for all extra or spare wires, neatly organized at base of controller cabinet.
6. Diagnostics:
  - a. Provide an onboard monitor or screen, either inside the controller or in a stand-alone PC station, to display an easily understood format.
  - b. Upon command, the current operating parameters, individual car status, floor positions or other selected operational features will be displayed.
  - c. A display function shall be provided to reference a minimum of twenty (20) previous errors (malfunctions), which will be transmitted to the group dispatcher data log for statistical purposes or selected hard copy printouts.
    - 1) A color printer shall be provided on site.
  - d. Diagnostic display shall be programmed for monitoring of elevator motion, velocity, door operation parameters and timing functions.
    - 1) Provisions shall be made to allow printing of this information at Owner's request.
  - e. Non-volatile memory shall be used to store group operation data with provisions for data logging and hard copy reporting.
  - f. A telephone data link provision shall be incorporated in the basic dispatching control system.
    - 1) At the Owner's request, this provision may be employed for traffic analysis, hard copy computation and/or remote monitoring of status conditions utilizing an isolated PC and compatible printer for reports or graphs.
    - 2) All reports shall be time and date stamped to confirm reporting period.
  - g. Monitor shall employ color video displays for the following information:
    - 1) Display screen (group operations statistics).
    - 2) Monitoring screen (diagnostics, system status).
    - 3) Performance screen (traffic analysis).
  - h. Features required regarding remote and additional location monitoring, as indicated in other applicable sections, apply.
7. Permanently mark components (relays, fuses, PC boards, etc.) with symbols shown on wiring diagrams.

8. Provide control panel compliant with UL 508A SB.SCCR of 5000A required.
- F. Electrical Wiring and Wiring Connections:
1. Auxiliary Disconnect:
    - a. Provide controller or machine mounted auxiliary, lockable "open" disconnect.
  2. Conductors and Connections:
    - a. Copper throughout with individual wires coded and connections on identified studs or terminal blocks.
    - b. Use no splices or similar connections in wiring except at terminal blocks, control compartments, or junction boxes.
  3. Conduit:
    - a. Galvanized steel conduit, EMT, or duct.
    - b. Flexible conduit length not to exceed 3'-0".
  4. Traveling Cables:
    - a. Tag spares in machine room.
    - b. Provide cables from controller to car top.
  5. Auxiliary Wiring:
    - a. Provide machine room demarcation junction boxes for the fire alarm initiating devices, emergency two-way communication system, firefighters' phone jack, paging speaker, CCTV, security system and card reader interface terminals and relays, announcement speaker and/or background music.
- G. Sleeves and Guards:
1. Provide 4" steel angle guards around cable or duct slots through floor slabs or grating.
  2. Provide rope and smoke guards for sheaves, cables, and cable slots in machine room offset machinery levels.
  3. Configure guards to minimize free area around cables.
- H. Machine and Equipment Support Beams:
1. Provide structural steel beams required for direct support of and attachment to building structure of hoist machine, deflector sheaves, overhead sheaves, governor, and hoist rope dead-end hitch assemblies.
  2. Provide bearing plates, anchors, shelf angles, blocking, embedment, etc., for support and fastening of machine beams or equipment to the building structure.
  3. Isolate machine and overhead sheave beams to prevent noise and vibration transmission to building structure.
  4. Provide hold-down bolts for offset hoist machines located beside or under hoistway where concrete hold-down pad is provided.
- I. Structural Floor:
1. Provide template for equipment layout.
- J. Governor:
1. Centrifugal-type, car driven machine room mounted with pull-through jaws and bi-directional shutdown switches.
  2. Provide required bracketing and supports for attachment to building structure.

## 2.8 HOISTWAY EQUIPMENT

- A. Rails and Guides:
1. Rails:
    - a. Continuous steel angles.
    - b. Shall be securely fastened to the building structure and the entrance frame, at intervals, throughout their entire length.



2. Guides:
  - a. Provide four (4) guide shoes per panel.
- B. Sheaves:
  1. Machined grooves and sealed bearings.
  2. Provide mounting to machine beams, machine bedplate, car and counterweight structural members, or building structure.
- C. Counterweight:
  1. Steel frame with metal filler weights.
- D. Counterweight Guide Shoes:
  1. Solid guides with oilless inserts.
- E. Governor Rope and Encoder Tape Tensioning Sheaves:
  1. Mount sheaves and support frame on pit floor or guide rail.
  2. Provide frame with guides or pivot point to enable free vertical movement and proper tension of rope and tape.
- F. Suspension Means:
  1. 8 x 19 or 8 x 25 Seale construction, traction steel type:
    - a. Fasten with staggered length, adjustable, spring isolated wedge type shackles.
  2. Approved governor rope.
- G. Terminal Stopping:
  1. Provide normal and final devices.
- H. Electrical Wiring and Wiring Connections:
  1. Conductors and Connections:
    - a. Copper throughout with individual wires coded and connections on identified studs or terminal blocks.
    - b. Use no splices or similar connections in wiring except at terminal blocks, control compartments, or junction boxes.
    - c. Provide 20% spare conductors for each wire type.
    - d. Run spare wires from car connection points to individual elevator controllers in the machine room.
  2. Conduit:
    - a. Galvanized steel conduit, EMT, or duct.
    - b. Flexible conduit between isolated equipment, length not to exceed 3'-0".
    - c. Flexible heavy-duty service cord may be used between fixed car wiring and car door switches for door protective devices.
    - d. Coordinate conduit from the closest hoistway of each elevator or group or single elevator to the firefighters' control panel. Provide wiring.
  3. Traveling Cables:
    - a. Flame and moisture-resistant outer cover.
    - b. Prevent traveling cable from rubbing or chafing against hoistway or equipment within hoistway.
    - c. Provide the following composition at a minimum, which shall not be considered spares:
      - 1) Five pair of shielded 20-gauge wire for card reader.
      - 2) Two pair of shielded 18-gauge wire for CCTV, from car controller to car top junction box, plus 3'-0" excess loop at both ends.
      - 3) Two pair of 18-gauge wire for CCTV power.

- d. Provide eight pair of spare shielded communication wires in addition to those required to connect specified items.
- e. Tag spares in machine room. Provide cables from controller to car top.
- f. Support traveling cable by their steel supporting member by suspending from supports by means that automatically tighten around the cable when tension is increased.
- 4. Auxiliary Wiring:
  - a. Provide conduit, wiring and connections for systems defined within.
- I. Entrance Equipment:
  - 1. Continuous steel door guide tracks consisting of angles or formed steel tracks fastened to hoistway door jamb.
  - 2. Door Guide Shoes:
    - a. Machined iron door guide shoes.
    - b. Four shoes per door panel, with not less than 2" lateral contact per shoe.
  - 3. Door Interlocks:
    - a. Operable door locks without retiring cam.
  - 4. Provide hoistway door unlocking device with pull chain under hinged, lockable cover with stainless-steel No. 4 finish at all floors.
- J. Floor Numbers:
  - 1. Stencil paint 4" high floor designations in contrasting color on inside face of hoistway doors and hoistway fascia visible from within car.

## 2.9 HOISTWAY ENTRANCES

- A. Entrance Assemblies:
  - 1. Complete entrances bearing fire labels from a certified testing laboratory approved by authority having jurisdiction.
  - 2. Provide entrance assemblies bearing 1-1/2hr UL label.
  - 3. Paint all exposed metal ferrous metal black.
- B. Frames:
  - 1. 14-gauge hollow metal at all floors.
  - 2. Provide Arabic floor designation/Tactile marking plates:
    - a. Centered at 60" above finished floor.
    - b. Located on both side jambs of all entrances.
    - c. Minimum 4" in height.
    - d. Tactile marking indications shall be below Arabic floor designation.
    - e. Permanently fastened.
  - 3. Provide car identification label:
    - a. Mounted directly below floor designation/Tactile marking plates.
    - b. Located on both side jambs at the following levels:
      - 1) Designated Level.
      - 2) Alternate Level.
      - 3) Level where means necessary for tests is provided.
    - c. Finish and design to match floor designation/Tactile marking plates.
    - d. Permanently fastened.
  - 4. Provide plates at main egress landing with "Star" designation.
  - 5. For designated emergency car, provide "Star of Life" cast designation plates at height of 78"-84" above finished floor on both side jambs at all floors.
- C. Vertical Bi-Parting Freight Door Panels:
  - 1. 12-gauge formed steel plates welded into frame angles with enamel finish.

2. Provide with safety astragals, vision panels, unlocking device, and truckable sills, and load transfer angles.
3. Provide telescoping upper section or pass-type doors as required.
4. Provide stainless-steel finish.

D. Vertical Bi-Parting Door Cover Frames:

1. Hollow metal, bolted, fabricated from not less than 14-gauge material to form a one-piece unit covering steel channel subframes.

E. Hoistway Access:

1. Hoistway Door Unlocking Device:
  - a. Provide unlocking device with locking escutcheon in door panel at all floors, with finish to match adjacent surface.
2. Hoistway Access Switches:
  - a. Mount in wall at top floor.
  - b. Provide switch with faceplate.

## 2.10 PIT EQUIPMENT

A. Buffers:

1. Provide Spring type with blocking and support channels.

B. Pit Access:

1. Hoistway Access Key Switch:
  - a. Provide key switch at lowest terminal landing.
  - b. Mount in wall.
  - c. Provide switch with faceplate.
2. Provide pit stop switch(es).
3. Provide pit access door switch configured to effectively remove power to elevators in the event of pit access door operation.

C. Counterweight Guard:

1. Metal guard in pit in front of counterweight where no compensation is provided or where there is no space greater than 20 inches between the compensation means, suspension means, counterweight rails, or guard(s).

D. Compensation:

1. Encapsulated chain with pit guide assembly.
2. Pit mounted guide assembly shall:
  - a. Provide quiet, effective restraint without excessive wear of components.
  - b. Inhibit rubbing or chafing against hoistway or equipment within hoistway or pit.
3. Application must meet performance/noise level requirement of specification.

## 2.11 CAR EQUIPMENT

A. Frame:

1. Welded or bolted or formed steel channel construction to meet load classification specified.

B. Safety Device:

1. Type "B," flexible guide clamp.

C. Platform:

1. Design and construct to accommodate load classification requirements:

- a. Provide Class C3 construction for freight elevator.
2. The car platform shall consist of a steel frame with necessary steel stringers, all securely welded together.
3. Work Light Fixtures and AC Receptacles:
  - a. Provide permanent mounted work light fixtures below platform, complete with proper lamp guards.
- D. Platform Guard:
  1. Minimum 14-gauge steel, reinforced and braced to car platform Manufacturer's standard finish guard meeting 48" requirement when not at lowest terminal landing.
- E. Cartop Guard Rail:
  1. Provide a railing system provided on the outside perimeter of the car top on all sides where the horizontal distance between the edges of the car top and the adjacent hoistway enclosure exceeds 12 in.
- F. Freight Guide Shoes:
  1. Solid guides with oil less inserts.
- G. Cab Steadying Plates:
  1. Provide and install top of car steadying plates.
  2. Emphasis shall be placed on proper tension to car styles allowing minimal lateral movement of the cab.
  3. Steadying plates shall be isolated using non-metallic guides or rollers.
- H. Power-Operated Freight Door and Gate:
  1. Provide means to open doors and gate from inside of car in the event of power failure.
  2. Closing Speed:
    - a. Doors: Minimum of 0.8 f.p.s.; maximum of 1.0 f.p.s.
    - b. Gates: Minimum of 1.6 f.p.s.; maximum of 2.0 f.p.s.
  3. Provide emergency manual operation without necessity of disconnecting mechanical operator equipment.
  4. Provide an adjustable timer to hold doors open up to five minutes.
  5. Door closing initiated upon expiration of timer, activation of door close button or activation of a floor button within car.
  6. The door and gate operators shall be synchronized as follows:
    - a. Door and gate shall accelerate and decelerate smoothly
    - b. Provide means for door checking in both opening and closing motions electrically or by other suitable means.
    - c. Car gate shall close completely before the hoistway doors begin to close.
    - d. Car gate shall not open until the hoistway doors are completely open.
  7. Provide automatic closing of car doors after dwell time expires.
    - a. A loud audible signal and highly visible signal shall actuate not less than 5.0 seconds prior to initiation of door sequence.
    - b. Dwell time shall be easily adjustable between 20.0 and 300.0 second.
    - c. Pressing the Door Close button shall cancel dwell time.
    - d. Pressing the Door Open button shall restart the dwell time.
    - e. Dwell time shall initially be set at 60.0 seconds.
  8. Door operation at landing initiated by operation of elevator call button for that floor.
  9. Car gate includes protective edge to stop motion if gate is interrupted in closing.
  10. Provide an adjustable timer to hold doors open, up to five minutes.
  11. Door closing initiated upon expiration of timer, activation of door close button or activation of a floor button within car.

- I. Car Gate:
  - 1. Power-operated, vertical rise, single section minimum 6'-0" high, constructed of 12-gauge welded wire mesh welded into frame angles.
  - 2. Mount car gate lift chains on hoistway side of car gate.
  - 3. Include reversing safety edge device on gate.
  
- J. Infrared Reopening Device:
  - 1. Black, fully enclosed device with full screen infrared matrix or multiple beams extending vertically inside or along edge of each car gate guide track to the full height of opening.
  - 2. Obstruction of beams during gate closing shall cause immediate re-opening.
  
- K. Car Operating Panel:
  - 1. Freight:
    - a. One car operating panel with faceplates:
      - 1) Consisting of a metal box containing the vandal resistant operating fixtures, mounted behind the car stationary side return panel.
      - 2) Faceplates shall be hinged and constructed of No. 4 satin finish stainless-steel.
    - b. Suitably identify floor buttons, alarm button, door open button, door close button and emergency push-to-call button with flat stainless tactile symbols rear mounted.
    - c. Provide "door open" button to stop and reopen doors or hold doors in open position.
    - d. Provide "door close" button to activate door close cycle.
      - 1) Cycle shall not begin until normal door dwell time for a car or hall call has expired, except firefighters' operation.
    - e. Pushbuttons:
      - 1) Provide minimum 3/4" diameter raised floor pushbuttons which illuminate to indicate call registration.
    - f. Locate operating controls no higher than 48" above the car floor; no lower than 35" for emergency push-to-call button and alarm button.
    - g. Locked Firefighters Operation Panel:
      - 1) For fire officer use and use of car on independent service only.
      - 2) Openable by the same key which operates the Fire Operation switch.
      - 3) Including the following features:
        - a) Phase II fire access switch.
        - b) Firefighters' visual indication.
        - c) Call cancel button.
        - d) Stop switch, manually operated.
        - e) Door open button.
        - f) Door close button.
  - 2. Service Compartment (all cars):
    - a. Provide lockable service compartment with recessed flush door.
    - b. Door material and finish shall match car return panel or car operating panel faceplate.
    - c. Include the following controls in lockable service cabinet with function and operating positions identified by permanent signage or engraved legend:
      - 1) Access switch.
      - 2) Light switch.
      - 3) 4-position Exhaust blower switch.
      - 4) Independent service switch.
      - 5) Constant pressure test button for battery pack emergency lighting.
      - 6) 120-volt, AC, GFCI protected electrical convenience duplex outlet.
      - 7) Card reader override switch.
      - 8) Switch to select either floor voice annunciation, floor passing tone, or chime.

- 9) Attendant operation switch.
- 10) Keyed stop switch.
- 3. Provide black paint filled (except as noted), engraved, or approved etched signage as follows with approved size and font:
  - a. Phase II firefighters' operating instructions on inside face of firefighters' compartment door.
  - b. Engrave filled red firefighters' operation on outside face of compartment door.
  - c. Building identification car number on main car operating panel.
  - d. "No Smoking" on main car operating panel.
  - e. Car capacity in pounds on service compartment door.
  - f. Loading classification and description on service compartment door.
- L. Car Top Control Station:
  - 1. Mount to provide safe access and utilization while standing on car top.
  - 2. Operating device shall contain Up and Down direction buttons, a Run button, an Inspection/Automatic switch and Emergency Stop switch.
  - 3. Operating device shall contain an audible and visible indicator that fire recall has been initiated.
  - 4. This station shall be fixed to the car crosshead or may be portable provided the extension cord and housing is permanently attached to the car crosshead.
  - 5. The car will be operated by constant pressure on the appropriate directional button and the Run button simultaneously.
  - 6. Normal operating devices will be inoperative while this device is in use.
- M. Emergency Audible Signal:
  - 1. Provide on top of each elevator.
  - 2. Activation of Alarm Button or Emergency Stop switch will cause Emergency Audible Signal.
  - 3. Provide battery back-up system to provide 1hr power in the event of loss of normal power.
- N. Work Light and Duplex Plug Receptacle:
  - 1. GFCI protected outlet at top and bottom of car.
  - 2. Include on/off switch and lamp guard.
  - 3. Provide additional GFCI protected outlet on car top for installation of car CCTV.

## 2.12 CAR ENCLOSURE

- A. Freight Elevator: Provide complete as specified herein:
  - 1. Shell:
    - a. Reinforced 10-gauge furniture steel formed panels no more than 20" wide with light-proof joints.
    - b. Clad panels with stainless-steel textured finish as specified in Item 2.3.
    - c. Reinforce and brace panels to provide rigid structure and securely fasten to car sling and platform.
    - d. Provide recess in car side wall for recessed mounting of car operating panel.
  - 2. Finish Floor Covering:
    - a. Freight Cars 3/8" thick steel friction coated plate. Design for ease of replacement from within cab.
  - 3. Canopy:
    - a. Reinforced 12-gauge furniture steel formed panels no more than 20" wide with light-proof joints. Interior finish white reflective baked enamel.
    - b. Provide hinged emergency exit.
  - 4. Lighting:

- a. Minimum eight recessed fixtures flush mounted in canopy with expanded metal protective diffuser and steel guard over fixtures on car top.
- b. Provide protective fluorescent tube covers.
- 5. Bumper Rails:
  - a. Two rows of 2" x 12" oak or maple bumpers mounted on both sides and rear of the car.
  - b. Locate bottom rail at floor level and top rail at 36" above the car floor.
  - c. Bolt rails through car walls with countersunk bolt, backing plates and captive nuts on exterior of wall panel sections.
- 6. Ventilation:
  - a. Morrison Products, Inc. three-speed model AA No. 06-01048 exhaust blower mounted to car canopy on isolated rubber grommets.

### 2.13 HALL CONTROL STATIONS

- A. Pushbuttons:
  - 1. Provide one pushbutton riser.
  - 2. Provide flush mounted faceplates.
  - 3. Include pushbuttons for each direction of travel that illuminate to indicate call registration.
  - 4. Include approved engraved message and pictorial representation prohibiting use of elevator during fire or other emergency as part of faceplate.
  - 5. Pushbutton design shall match car operating panel pushbuttons.
  - 6. Provide vandal resistant pushbutton and light assemblies.
  - 7. Provide LED illumination.
  - 8. Provide Phase I Fire Service key switch, engraved operating instructions and illuminating jewel.
  - 9. Provide communication check failure indication and silence key switch.
  - 10. Provide illuminating jewels indicating standby power status.
  - 11. Incorporate all items required by Code at the primary egress level into a single hall fixture.
- B. Door Control Buttons:
  - 1. Include vandal resistant "door open," "door close," and "stop" buttons for control of power operated vertical bi-parting doors at each landing call button fixture.
  - 2. Provide buttons integral with hall control station.
  - 3. Pushbutton design shall match car operating panel pushbuttons.

### 2.14 SIGNALS

- A. Car Direction Lantern:
  - 1. Provide flush-mounted car lantern in all car entrance columns.
  - 2. Illuminate up or down LED lights and sound tone once for up and twice for down direction.
  - 3. Illuminate light until the car doors start to close.
  - 4. Sound level shall be adjustable from 20-80 dBA measured at 5'-0" in front of hall control station and 3'-0" off floor.
  - 5. Car direction lenses shall be arrow shaped with faceplates.
  - 6. Lenses shall be minimum 2" in their smallest dimension.
  - 7. Provide vandal resistant lantern and light assemblies consisting of series of dots or lines for maximum visibility.
- B. Hall Position Indicator:
  - 1. Alpha-numeric digital indicator containing floor designations and direction arrows a minimum of 2" high to indicate floor served and direction of car travel.

2. Mount integral with hall station at primary egress floor.
- C. Car Position Indicator:
1. Alpha-numeric digital indicator containing floor designations and direction arrows a minimum of 2" high to indicate floor served and direction of car travel.
  2. Locate fixture in car operating panel.
  3. When a car leaves or passes a floor, illuminate indication representing position of car in hoistway.
  4. Illuminate proper direction arrow to indicate direction of travel.
- D. Fixture Faceplate Material and Finish:
1. Satin finish stainless-steel, all fixtures.
  2. Tamper resistant fasteners for all fastenings exposed to the public.
- E. Floor Passing Tone:
1. Provide an audible tone of no less than 20 decibels and frequency of no higher than 1500 Hz, to sound as the car passes or stops at a floor served.

## 2.15 COMMUNICATION

- A. Car Communication System:
1. Hands-Free Phone System:
    - a. Two-way communication instrument in car with automatic dialing, tracking, and recall features, with shielded wiring to car controller in machine room.
    - b. Provide dialer with automatic rollover capability with minimum two numbers:
      - 1) Actuate two-way communication via "Help" button.
      - 2) Adjacent light jewel shall illuminate and flash when call is acknowledged.
      - 3) Button shall match car operating panel pushbutton design.
      - 4) Provide "Help" button tactile symbol, engraved signage, and Tactile marking adjacent to button mounted integral with car front return panel.
  2. Emergency Personnel Communication:
    - a. Communication system shall be provided allowing emergency personnel to establish communications with each elevator individually.
    - b. Emergency Personnel Communication shall override any existing connection outside of building.
    - c. Adjacent light jewel shall illuminate and flash when call is acknowledged.
    - d. Provide operating instructions.
    - e. On the same car operating panel as the phone push button, provide capability to communicate with and obtain responses from passengers.
    - f. Provide display video capability for entrapment assessment.
  3. Communication for deaf, hearing and speech impaired:
    - a. On the same car operating panel as the phone push button, provide capability to communicate with and obtain responses from passengers, including those passengers who cannot communicate verbally or hear.

## 2.16 FIREFIGHTERS' CONTROL PANEL

- A. Firefighters' Control Panel:
1. Locate in building fire control room or as directed by Contractor.
  2. Fixture faceplate, stainless-steel, satin finish, including the following features:
    - a. Car position and direction indicator, digital-readout or LCD flat screen color monitor.
      - 1) Identify each position indicator with car number and group identification.
    - b. Indicator showing operating status of car.



- c. Manual car standby power selection switches and power status indicators.
    - d. Two-position firefighters' emergency return switches and indicators with engraved instructions filled red.
  3. Where applicable, identify all indicators and manual switches with appropriate engraving.
  4. Provide wiring to control panel.
    - a. Coordinate size and location of conduit with Contractor.
- B. Firefighters' Key Box:
  1. Flush-mounted box with lockable hinged cover.
  2. Engrave instructions for use on cover per Local Fire Authority requirements.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Prior to beginning installation of equipment examine hoistway and machine room areas.
- B. Verify no irregularities exist that affect execution of work specified.
- C. Verify electrical power location and characteristics in coordination with equipment requirements.
- D. Do not proceed with installation until work in place conforms to project requirements.

#### **3.2 INSTALLATION**

- A. Install all equipment in accordance with Contractor's instructions, referenced codes, specification, and approved submittals.
- B. Install machine room equipment with clearances in accordance with referenced codes and specification.
- C. Install all equipment so it may be easily removed for maintenance and repair.
- D. Provide any required hoisting/safety beams.
- E. Install all equipment to afford maximum accessibility, safety, and continuity of operation.
- F. Remove oil, grease, scale, and other foreign matter from the following equipment and apply one coat of field-applied machinery enamel.
  1. All exposed equipment and metal work installed as part of this work which does not have architectural finish.
  2. Machine room equipment, hoistway equipment including guide rails, guide rail brackets, and pit equipment.
  3. Neatly touch up damaged factory-painted surfaces with original paint color. Protect machine-finish surfaces against corrosion.
- G. Fill hoistway door frames, back boxes for hallway stations and signal devices, and sills.
- H. Clean all architectural finishes and replace or restore any surfaces damaged during construction to like new condition.

#### **3.3 FIELD QUALITY CONTROL**

- A. Acceptance Testing:

1. On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Advise Contractor, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.
- C. Independent Testing by Owner's Consultant.

### **3.4 CONSTRUCTION TOLERANCES**

- A. Install rails plumb and align vertically with tolerance of 1/16" in 100'-0".
  1. Secure joints without gaps and file any irregularities to a smooth surface.

### **3.5 ADJUSTING**

- A. Static balance car to equalize pressure of guide shoes on guide rails.
  1. Dynamically balance car and counterweight.
- B. Lubricate all equipment in accordance with Contractor's instructions.
- C. Adjust motors, power conversion units, brakes, controllers, leveling switches, limit switches, stopping switches, door operators, interlocks, and safety devices to achieve specified performance levels.

### **3.6 CLEANING**

- A. Keep work areas orderly and free from debris during progress of project.
- B. Remove packaging materials on a daily basis.
- C. Remove all loose materials and filings resulting from work.
- D. Clean machine room equipment and floor.
- E. Clean hoistways, car, car enclosure, entrances, operating and signal fixtures.
- F. Clean pit equipment and floor.

### **3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate all aspects of elevators while in normal operation.
- B. Check operation of each elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period.
  1. Determine that operation systems and devices are functioning properly.

### **3.8 PROTECTION**

- A. Temporary Use: Comply with the following requirements for each elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service.
  - a. Include preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity.
  - b. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage Elevator Installer to restore damaged work, if any, so no evidence remains of correction.
  - a. Return items which cannot be refinished in the field to the shop, make required repairs, and refinish entire unit, or provide new units as required.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 14 31 00 - ESCALATORS****PART 1 – GENERAL****1.1 SUMMARY**

- A. Scope Includes: Three (3) Escalators as follows:
1. Step Width:
    - a) Escalators: ESC 1-3: 40" Step
    - b) Balustrade: Escalators 1-3: Glass.

**1.2 ACTION SUBMITTALS**

- A. Product Data:
1. Provide complete product data including:
    - a) Duty type.
    - b) Step loading capacities.
    - c) Sizes and dimensions.
    - d) Performance data.
    - e) Control system details.
    - f) Signal system details.
    - g) Operational features.
    - h) Safety features.
    - i) Finish details.
- B. Shop Drawings:
1. Provide scaled shop drawings and construction drawings of the following:
    - a) Plan and section layouts of wellways, pits, intermediate support, truss structural support locations and rise, to include the following:
      - b) Location of all equipment.
      - c) Static loads imposed on building structure.
      - d) Details of equipment isolation.
      - e) Required clearances around equipment.
      - f) Equipment heat release.
      - g) Power requirements:
        - 1) Motor horsepower, code letter, starting current, full load running current.
        - 2) Provide maximum and average power consumption.
      - h) Service connections.
      - i) Signage.
      - j) Lighting.
    2. Wellway/Truss/Pit Equipment:
      - a) Escalator truss reactions/loads.
      - b) Stop switches.
    3. Fixtures:
      - a) Stop switch.

- b) Starting and Inspection switches
  - c) Fault indicator.
  - d) Diagnostic access port.
- C. Submittals:
- 1. All submittals shall be provided via Portable Document Format (.pdf).
  - 2. All submittals shall be marked and identified with project name and appropriate device identification.
  - 3. All submittals are subject to approval.
  - 4. Corrections shall be incorporated into the revised submittals.
- D. Samples for Initial Selection:
- 1. For visible finishes provide material and finish samples including paint, balustrades, skirts, step, decking, handrails, combplates, walk-on areas, fixture faceplates, signage, and lighting.
- E. Samples for Verification:
- 1. For exposed escalator and signal equipment finishes.
  - 2. Samples of sheet materials: 3" (75 mm) square.
  - 3. Running trim members: 4" (100 mm) lengths.

### 1.3 CLOSEOUT SUBMITTALS

- A. Continuing Maintenance Proposal:
- 1. Submit executed Installer's standard five-year maintenance agreement, commencing at the expiration of the warranty maintenance period.
  - 2. State services, obligations, conditions, and terms for agreement period and for future renewal options.
- B. Record Documents
- 1. The following record documents shall be furnished upon completion and before final payment delivered via Portable Document Format (.pdf):
    - a) Shop Drawings:
      - 1) Complete sets of as installed plan and section layouts of escalators, wellway/pits, machinery spaces, and requirements contained within submittal drawings.
    - b) Wiring Diagrams:
      - 1) Complete sets of as installed straight-line wiring diagrams, showing the electrical connections of all equipment, furnished upon completion.
      - 2) A legend sheet shall be furnished with each set of drawings containing the following information:
        - (a) Name and symbol of each relay, switch and other electrical or solid-state apparatus.
        - (b) Location on drawings, drawing sheets, number and area of switches and relays, and location of all contacts.
        - (c) Location of apparatus whether on controller, in well, or operating devices.
    - c) Maintenance and Operating Manuals:
      - 1) Description and sequence of operation of all equipment installed, including operating use for Building Personnel as well as system troubleshooting manuals for technicians.

- 2) Maintenance instructions and procedures of all vertical transportation equipment installed, including parts lists, for each escalator system.
- 3) Lubrication charts indicating all lubricating points and type of lubricant recommended for all equipment.
- 4) Complete parts catalogs for all replaceable parts.
- 5) Maintenance Control Program

C. Tools:

1. The following equipment shall be furnished upon completion before final payment:
  - a) Provide tools to allow performance of all necessary procedures to complete all safety tests as required by code and local governing authority.
  - b) The Escalator Contractor shall provide a backup copy of any software required for normal operation on an external storage medium.

D. Keys:

1. Four sets of keys for each type of lock shall be furnished upon completion.
2. Keys shall be properly tagged to identify related lock.

#### 1.4 PERMITS TESTS & CERTIFICATES

A. Permits:

1. The Contractor shall secure the necessary permits required for work to be performed, including work performed by sub-contractors.
2. The Contractor shall obtain and pay for all municipal and state permits necessary for execution of the work, including fees for permit renewals.
3. The Contractor shall be responsible for posting all permits.
4. The Contractor shall be responsible for obtaining final approval for completed work for each permit filed by them.

B. Tests and Inspections:

1. The Contractor shall perform all necessary tests as required by ASME A17.1 and A17.2.
2. The Contractor shall be responsible for scheduling the necessary tests as required by the local authorities.
  - a) Any fees associated with a missed appointment, or for expediting of test or overtime test due to delays caused by the Contractor shall be the responsibility of the Contractor.

C. Certificates:

1. The Contractor is responsible for obtaining and providing all temporary and final inspection certificates of the proper governing authorities.
2. The Contractor shall pay for all fees necessary for obtaining temporary and final inspection certificates.
3. Include copies of all certificates with closeout documentation.

#### 1.5 QUALITY ASSURANCE

A. Compliance with Regulatory Agencies:

1. Comply with most stringent provisions of codes, laws, and/or authorities, including revisions and changes in effect.
2. See Item 2.1 "REFERENCES"

**B. Progress Reviews:**

1. The Contractor's work is subject to review by the Consultant at any time.
2. Contractor to assist without cost.

**1.6 DELIVERY STORAGE & HOISTING****A. General:**

1. The protection of all equipment and exposed finishes shall be the responsibility of the Contractor during delivery, handling, and installation until final acceptance of escalator equipment.
2. The Contractor shall replace damaged materials with new, with no additional cost for material and labor.

**B. Delivery & Storage:**

1. It is the responsibility of the Contractor to safely store in designated space. Protect all materials to prohibit damage, stains, scratches, corrosion, weather, construction debris and environmental conditions.
2. Deliver materials to the site in the manufacturer's original and unopened containers and packaging, bearing labels as to type of material, brand name and manufacturer's name.
3. Store materials under cover in a dry and clean location, off the ground. Remove delivered materials that are damaged or not suitable for installation from the job site and replace with acceptable materials.

**C. Hoisting:**

1. All required hoisting and movement of equipment shall be the responsibility of the Contractor.

**1.7 COORDINATION****A. General:**

1. Coordinate the requirements of other trades.
2. Provide access to truss and controller areas for installation of life safety signals and equipment

**B. Cast-in-Place Concrete:**

1. Contractor to coordinate support location requirements.
2. Provide pit requirements, including location of sump pits or drains.

**C. Electric:**

1. Electrical service, outlets, lights, and switches in escalator machine space and pits.

**D. Sprinklers:**

1. Installation of sprinkler systems as per NFPA 13.

**E. HVAC:**

1. Provide necessary information to Contractor and coordinate installation of equipment for escalator including truss heating and cooling.

**F. Finishes:**

1. Balustrades, skirt panels, fixtures, walk on plates, truss cladding, signage, lighting, and guards.



## 1.8 WARRANTY

### A. Manufacturer's Warranty:

1. Manufacturer will repair, restore, or replace escalator equipment that fails due to defective materials or poor workmanship within specified warranty period.
2. Failures include but are not limited to:
3. Operation or control system failure and malfunctions
4. Performance outside specified ratings and ranges
5. Excessive wear
6. Unusual deterioration or aging of materials or finishes
7. Unsafe conditions
8. Need for excessive maintenance
9. Unusual noise or vibration
10. Unexpected or unsatisfactory conditions.

### B. Warranty Period:

1. In accordance with contract documents.
2. The Contractor shall guarantee that the materials and workmanship of the equipment installed by them and any subcontractor under this contract, shall be first class in every respect and that they will make good on any defects not due to ordinary wear and tear or improper use, which may develop within one year from the date of final acceptance of all equipment.
3. Manufacturer's warranty to repair or replace defective products or their components in the event of defects occur within specified warranty period.
4. Neither the final payment nor any provisions of the contract documents shall relieve the Contractor of any obligation provided by law. They shall remedy any defects and pay all expenses for any damage to other work.
5. The warranty as outlined above, for all devices, shall start from the date of final acceptance of each device, by the Consultant and the Owner, of all work specified and intended under these contract documents.

## 1.9 MAINTENANCE

### A. General:

1. All maintenance shall be performed according to the guidelines stated in manufacturer's Maintenance and Operations manuals.
2. Maintenance records for each device, including lubrication logs, check charts, shall be provided in each machine room.

### B. Warranty Maintenance:

1. Upon final acceptance of each device, after receiving written final acceptance from the governing authorities, each device shall be accepted for full operation.
2. The warranty maintenance period shall begin for each device when all conditions in the above paragraph are met and will continue for the specified period.
  - a) Warranty maintenance period will begin with the completion of the last escalator.
3. The warranty maintenance program shall include the following:
  - a) Monthly examinations, including adjustments, cleaning, and lubrication of equipment. Maintenance will be performed during normal working hours.

- b) 24-hour 7 days a week Emergency Call back service shall be provided at no additional cost to Owner. Call back response time no more than 30 minutes.
  - c) Replace components using only parts produced by the original manufacturer.
- C. Maintenance Specification:
- 1. Upon completion of the Warranty Maintenance period, the Escalator Contractor will provide the personnel to service the vertical transportation equipment.
    - a) Full-Service Maintenance Specification shall commence upon the completion of the warranty maintenance period for a term of five (5) years.
      - 1) The Contractor shall provide a proposal for a full-service coverage which includes the following:
        - (a) All required inspections and tests.
        - (b) 24-hour 7 days a week Emergency Call back service shall be provided at no additional cost to Owner. Call back response time no more than 30 minutes.

## **PART 2 – PRODUCTS**

### **2.1 REFERENCES**

- A. Definitions:
- 1. Terms used are defined in the latest edition of the Safety Code for Elevators and Escalators, ASME A17.1.
  - 2. Reference to a device or a part of the equipment applies to the number of devices or parts required to complete the installation.
  - 3. Provisions of this specification are applicable to all devices unless identified otherwise.
- B. American Society of Mechanical Engineers:
- 1. ASME A17.1 - Safety Code for Elevators and Escalators.
  - 2. ASME A17.2 – Guide for Inspection of Elevators and Escalators.
  - 3. ASME A17.5 – Elevator and Escalator Electrical Equipment.
- C. National Fire Protection Association (NFPA):
- 1. NFPA 70 – National Electric Code.
  - 2. NFPA 101 – Life Safety Code.
  - 3. NFPA 130 – Standard for Fixed Guideway Transit and Passenger Rail Systems

### **2.2 MANUFACTURERS**

- A. Subject to compliance with project requirements, provide products by one of the following:
- 1. KONE Corporation
  - 2. Otis Elevator Company
  - 3. Schindler Elevator Corporation
  - 4. TK Elevator

### **2.3 PERFORMANCE**

- A. Ride Quality:
- 1. Maximum 15 milli-g in all axes, measured in accordance with ISO 18738 standard.
- B. Step Speed:

1. Unit shall be capable of operating at rated speed under any loading condition in either direction of travel.
- C. Handrail Speed:
  1. Synchronize with steps.
- D. Speed Variation:
  1. Speed of steps and handrail shall not vary more than 2% from contract speed.
  2. Handrail speed must be synchronized with steps.
- E. Commercial Escalator Duty Type:
  1. Escalator system and all individual components or subsystems designed to operate under moderate loads and operation:
    - a) 1.5 persons per step.
    - b) Loading factor of 195 lbs. per step.
    - c) Continuous operation:
      - 1) 12 hours per day
      - 2) 7 days per week
  2. 100,000 hours of useful life preceding replacement or major component obsolescence.
- F. Designed Minimum Component Lifecycle Before Replacement:
  1. Components designed for 10 year (44,000 operating hours) minimum service life before replacement is required:
    - a) Bearings.
    - b) Step chain rollers.
    - c) Step rollers.
    - d) Step chains.
    - e) Main drive chains.
    - f) Belts.
    - g) Gear box: Bearings, ring, and pinion gears.
    - h) Step tracks.
    - i) Handrails.
  2. Components designed for 5 year (22,000 operating hours) minimum service life before replacement is required:
    - a) Handrail Drive.
- G. Noise and Vibration Control:
  1. Limit noise levels relating to escalator equipment and its operation to no more than 55 dBA, measured 3'-0" above escalator at any point of its length.
  2. Mechanically isolate escalator equipment from the building structure and other components to minimize noise and vibrations being transmitted to occupied areas of the building.

## 2.4 ESCALATORS

- A. Description:
  1. Escalator Identification: ESC 1-3.
  2. Size:
    - a) Escalators ESC 1-3: 40" Step, 2 flat steps.

3. Speed: 100 fpm.
4. Rise: Floor 01-02: 25'-6 ½"
5. Floors Served:
  - a) 01 Event Level -02 Main Concourse
6. Configuration: Linear.
7. Arrangement: Adjacent
8. Angle of Inclination: 30°
9. Operation: Reversible.
10. Drive Motor Gear Box: Worm,
11. Balustrade Height: 1000 mm (40")
12. Balustrade Panel Gap: Perpendicular to deck.
13. Balustrade Material: 1/2" Transparent Glass
14. Deck: Low inner and outer.
15. Deck Finish: Satin finish stainless steel
16. Molding and Trim: Match deck finish.
17. Skirt Panels: Match deck. Black low friction material applied to metal skirt panels.
18. Handrail Color: Black .
19. Step Tread and Riser: Cleated and meshed with adjacent step with replaceable tread demarcation, rear and sides.
20. Demarcation Color: Yellow.
21. Power Supply: 480 Volts, 3 Phase, 60 Hertz.
22. Additional Features:
  - a) Oilless step chain
  - b) Step demarcation lighting.
  - c) Emergency stop buttons.
  - d) Caution signs at each landing.
  - e) Comb plate lighting.
  - f) Under handrail LED lighting.
  - g) Deck Guards

## 2.5 MATERIALS

- A. General:
  1. All materials and finishes are subject to approval by Architect.
- B. Steel:
  1. Sheet Steel Furniture Steel for Exposed Work:
    - a) Stretcher-leveled, cold-rolled, commercial quality carbon steel, complying with ASTM A366, matte finish.
  2. Sheet Steel for Unexposed Work:
    - a) Hot-rolled, commercial quality carbon steel, pickled and oiled, complying with ASTM A568/A568M-03.
  3. Structural Steel Shapes and Plates:
    - a) ASTM A36.

- C. Stainless Steel:
1. Type 302 or 304 series complying with ASTM A240, with standard tempers and hardness required for fabrication, strength, and durability.
  2. Apply mechanical finish on fabricated work in the locations shown or specified, Federal Standard and NAAMM nomenclature, with texture and reflectivity required to match Architect's sample.
  3. No. 4 Satin:
    - a) Directional polish finish.
    - b) Graining directions as shown or, if not shown, in longest dimension.
  4. Protect with adhesive paper covering.
- D. Aluminum:
1. Extrusions per ASTM B221; sheet and plate per ASTM B209.
  2. Die Cast Aluminum – ASTM B108, Alloy 356.0, T6.
  3. Extruded Aluminum – FS QQ-A 200/8, Alloy 6061, T6.
- E. Paint Finishes:
1. General:
    - a) Clean exposed metal parts and assemblies of oil, grease, scale, and other foreign matter and factory paint one shop coat of standard rust-resistant primer.
    - b) Galvanized metal not painted.
  2. Prime Finish:
    - a) Apply one coat of rust-resistant primer followed by a filler coat over uneven surfaces.
    - b) Sand smooth and apply final coat of primer.
- F. All equipment and metal work installed under this contract, which does not have a baked enamel or special architectural finish, and which is exposed in the wellway, shall be cleaned, and painted one field coat of enamel.
- G. Escalator designation, number and/or letter, shall be prominently indicated on disconnect.

## 2.6 OPERATION

- A. Each unit shall be capable of operating smoothly and quietly at rated speed with synchronized step and handrail operation in both directions.
- B. Reduced speed and passenger approach activity:
1. When usage drops to below the code prescribed preset level, reduce step speed via variable motor speed operation.
  2. As passenger approach is detected, accelerate to rated speed.
  3. Provide means to monitor usage, including count of users over entry.
- C. Maintenance speed reduction:
1. Provide reduced speed maintenance operation via Plug-in Portable control station
  2. When plugged in the escalator shall operate on Inspection operation.
  3. Run via constant pressure on "up" or "down" button.
  4. The handset shall have a ten-foot (10) foot cord with plug connector. When plugged into special receptacle, there shall be no means of running the escalator except by the service handset. Receptacles shall be provided in top and bottom pits.

## D. Inspection:

1. Escalator design and inspection operation shall permit inspection of wellway interior, including step chains, while unit is running with steps removed.

**2.7 MACHINE SPACE**

## A. Driving Machine:

1. Worm geared, reduction unit coupled directly to AC Permanent Magnet Synchronous drive motor.
2. Handrail drive shall be directly coupled to drive machine.

## B. Drive Motor:

1. Three-phase, operating at no greater than 1800 rpm.
2. Designed to operate in confined spaces.
3. Motor insulation class "F".
4. Motor drive shall incorporate variable speed variable frequency control.

## C. Brake:

1. Electromechanical brake to safely decelerate, stop, and hold brake rated load.
2. Brake shall stop escalator operating in the down direction at an average rate not to exceed 3.0 feet/second□
3. Provide auxiliary brake for escalators not utilizing dynamic braking and a rise greater than 20 ft.

## D. Controller:

1. UL/CSA labeled.
2. NEMA 4 ingress rated enclosure.
3. Compartment:
  - a) Securely mount all assemblies, relays, power supplies, and chassis switches, in a substantial, self-supporting steel cabinet, removable from machine space for access to controls and wiring.
  - b) Include mainline circuit breaker, phase, and overload protection.
  - c) Completely enclose equipment with cover.
4. Relay Design:
  - a) Magnet operated with contact design and material to insure maximum conductivity, long life, and reliable operation without overheating or excessive wear.
  - b) Provide wiping action and means to prevent sticking and fusion.
  - c) Contacts carrying high inductive currents shall be provided with arc deflectors or suppressors.
5. Microprocessor Hardware:
  - a) Provide noise suppression devices that provide noise immunity on all solid-state hardware and devices.
  - b) Provide power supplies with noise suppression devices.
  - c) Isolate inputs from external devices.
  - d) System memory shall be retained in the event of power failure or disturbance.
  - e) Store 100 most recent fault events.

- f) Equipment shall be provided with Electro Magnetic Interference (EMI) shielding within FCC guidelines.
- 6. Wiring:
  - a) Neatly route all wiring interconnections and securely attach wiring connections to studs or terminals.
  - b) Provide labels for all devices, wiring, extra and spare wires, neatly organized in controller cabinet.
  - c) Permanently mark components with symbols shown on wiring diagrams.
- 7. Diagnostics:
  - a) Equip controller with standard ports, interface boards, and drivers to accept maintenance, data logging, fault finding diagnostic, and monitoring system computers, keyboards, modems, and programming tools.
  - b) Provide wireless connection to contractor's cellular provided at no additional cost.
- 8. Provide control panel compliant with UL 508A SB. SCCR of 5000A required.

## 2.8 WELLWAY EQUIPMENT

- A. Truss:
  - 1. Steel truss to carry entire load of escalator, including all code prescribed loads for components, full-capacity load and weight of exterior balustrade covering material.
  - 2. Provide clearly identified exterior cladding support attachment locations on exposed sides and bottom of the entire length of truss.
  - 3. Deflection of the loaded truss shall not exceed 1/1000 of the span dimension under code prescribed live loads.
- B. Truss Isolation:
  - 1. Provide pads at support locations to isolate truss and prevent transmission of vibration to building structure.
- C. Drip Pans:
  - 1. Liquid-tight steel pans with sufficient strength to withstand weight of workers entire width and length of truss.
- D. Sump and Drain Access:
  - 1. Provide hinged access to sump, drain, oil, oil/water separator or other equipment via lower pit pan.
- E. Step Tracks:
  - 1. Steel construction.
  - 2. Bolted sections including transitions to facilitate maintenance and replacement when required.
  - 3. Sections, including transitions, shall be factory installed and aligned to ensure smooth, quiet operation of running gear under all conditions.
  - 4. Thickness: 2.5 mm on incline and 5 mm on transition curves.
- F. Step Drive Assembly:
  - 1. Direct or indirect drive.
  - 2. Machine drive sprockets at each side which engage step chains.
  - 3. Step chain rollers to transmit motion from machine to steps.

4. When chain drives are used between machine and main drive shaft, provide emergency brake on drive assembly to automatically set when chain disengagement or failure occurs.
  5. Provide roller-type sealed bearings.
  6. Individual track sections, together with transition section, main drive shaft, and handrail drive shaft shall form a fully independent assembly.
- G. Step Chain:
1. Provide oilless step chain with hardened pins or cast links connecting adjacent steps and engaging step drive assembly.
  2. 3" synthetic roller assemblies with sealed bearings.
- H. Automatic Oiler:
1. Capability to adjust lubricant flow rate, based on hours of usage.
  2. Applied to all chains and rotating equipment via brush
- I. Step Guidance System:
1. Provide a step guidance system to control the horizontal and vertical movement of the steps.
- J. Lower Reversing Station Tension Carriage:
1. Fully independent, floating track system with spring tensioning device to maintain constant step band tension.
- K. Step Assembly:
1. Single piece die-cast aluminum fastened to the step chain.
  2. Step rollers shall have sealed bearings.
  3. Step roller contact surface shall be coated with synthetic composition material.
  4. Treads and riser shall be cleated.
  5. Steps shall be removable from unit without disassembly of balustrade.
  6. Provide renewable step demarcation inserts on trailing edge of each step tread and both sides of each step tread.
- L. Safety Devices:
1. Provide step and handrail safety devices:
    - a) Broken step chain.
    - b) Broken drive chain/drive belt.
    - c) Skirt obstruction.
    - d) Reversal stops.
    - e) Step up-thrust.
    - f) Handrail speed.
    - g) Missing step.
    - h) Step level.
    - i) Handrail entry.
    - j) Combplate impact.
    - k) Step Demarcation Lights.
    - l) Stop Button.
    - m) Speed Monitoring Devices.



- n) Disconnected Motor Safety.
  - o) Braking Distance Monitor.
- M. Electrical Wiring:
- 1. Conductors:
    - a) Copper throughout with individual wires coded and all connections identified on studs or terminal blocks.
    - b) Flexible cable may be utilized for wiring.
    - c) Provide conduit, junction boxes, connections, and mounting means per requirements of Division 16.
    - d) Provide painted or galvanized steel or aluminum conduit, minimum conduit size, 1/2".
    - e) No Flexible conduit exceeding 24" in length

## 2.9 HANDRAILS

- A. Construction:
- 1. Thermoplastic urethane on metal guides.
  - 2. Handrail shall be spliced and thermoplastic welded with smooth joint.
  - 3. Provide tensioning device and slack-tension switch.
- B. Under Handrail Lighting: RGB color changing continuous LED along the entire length of the escalator. Remote controller to easily change lighting color.
- C. Handrail Drive:
- 1. Friction drive wheel.
  - 2. Handrails shall be driven in both directions and synchronize precisely with step band

## 2.10 BALUSTRADE

- A. Interior Panel:
- 1. 1/2" Glass.
- B. Skirt Panels:
- 1. Reinforced composite panel with smooth surface.
  - 2. Low friction black composite finish material.
  - 3. Install to maintain loaded step gap clearance.
  - 4. Provide skirt brushes and matching mounting extrusion.
  - 5. Extend skirt panel beyond combplates and wrap base of newel.
  - 6. Install to fit flush with handrail inlet end caps.
- C. Deck Boards:
- 1. Reinforced metal.
  - 2. All deck section joints shall abut to provide a smooth surface to surface connection with curved transition, top and bottom, horizontal to incline sections.
- D. Newel Ends:
- 1. Continuous radiused metal guide at upper and lower end of the balustrade.
  - 2. Newel end shall include a handrail guide with integral multi-roller bearing system to minimize friction and provide smooth movement of handrail.

- E. Handrail Guides:
  - 1. For stationary sections of balustrade provide removable handrail guides.
- F. Finishes:
  - 1. Interior Panels:
    - a) Provide 1/2" Clear glass with gaps vertical to floor.
    - b) Satin finish stainless steel.
  - 2. Inner and Outer Deck:
    - a) Satin finish stainless steel.
- G. Trim and Moldings:
  - 1. Match deck finish.
- H. Ceiling Intersection Guards:
  - 1. Provide clear Plexiglas guards at floor.
- I. Deck Guards:
  - 1. Provide clear Plexiglas guards between adjacent units at top and bottom of trusses.

## 2.11 LANDINGS

- A. Flat Steps:
  - 1. Provide upper and lower landings with two flat steps.
- B. Step Demarcation Lighting:
  - 1. Provide minimum of two green LED step demarcation lights within the step band at upper and lower landings.
  - 2. Locate a maximum of 16" from combplates.
- C. Combplates:
  - 1. Plastic Composite provided with non-slip surface.
  - 2. Provide removable comb sections.
  - 3. Apply yellow powder coat finish.
- D. Combplate Lighting:
  - 1. Provide combplate LED lighting in skirt panel on both sides of units at both upper and lower landings.
- E. Landing Plates:
  - 1. Aluminum with non-slip surface.
  - 2. Plate shall extend from combplates to equipment access plates at upper and lower ends.
  - 3. Plates shall extend full width of truss.
- F. Equipment Access Plates:
  - 1. Aluminum with non-slip surface.
  - 2. Provide removable access plates to provide for entry into equipment spaces at upper and lower ends.
  - 3. Plates shall cover entire wellway openings.
  - 4. Access plates shall match material and finish of adjacent landing plates.
  - 5. Provide landing plate and access floor plate without manufacturer's name or logo.

**2.12 SIGNAL AND CONTROL FIXTURES**

- A. Operating Station:
1. Provide newel or inner deck mounted operating stations.
  2. Mount on right side when facing unit.
  3. Match deck finish.
  4. Function and operating positions of switches and buttons shall be identified with engraved characters which are easily visible from a standing position.
  5. Each station shall contain the following:
    - a) Red "emergency stop" button.
    - b) The button shall be covered with a transparent cover which can be readily lifted or pushed aside.
    - c) When the cover is moved, an audible warning signal shall be activated.
    - d) The signal shall have a minimum sound intensity of 80 dBA at the button location.
    - e) The cover shall be engraved "EMERGENCY STOP"; "MOVE COVER" or equivalent legend, and "PUSH BUTTON."
    - f) "EMERGENCY STOP" shall be in letters not less than 1/2" (13mm) high.
    - g) Other required wording shall be in letters not less than 3/16" (4.8mm) high.
    - h) The cover shall be spring loaded to return to closed position.
    - i) Key switch to "start" unit.
    - j) Key directional control switch.
- B. Fault Indicator:
1. Provide upper and lower fault indicator to display fault code without removal of equipment access plate.
  2. Locate indicator in handrail inlet box or deck board visible from landing plate.
- C. Diagnostic Access:
1. Provide diagnostic access port at upper and lower landings.

**2.13 SIGNS**

- A. Landing Signs:
1. Provide caution signs at top and bottom landings.

**2.14 EXAMINATION**

- A. Prior to beginning installation of equipment, examine wellway and pit areas.
1. Verify no irregularities exist which affect execution of work specified.
- B. Verify electrical power has been provided in correct locations and of correct characteristics.
- C. Do not proceed with installation until work in place conforms to project requirements.

**2.15 INSTALLATION**

- A. Install all equipment in accordance with Contractor's instructions, referenced codes, specification, and approved submittals.
- B. Install all equipment so it may be easily removed for maintenance and repair.
- C. Install all equipment for ease of maintenance.

- D. Install all equipment to afford maximum accessibility, safety, and continuity of operation.
- E. Remove oil, grease, scale, and other foreign matter from the following equipment and apply one coat of field-applied machinery enamel, for the following:
  - 1. All exposed equipment and metal work installed as part of this work which does not have architectural finish.
  - 2. Machine room equipment truss.
  - 3. Neatly touch up damaged factory-painted surfaces with original paint color.
  - 4. Protect machine-finish surfaces against corrosion.
- F. Clean all architectural finishes and replace or restore any surfaces damaged during construction to like new condition.

## 2.16 FIELD QUALITY CONTROL

- A. Acceptance Testing:
  - 1. On completion of escalator installation and before permitting escalator use, perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on escalators.

## 2.17 ADJUSTING

- A. Track Alignment:
  - 1. Re-align factory installed tracks if required to ensure continuous 4-point contact with step and chain rollers.
  - 2. Secure joints without gaps and file any irregularities to a smooth surface.
- B. Lubricate all equipment in accordance with manufacturer's instructions.
- C. Adjust motors, brakes, controllers, stopping switches, and safety devices to achieve required performance levels.
- D. Adjust brakes and controlled descent devices to stop escalator with variable load.
- E. Drive machine brakes shall stop the down running escalator at a rate no greater than 3.0 feet/second□
- F. Adjust handrail speed to synchronize with step speed.

## 2.18 CLEANUP

- A. Keep work areas orderly and free from debris during progress of project.
- B. Remove packaging materials on a daily basis.
- C. Remove all loose materials and filings resulting from work.
- D. Clean machine room equipment, truss interior, and pit.
- E. Clean balustrades, deck boards, skirt panels, operating and signal fixtures, and trim.

## 2.19 TEST RESULTS

- A. Review procedures shall apply all escalators.

- B. Perform review and evaluation of all aspects of its work prior to requesting Consultant's final review. Work shall be considered ready for Consultant's final contract compliance review when all Contractor's tests are complete and all elements of work or a designated portion thereof are in place and escalator, or groups of escalators are deemed ready for service as intended.
- C. Furnish labor, materials, and equipment necessary for Consultant's review.
- D. Notify Consultant a minimum of five working days in advance when ready for final review of escalator or group.
- E. Equipment and Instruments:
  - 1. Furnish equipment and instruments to perform required tests.
  - 2. The following instruments may be necessary to complete the tests:
    - a) Multi meter.
    - b) 500 Volt Megger.
    - c) Alternating-current voltmeter and ammeter.
    - d) Celsius-calibrated thermometers (two minimum).
    - e) Precision tachometer.
    - f) Decibel meter for noise test.
    - g) Step Skirt index test equipment
- F. Consultant's written list of observed deficiencies of materials, equipment, and operating systems will be submitted to Contractor for corrective action.
  - 1. Consultant's review shall include as a minimum:
    - a) Workmanship and equipment compliance with Contract Documents.
    - b) Contract speed and performance comply with Contract Documents.
    - c) Performance of following is satisfactory:
      - 1) Starting and running.
      - 2) Stopping.
      - 3) Controlled descent.
      - 4) Equipment noise levels.
      - 5) Signal and operating devices.
      - 6) Overall ride quality.
      - 7) Handrail speed.
      - 8) Operations of safety devices.
  - 2. Operating Tests:
    - a) Overspeed Protection Device: Test by operating at rated speed, tripping overspeed device manually.
    - b) Handrail-Tension Device: Test manually.
    - c) Broken Drive Chain Devices: Test by operating at rated speed, tripping broken chain device manually.
- G. Test Results:
  - 1. In all test conditions obtain specified contract speed, handrail speed, controlled descent, performance, stopping, ride quality, and operation noise levels to satisfaction of Purchaser and Consultant.
- H. Performance Guarantee:

1. Should Consultant's review identify defects, poor workmanship, variance, or noncompliance with requirements of specified codes and/or ordinances, or variance or noncompliance with the requirements of Contract Documents, Contractor shall complete corrective work in an expedient manner to satisfaction of Purchaser and Consultant at no cost as follows:
  - a) Replace equipment which does not meet code or Contract Document requirements.
  - b) Perform work and furnish labor, materials, and equipment necessary to meet specified operation and performance.
  - c) Perform retesting required by Governing Code Authority, Purchaser, and Consultant.
  - d) A follow-up final contract compliance review shall be performed by Consultant after notification by Contractor that all deficiencies have been corrected.
  - e) Provide Consultant with copies of the initial deficiency report marked to indicate items which Contractor considers complete.
- I. A follow-up final contract compliance review shall be performed by Consultant after notification by Contractor that all deficiencies have been corrected.
  1. Provide Consultant with copies of the initial deficiency report marked to indicate items which Contractor considers complete.

END OF SECTION

**SECTION 14 42 00 - WHEELCHAIR LIFTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Inclined platform lifts.
- B. Related Requirements:
  - 1. Section 03 30 00 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
  - 2. Section 04 20 00 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry.
  - 3. Section 09 91 13 "Exterior Painting" for field painting of lift equipment.

**1.2 DEFINITIONS**

- A. Definitions in ASME A18.1 apply to Work of this Section.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components, and finishes for lifts.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, safety features, controls, finishes, and accessories.
- B. Shop Drawings: For each lift.
  - 1. Include plans, elevations, sections, attachment details, and required clearances.
  - 2. Indicate dimensions, weights, loads, and points of load to building structure.
  - 3. Include details of equipment assemblies, method of field assembly, components, and location and size of each field connection.
  - 4. Include diagrams for power, signal, and control wiring.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:
  - 1. Metal Finish: Manufacturer's standard-size unit, not less than 3 inches square.
  - 2. Wood Finish: Manufacturer's standard-size unit, not less than 3 inches square.
  - 3. Fiberglass Finish: Manufacturer's standard-size unit, not less than 3 inches square.
  - 4. Tubular Products and Running Trim: Manufacturer's standard-size unit, 6 inches long.
  - 5. Glass and Glazing: Units 12 inches square.
  - 6. Hardware: Manufacturer's standard, exposed, door-operating device.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer and Installer.
- B. Product Certificates: For each type of lift.
  - 1. Include statement that runway, ramp or pit, dimensions as shown on Drawings, and electrical service as shown and specified are adequate for lift being provided.
- C. Sample Warranty: For special warranty.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each type of lift to include in operation and maintenance manuals.
  - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
    - a. Parts list with sources indicated.
    - b. Recommended parts inventory list.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted use of lifts.

**1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.
- C. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

**1.7 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of lifts that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC/ANSI A117.1 or other locally enforced accessibility standards.
- B. Regulatory Requirements: Comply with ASME A18.1, "Safety Standard for Platform Lifts and Stairway Chairlifts."

**2.2 INCLINED PLATFORM LIFT**

- A. Inclined Platform Lift, General: Pre-engineered lift system.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Savaria Concord Lifts, Inc; Omega or comparable product by one of the following:
    - a. Butler Dynamics, LLC.
    - b. Garaventa Lift.
    - c. ThyssenKrupp Access.
- B. Number of Stops: As indicated on Drawings.
- C. Platform Size: 30-1/2 by 49-1/4 inches.
- D. Door Operation and Clear Opening Width: Low-energy, power-operated doors that remain open for 20 seconds minimum; end door with minimum 32-inch and side door with minimum 42-inch clear opening width.
- E. Emergency Operation: Provide manual operation to raise or lower units to a landing in case of malfunction or power loss.



- F. Platform: Steel sheet or galvanized-steel sheet with baked enamel finish and slip-resistant surface or coating.
- G. Automatic Folding Platforms: When not in use, platforms shall automatically fold up against wall to minimize projection into stairway.
- H. Platform Guarding: Guard platform with:
  1. Passenger-Restraining Arms: power operated.
- I. Ramp: Retractable ramp matching platform to provide transition from floor to lift platform. Ramp lowers to floor automatically when lifts reach landing and enclosure door opens. Ramp rises automatically when lift control is activated for lift to leave landing.
  1. Ramp Size: End ramps a minimum of 32 inches and side ramps a minimum of 42 inches wide; length as required for slope.
  2. Ramp Slope: Maximum 1:12.
  3. Ramp Finish: Finish ramps to match lift platform.
- J. Support to Structure: Provide framing and brackets to support vertical loads from floor or stair treads and only lateral loads from walls. Fabricate framing and brackets from stainless-steel rectangular tubing, plates, shapes, and bars.
- K. Guide Rails: Fabricate from stainless-steel tubing.
  1. Provide pedestrian handrail integrated with guide rails, and complying with accessibility requirements.
- L. Accessories: Provide units with the following accessories:
  1. Fold-down seat with seatbelt.
  2. Caution sign as required by ASME A18.1.
- M. Compact Drive Cabinet with Separate Control Box:
  1. Compact drive cabinet will house all mechanical drive system components and shall be located at the end of the tube system.
  2. Controller box will contain all the electrical components of the drive system and be located up to 50 feet away from the compact drive. Control box dimensions are 20 inches wide by 20 inches high by 12 inches deep.
  3. Provide an integrated lockable mains disconnect and breaker in the compact drive control box.

## 2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Tubing: ASTM A500/A500M.
- C. Steel Pipe: ASTM A53/A53M; standard weight (Schedule 40) unless otherwise indicated or required by loads.
- D. Steel Sheet: ASTM A1008/A1008M, cold-rolled commercial steel (CS) or ASTM A1011/A1011M hot-rolled, commercial steel (CS); as required for each use.
- E. Galvanized-Steel Sheet: ASTM A653/A653M, G90 zinc coating.
- F. Galvanizing: Hot-dip galvanize items complying with the following:
  1. ASTM A123/A123M, for galvanizing steel and iron products.
  2. ASTM A153/A153M, for galvanizing steel and iron hardware.
- G. Stainless-Steel Bars and Shapes: ASTM A276/A276M, Type 304.
- H. Stainless-Steel Tubing: ASTM A554, Grade MT-304.
- I. Stainless-Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.

- J. Expansion Anchors: Anchor-bolt-and-sleeve assembly of material indicated below with capability to sustain a load equal to 10 times the load imposed as determined by testing according to ASTM E 488 conducted by a qualified independent testing agency.
  - 1. Material: Group 1, Alloy 304 or Alloy 316, stainless-steel bolts and nuts complying with ASTM F 593 and ASTM F 594.
- K. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.4 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.5 FINISHES

- A. Galvanized-Steel Factory Finish:
  - 1. Baked-Enamel or Powder-Coat Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat with a minimum dry film thickness of 1 mil for topcoat.
  - 2. Color and Gloss: As selected by Architect from manufacturer's full range.
- B. Stainless-Steel Finishes: Directional satin finish No. 4.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, critical dimensions, and other conditions affecting performance of the Work.
- B. Minimum Headroom Clearance: Verify that installed lift will have a minimum headroom of 80 inches above any point on platform floor at any point of travel.
- C. Minimum Headroom Clearance: Verify that installed lift will have a minimum headroom of 60 inches at any point during travel and minimum of 79 inches where the platform is positioned for boarding.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Comply with ASME A18.1 and manufacturer's written instructions for installation of lifts unless otherwise indicated.
- B. Secure lifts to building construction as follows unless otherwise indicated:
  - 1. For concrete and solid masonry anchorage, use post-installed anchors.
  - 2. For hollow masonry anchorage, use toggle bolts.
  - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.

4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
  5. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
  6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.
- C. Wiring Method: Conceal conductors and cables within housings of units or building construction. Do not install conduit exposed to view in finished spaces. Bundle, lace, and route conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Coordinate platform doors with platform travel and positioning.
- E. Adjust stops for accurate stopping and leveling at each landing, within required tolerances.
1. Leveling Tolerance: 1/4 inch up or down, regardless of load and direction of travel.
- F. Lubricate operating parts of lift, including drive mechanism, guide rails, hinges, safety devices, and hardware.
- G. Test safety devices and verify smoothness of required protective enclosures and other surfaces.

### **3.3 FIELD QUALITY CONTROL**

- A. Acceptance Testing: On completion of lift installation and before permitting use of lifts, perform acceptance tests as required and recommended by ASME A18.1 and authorities having jurisdiction.
- B. Operating Test: In addition to acceptance testing, load lifts to rated capacity and operate continuously for 30 minutes between lowest and highest landings served. Readjust stops, signal equipment, and other devices for accurate stopping and operation of system.
- C. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on lifts.

### **3.4 MAINTENANCE SERVICE**

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of lift Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper lift operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lifts. Include a review of emergency systems and emergency procedures to be followed at time of operational failure and other building emergencies.
- B. Check operation of lifts with Owner's personnel present and before date of Substantial Completion. Determine that operating systems and devices are functioning properly.
- C. Check operation of lifts with Owner's personnel present not more than one month before end of warranty period. Determine that operating systems and devices are functioning properly.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**TABLE OF CONTENTS**

**DIVISION 21 - FIRE SUPPRESSION SPECIFICATION**

210010	GENERAL FIRE SUPPRESSION REQUIREMENTS
210500	COMMON WORK RESULTS FOR FIRE SUPPRESSION
210515	BASIC FIRE SUPPRESSION PIPING METHODS AND MATERIALS
210553	IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
211100	FIRE SUPPRESSION WATER SERVICE PIPING
211200	FIRE SUPPRESSION STANDPIPES
211313	WATER BASED FIRE SUPPRESSION SYSTEMS
213113	ELECTRIC-DRIVE CENTRIFUGAL FIRE PUMPS

END OF DIVISION 21 TABLE OF CONTENTS



12/11/2024

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 21 00 10 - GENERAL FIRE SUPPRESSION REQUIREMENTS****PART 1 - GENERAL REQUIREMENTS****1.1 DESCRIPTION OF WORK**

- A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
- B. Division 21 of the Specifications and Drawings numbered with prefixes F generally describe these systems, but the scope of the Fire Suppression work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Fire Suppression, Mechanical, Plumbing, Fire Alarm and Electrical Drawings and Specifications; and Addenda.
- C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general location and arrangement of the equipment, piping, etc. without showing all the exact details as to elevations, offsets, pipe routing, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.
- D. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 7 Section "Penetration Firestopping" for material and methods for firestopping systems.
  - 2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
  - 3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
  - 4. Division 21 Section 210553 "Identification for Fire Suppression Piping and Equipment" for labeling and identification of installed fire suppression equipment.
  - 5. Division 21 Section 211100 "Fire Suppression Water Service Piping" for fire suppression piping starting 5 feet outside the building to within the building.
  - 6. Division 21 Section 211200 "Fire Suppression Standpipes" for fire suppression standpipes inside the building.
  - 7. Division 21 Section 211313 "Water-Based Fire Suppression Systems" for fire suppression sprinkler systems inside the building.
  - 8. Division 21 Section 213113 "Electric-Drive, Centrifugal Fire Pumps" for electric-driven fire pumps.
  - 9. .

**1.2 QUALITY ASSURANCE**

- A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.
- B. All work shall be installed in strict conformance with manufacturer's requirements and recommendations. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.

- C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.
- D. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Threaded joints shall conform to ASME B1.20.1, Pipe Threads, General Purpose and the Pipe Fitters Handbook.
- G. Regulatory Requirements: Comply with all standards listed in Section 1.2 and all applicable local requirements.
- H. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section, Division 26 and Division 28.
- I. Through and Membrane Penetration Firestopping Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

### 1.3 CODES REFERENCES AND STANDARDS

- A. Execute Work in accordance with the National Fire Protection Association Standards and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.
- B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the submission of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.
- C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.
- D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes.
  - 1. NFPA (National Fire Protection Association) 13, "Installation of Sprinkler Systems", 2019 Edition.
  - 2. NFPA 14, "Installation of Standpipes, Private Hydrants and Hose Systems", 2019 Edition.
  - 3. NFPA 20, "Installation of Stationary Pumps for Fire Protection", 2019 Edition.
  - 4. NFPA 24, "Private Fire Service Mains and their Appurtenances", 2019 Edition.
  - 5. NFPA 25, "Inspection, Testing and Maintenance of Water-Based Fire Protection Systems", 2020 Edition.
  - 6. Underwriters Laboratories, "Fire Protection Equipment Directory", Latest Edition.
  - 7. Alabama Building Code (IBC 2021), 2021 Edition with local amendments.
  - 8. Alabama Fire Code (IFC 2021), 2021 Edition with local amendments.
- E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.



- F. All Fire Suppression work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the Fire Suppression work shall be provided by the Contractor.

#### 1.4 DEFINITIONS

A. General:

1. Furnish: The term "furnish" is used to mean "supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations."
  2. Install: The term "install" is used to describe operations at the project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
  3. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use." When 'furnish', 'install', 'perform', or 'provide' is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.
  4. Furnished by Owner or Furnished by Others: The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
  5. Engineer: Where referenced in this Division, "Engineer" is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the "Architect".
  6. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
  7. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
  8. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
    - a. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
    - b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
  9. Value Engineering: A systematic method to improve the "value" of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.
- B. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.
- C. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).
- D. Other definitions for fire protection systems are listed in NFPA Standards 13, 14, 20 and 24.

- E. Working Plans, also referred to as Fire Protection Drawings as used in this Section means those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 for obtaining approval of the Authority Having Jurisdiction.
- F. The following definitions apply to excavation operations:
  - 1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
  - 2. Sub-base: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
  - 3. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
  - 4. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.

### 1.5 COORDINATION

- A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.
- B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping in the manner anticipated in the design.
- C. The Contractor shall maintain a foreman on the jobsite at all times to coordinate their work with other contractors and subcontractors so that various components of the Fire Suppression systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the work in such a manner that the work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.
- D. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and their subcontractors and as approved by the Architect/Engineer. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.
- E. The contractor shall coordinate work in this section with all related trades. Work and/or equipment provided in other sections and related to the fire protection system shall include, but not be limited to:
  - 1. Sprinkler monitoring equipment (water flow switches, valve tampers, etc) shall be provided by the fire sprinkler installer, but wired and connected by Division 28.
- F. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and described within the specification sections.

### 1.6 MEASUREMENTS AND LAYOUTS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by

reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

## 1.7 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to the requirements of individual Sections. Additionally, prepare coordination drawings as required scope of installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one trade.
1. Information shall be project specific and drawn accurately to a scale large enough to resolve conflicts. Do not base coordination drawings on standard dimensional data.
  2. Prepare floorplans, sections, elevations, and details as needed to adequately describe relationship of various systems and components.
  3. Clearly indicate functional and spatial relationships of components of all systems specified in the Contract Documents, including but not limited to: architectural, structural, civil, mechanical, electrical, fire protection, and specialty systems.
  4. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
  5. Show location and size of access doors required for access to concealed equipment, fittings, controls, terminations, and cabling.
  6. Indicate required installation sequence to minimize conflicts between entities.
  7. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Contract Administrator indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
  8. The details of the coordination are the responsibility of the Contractor and, where indicated on the Drawings, minor adjustments in raceway routing, device placement, device type, or equipment arrangement are not to be considered changes to the Contract.
- B. Equipment Room Coordination Drawings: In accordance with the submittal procedures outlined within these Specifications, provide dimensioned layouts of electrical equipment locations within electrical rooms/closets, mechanical rooms, generator rooms, and fire pump rooms with equipment drawn to scale and identified therein.
1. Clearly identify all required working clearances and access provisions required for installation and maintenance.
  2. Equipment layouts should be arranged accounting for considerations for required door openings and the clearances required by the equipment manufacturer.
  3. Indicate path to allow for the future removal of each large piece of equipment (up to and including generators and unit sub-station transformers) without removal of non-related equipment or architectural elements.
  4. Include work provided by others routed through the equipment rooms.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
  2. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.
    - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Contract Administrator.
  3. Where the Engineer's digital data files are provided to the Contractor for use in preparing coordination digital data files, the Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings or Specifications.

4. Submit coordination drawings in accordance with the submittal procedures outlined within these Specifications.

## 1.8 SUBMITTALS

- A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.
- B. Refer to Division 01 for acceptance of electronic submittals. If not specified by Division 01, provide electronic submittals. If Division 01 requires paper submittals, provide the quantity of submittals required, but no fewer than seven (7) sets.
- C. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Contract Administrator and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 01, Contractor shall include the website, username and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Contract Administrator's and Engineer's designated representatives. Contractor shall allow for the Engineer Review Time as specified. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.
- D. Engineer Review Time: Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time plus to/from mailing time via the Contract Administrator, plus a duplication of this time for resubmittal if required. Transmit submittals as soon as possible after Notice to Proceed and before Mechanical construction starts.
- E. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.
- F. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division as noted in each individual Section. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.
- G. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.
- H. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.
- I. Refer to individual Sections for additional submittal requirements.
- J. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- K. Submittals shall contain the following information:
  1. The project name.
  2. The applicable specification section and paragraph.
  3. Equipment identification acronym as used on the drawings.
  4. The submittal date.

5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
  6. Submittals not so identified will be returned to the Contractor without action.
- L. The checking and subsequent acceptance by the Engineer and/or Contract Administrator of submittals shall not relieve responsibility from the Contractor for (1) deviations from Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Contract Administrator prior to implementing any deviation.
- M. Provide shop drawings prepared in accordance with referenced standards identified as "Working Plans", including hydraulic calculations where applicable. Shop drawings shall be developed by minimum NICET Level III technician. Submit copies of the certification for the designer with submittal. Shop drawings consisting of the following shall be furnished at a minimum. Refer to NFPA 13 for additional requirements.
1. Scaled site plan indicating underground piping with sizes and hydrants utilized for flow test in relation to the building.
  2. Layout drawings of complete fire sprinkler system indicating relationship to all other trades. This shall include all equipment, piping and a reflected ceiling plan indicating sprinkler locations.
  3. Complete details and sections as required to clearly define and clarify the design indicated.
  4. Shop drawings shall be to a standard scale and not less than 3/32" = 1'-0".
  5. Shop drawings shall be produced using computer-aided design. Hand drawn documents will not be reviewed or approved.
  6. Hydraulic calculations shall be based on a water flow test conducted at the site within twelve (12) months of the submittal of plans for approval. The contractor shall be responsible for obtaining the flow test if existing data is not provided in contract documents. Flow test information shall be documented on shop drawings with an accompanying site plan to scale. Contractor shall verify with AHJ any minimum safety factor requirements. Demand shall not be less than 10 percent below the supply at the demand point.
    - a. Hydrant testing shall be in accordance with NFPA 13 and 291 requirements.
  7. Available fire-hydrant flow test records indicate the following conditions:
    - a. Date: 04/26/2024
    - b. Time: 7:00 a.m
    - c. Performed by: Water Utility Company .
    - d. Location of Residual Fire Hydrant: 249 S Lawrence ST.
    - e. Location of Flow Fire Hydrant: 244 S Claiborne ST.
    - f. Static Pressure at Residual Fire Hydrant: 70 psig.
    - g. Measured Flow at Flow Fire Hydrant: 2600.
    - h. Residual Pressure at Residual Fire Hydrant: 60 psig.
- N. Contractor shall prepare installation drawings (working shop drawings) based upon this design. Requests for deviations from the approved design shall be submitted in writing to the Engineer of Record for approval. Shop drawings showing deviations from the design without prior approval will not be approved.
- O. Provide Test Reports and Certificates including:
  1. "Contractor's Material & Test Certificate for Aboveground Piping"
  2. "Contractor's Material & Test Certificate for Underground Piping" as described in NFPA
    - a. Underground piping test certificate shall be obtained prior to connection of the aboveground system.
- P. Provide welders' qualification certificates.
- Q. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.

**1.9 ELECTRONIC DRAWING FILES**

- A. Contractor may request an electronic version of the contract drawing set in AutoCAD format from the Engineer for a fee of 250. Contact the Architect for written authorization. Contact the Engineer for the release agreement form and specify the shipping method and drawing format. Allow up to ten (10) working days for electronic file delivery after authorization and release agreements are completed and delivered to the Engineer.

**1.10 SUBSTITUTIONS**

- A. Refer to Division 1 and General Conditions for substitutions in addition to requirements specified herein.
- B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.
- D. Request for Substitution:
  - 1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
  - 2. The burden of proof of the merit of the proposed substitution is upon the proposer.
  - 3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:
    - a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
    - b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
    - c. Proposed substitution has received necessary approvals of authorities having jurisdiction.
    - d. Same warranty will be furnished for proposed substitution as for specified Work.
    - e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
    - f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.
- E. Substitution Consideration:
  - 1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
  - 2. No substitutions will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.
  - 3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
  - 4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

**1.11 OPERATION AND MAINTENANCE MANUALS**

- A. Refer to Division 1 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

- B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.
- C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.
- D. Prior to Substantial Completion for the project, furnish to the Architect, for Engineer's review, and for Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.
- E. Include the following sections with the appropriate information for each section:
  - 1. Typewritten Index.
  - 2. Qualifications. Provide designer and installer qualification.
  - 3. Bill of Materials. Provide complete nomenclature, model number and vendor information for all parts.
  - 4. Operating Instructions. Complete instructions detailing operation and maintenance of all equipment installed.
  - 5. Product Data: Provide product cut-sheets for all equipment utilized and installed.
  - 6. Guarantee. Copy of all guarantees and warranties issued.
  - 7. Testing/Certification: Provide all completed testing and certification forms as required per NFPA 13 and 25.
  - 8. Contact list with minimum three service representative phone numbers.
- F. Refer to Division 1 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives.

#### **1.12 SPARE PARTS**

- A. Provide to the Owner the spare parts specified in the individual sections in Division 21 specifications.

#### **1.13 RECORD DRAWINGS**

- A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.
- B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.
- C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.
- D. The fire shop drawings and all information contained therein shall be utilized as the basis for the Record Drawings.

**1.14 TRAINING**

- A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video tape the training sessions in a format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

**1.15 PAINTING**

- A. Exposed ferrous surfaces, including pipe, pipe hangers, equipment stands and supports shall be painted by the Fire Suppression Contractor using materials and methods as specified under Division 9 of the Specifications; colors shall be as selected by the Architect.
- B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.
- C. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

**1.16 DELIVERY STORAGE AND HANDLING**

- A. Refer to Division 1 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.
- B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.
- C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.
- D. The Contractor shall be responsible for the safe storage of their own tools, material and equipment.

**1.17 GUARANTEES AND WARRANTIES**

- A. Refer to Division 1 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.
- B. Furnish service and maintenance of fire protection system for one year from date of substantial completion.
- C. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.
- D. The following additional items shall be guaranteed:
  - 1. Piping shall be free from obstructions, holes or breaks of any nature.
  - 2. Proper sloping of pipe to drain in each piping system per NFPA 13.



- E. The above guarantees shall include labor (including travel expenses), troubleshooting and material; and repairs or replacements shall be made without additional cost to the Owner.
- F. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.
- G. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed and stating the commencement date and term.

#### **1.18 PRO ECT CONDITIONS**

- A. Conditions Affecting Excavations: The following project conditions apply:
  - 1. Maintain and protect existing building services which transit the area affected by selective demolition.
  - 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
  - 3. Use of explosives is not permitted.
- B. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

### **PART 2 - PRODUCTS AND MATERIALS**

#### **2.1 GENERAL**

- A. Electrical Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Fire Suppression Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, the Fire Suppression Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.
- B. Refer to Division 26, "Common Work Results for Electrical" for specification of motor connections.
- C. Refer to Division 26, "Enclosed Switches and Circuit Breakers" for specification of disconnect switches.
- D. Refer to Division 28, "Fire Detection and Alarm" for specification of sprinkler monitoring equipment connections.
- E. All fire protection equipment shall be UL listed for its intended use and in conformance with the applicable NFPA codes.
- F. System Pressures: All system components shall be listed for the actual designed system pressures.
  - 1. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

#### **2.2 SOIL MATERIALS**

- A. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand.
- B. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve.

- C. Backfill and Fill Materials: Materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP; free of clay, rock, or gravel larger than 2 inches in any dimension; debris; waste; frozen materials; and vegetable and other deleterious matter.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. The Contractor shall install, and test all new equipment identified in this contract and revise existing equipment as noted.
- B. Installation shall be in accordance with NFPA requirements and the Contractor shall have employed or enlist the design services of at least one minimum NICET Level II certified technician.
- C. Installer: Company specializing in the products indicated in this section with minimum three years documented experience. Shall be bondable and licensed contractor and employ full-time factory-trained and certified installers and technicians. Installers shall provide with the fire sprinkler submittal proof of factory training for each installer.
- D. The Contractor shall provide all required equipment, sprinklers and piping for a complete and operational fire protection system. All components shall be installed in accordance with the guidelines of these specifications and documents as well as the NFPA codes and standards listed in these specifications.
- E. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

#### **3.2 PERMITS**

- A. Secure and pay for permits required in connection with the installation of the Fire Suppression Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

#### **3.3 PREPARATION**

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Section.
- B. Report test results promptly and in writing.

#### **3.4 EXISTING UTILITIES**

- A. Schedule and coordinate with the Utility Company, Owner and with the Engineer connection to, or relocation of, or discontinuation of normal utility services from existing utility lines. Premium time required for any such work shall be included in the bid.
- B. Existing utilities damaged due to the operations of utility work for this project shall be repaired to the satisfaction of the Owner or Utility Company without additional cost.
- C. Utilities shall not be left disconnected at the end of a work day or over a weekend unless authorized by representatives of the Owner or Engineer.
- D. Repairs and restoration of utilities shall be made before workmen leave the project at the end of the workday in which the interruption takes place.

- E. Contractor shall include in their bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

### 3.5 SELECTIVE DEMOLITION

- a. Not used.

### 3.6 EXCAVATION AND BACKFILLING

- A. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this Division. Excavation shall be in conformance with applicable Division and section of the General Specifications.
- B. Roads, alleys, streets and sidewalks damaged during this work shall be restored to the satisfaction of Authorities Having Jurisdiction.
- C. Trenches close to walks or columns shall not be excavated without prior consultation with the Architect.
- D. The Contractor shall erect barricades around excavations, for safety, and shall place an adequate number of amber lights on or near the work and shall keep them burning from dusk to dawn. The Contractor shall be held responsible for any damage that any parties may sustain in consequence of neglecting the necessary precautions in prosecuting the work.
- E. Slope sides of excavations to comply with local, state and federal codes and ordinances. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
  - 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- F. Install sediment and erosion control measures in accordance with local codes and ordinances.
- G. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
  - 1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
  - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.
- H. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
  - 1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
  - 2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- I. Excavation for Underground Tanks, Basins, and Fire Suppression Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
  - 1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
  - 2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

- J. Trenching: Excavate trenches for Fire Suppression installations as follows:
1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.
  2. Excavate trenches to depth indicated or required for piping to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
  3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
  4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of pipe. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and pipe.
  5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.
    - a. For pipes or equipment 6 inches or larger in nominal size, shape bottom of trench to fit bottom 1/4 of the circumference. Fill unevenness with tamped sand backfill. At each pipe joint over-excavate to relieve the bell or pipe joint of the pipe of loads, and to ensure continuous bearing of the pipe barrel on the bearing surface.
- K. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.
- L. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
  2. Under building slabs, use drainage fill materials.
  3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
  4. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support. After installation and testing of piping, provide a 4-inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
  5. Other areas, use excavated or borrowed materials.
- M. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
  2. Removal of concrete formwork.
  3. Removal of shoring and bracing, and backfilling of voids.
  4. Removal of trash and debris.
- N. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- O. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- P. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.
- Q. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D

2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

- a. Areas under structures, building slabs, steps, and pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
  - b. Areas under walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
  - c. Other areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.
- R. Subsidence: Where subsidence occurs at Fire Suppression installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

### 3.7 CUTTING AND PATCHING

- A. The Contractor shall do necessary cutting of walls, floors, ceilings and roofs.
- B. No structural member shall be cut without permission from Architect and Structural Engineer.
- C. Patch around openings to match adjacent construction.
- D. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Architect.

### 3.8 CLEANING

- A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Fire Suppression Contractor shall cooperate in maintaining reasonably clean premises at all times.
- B. Immediately prior to the final inspection, the Fire Suppression Contractor shall clean material and equipment installed under the Fire Suppression Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

### 3.9 SUBSTANTIAL COMPLETION REVIEW

- A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:
  1. Submit complete Operation and Maintenance Manuals.
  2. Submit complete Record Drawings.
  3. Perform special inspections.
  4. Start-up testing of systems.
  5. Removal of temporary facilities from the site.
  6. Comply with requirements for Substantial Completion in the "General Conditions".
- B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days notice prior to the review.

- C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.
- D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.
- E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, they shall reimburse the Architect/Engineer for time and expenses incurred for the visit.
- F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.
- G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.
- H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. The Contractor shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION

**SUBSTITUTION REQUEST FORM**

To Project Engineer: \_\_\_\_\_ Request # (GC Determined): \_\_\_\_\_

Project Name: \_\_\_\_\_

Project No/Phase: \_\_\_\_\_ Date: \_\_\_\_\_

Specification Title: \_\_\_\_\_

Section Number: \_\_\_\_\_ Page: \_\_\_\_\_ Article/Paragraph: \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_

Manufacturer: \_\_\_\_\_ Model No.: \_\_\_\_\_

Address: \_\_\_\_\_ Phone: \_\_\_\_\_

History:  New product  1-4 years old  5-10 years old  More than 10 years old

Differences between proposed substitution and specified Work: \_\_\_\_\_

Point-by-point comparative data attached – REQUIRED BY ENGINEER  
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached:  Drawings  Product Data  Samples  
 Tests  Reports  Other: \_\_\_\_\_

Reason for not providing specified item: \_\_\_\_\_

Similar Installation:  
Project: \_\_\_\_\_ Architect: \_\_\_\_\_

Address: \_\_\_\_\_ Owner: \_\_\_\_\_

\_\_\_\_\_ Date Installed: \_\_\_\_\_

Proposed substitution affects other parts of Work:  No  Yes; explain: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

**Substitution Certification Statement:**

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

- ▲ A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
- B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
- C. Proposed substitution does not affect dimensions and functional clearances.
- D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
- E. Same warranty will be furnished for proposed substitution as for specified Work.
- F. Same maintenance service and source of replacement parts, as applicable, is available.
- G. Proposed substitution will not adversely affect other trades or delay construction schedule.
- H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor	Date	Company
-----------------------	------	---------

**Manufacturer's Certification of Equal Quality:**

I \_\_\_\_\_ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative	Date	Company
-------------------------------	------	---------

**Engineer Review and Recommendation Section**

Recommend Acceptance       Yes       No  
 Additional Comments:       Attached       None

**Acceptance Section:**

Contractor Acceptance Signature	Date	Company
Owner Acceptance Signature	Date	Company
Architect Acceptance Signature	Date	Company
Engineer Acceptance Signature	Date	Company



**SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes limited scope general construction materials and methods for application with Fire Suppression installations as follows:
1. Access panels and doors in walls, ceilings, and floors for access to Fire Suppression materials and equipment.
  2. Concrete for bases and housekeeping pads.
  3. Non-shrink grout for equipment installations.
  4. Miscellaneous metals for support of Fire Suppression materials and equipment.
  5. Wood grounds, nailers, blocking, fasteners, and anchorage for support of Fire Suppression materials and equipment.
  6. Joint sealers for sealing around Fire Suppression materials and equipment.
- B. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 7 Section "Penetration Firestopping" for material and methods for firestopping systems.
  2. Division 21 Section 210010 "General Fire Suppression Requirements" for requirements for hydraulic calculations, fire flow test data, obtaining electronic drawings files, shop drawings and record drawings.
  3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
  4. Division 21 Section 210553 "Identification for Fire Suppression Piping and Equipment" for labeling and identification of installed fire suppression equipment.
  5. Division 21 Section 211100 "Fire Suppression Water Service Piping" for fire suppression piping starting 5 feet outside the building to within the building.
  6. Division 21 Section 211200 "Fire Suppression Standpipes" for fire suppression standpipes inside the building.
  7. Division 21 Section 211313 "Water-Based Fire Suppression Systems" for fire suppression sprinkler systems inside the building.
  8. Division 21 Section 213113 "Electric-Drive Centrifugal Fire Pumps" for electric-driven fire pumps.

**1.2 SUBMITTALS**

- A. General: Submit the following in accordance with Division 1 and Division 21 Section "General Fire Suppression Requirements".
1. Product data for the following products:
    - a. Access panels and doors.
    - b. Through and membrane-penetration firestopping systems.
  2. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
    - a. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 1 Section "Summary of Work."

**1.3 QUALITY ASSURANCE**

- A. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.

1. Provide UL Label on each fire-rated access door.

## **PART 2 - PRODUCTS AND MATERIALS**

### **2.1 ACCESS TO EQUIPMENT**

- A. Acceptable Manufacturers:
  1. Bar-Co., Inc.
  2. Elmdor Stoneman.
  3. JL Industries
  4. Jay R. Smith Mfg. Co.
  5. Karp Associates, Inc.
  6. Milcor
  7. Nystrom Building Products
  8. Wade
  9. Zurn
- B. Access Doors:
  1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section "Identification for Fire Suppression Piping and Equipment" for labeling of access doors.
  2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
  3. Access doors must be of the proper construction for type of construction where installed.
  4. The exact location of all access doors shall be verified with the Architect prior to installation.
  5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
  6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
    - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
    - b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
    - c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
  7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
    - a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
  8. Locking Devices: Flush, screwdriver-operated cam locks.

### **2.2 FIRE SUPPRESSION EQUIPMENT NAMEPLATE DATA**

- A. For each piece of power operated Fire Suppression equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

### **2.3 CONCRETE EQUIPMENT BASES HOUSEKEEPING PADS**

- A. Provide concrete equipment bases and housekeeping pads for various pieces of floor mounted Fire Suppression equipment. Concrete equipment bases/housekeeping pads shall generally

conform to the shape of the piece of equipment it serves with a minimum 4" margin around the equipment and supports.

- B. Form concrete equipment bases and housekeeping pads using framing lumber or steel channel with form release agent. Chamfer top edges and corners. Trowel tops and sides of each base/pad to a smooth finish, equal to that of the floors.
- C. Concrete equipment bases and housekeeping pads shall be made of a minimum 28 day, 4000 psi concrete conforming to American Concrete Institute Standard Building Code for Reinforced Concrete (ACI 318-99) and the latest applicable recommendations of the ACI standard practice manual. Concrete shall be composed of cement conforming to ASTM C 150 Type I, aggregate conforming to ASTM C33, and potable water. All exposed exterior concrete shall contain 5 to 7 percent air entrainment.
- D. Unless otherwise specified or shown on the structural drawings, reinforce equipment bases and housekeeping pads with No. 4 reinforcing bars conforming to ASTM A 615 or 6x6 – W2.9 x W2.9 welded wire mesh conforming to ASTM A185. Reinforcing bars shall be placed 24" on center with a minimum of two bars each direction.
- E. Provide galvanized anchor bolts for all equipment placed on concrete equipment bases and housekeeping pads or on concrete slabs. Anchor bolts size, number and placement shall be as recommended by the Manufacturer of the equipment.
- F. Concrete equipment bases and housekeeping pads shall have minimum heights in accordance with the following table:

Equipment	Minimum Height
Pumps and Equipment Less than or equal to 20 tons and Other Equipment Not Listed – Note 1	3-1/2"
Pumps 30 HP to 75 HP (See Note 1)	7-1/4"
Pumps greater than 75 HP (See Note 1)	11-1/4"

**NOTES:**

1. Height of equipment bases applies to equipment installed on slab-on-grade. For equipment installed on floors above grade and/or roof, reference the drawings.

## **2.4 GROUT**

- A. Provide nonshrink, nonmetallic grout conforming to ASTM C 1107, Grade B, in premixed and factory-packaged containers.
- B. Grout shall have post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement characteristics and shall be as recommended by manufacturer for interior and exterior applications.
- C. Grout shall have 5,000 psi, 28-day compressive strength design mix.

## **2.5 MISCELLANEOUS METALS**

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, welded.
- E. Fasteners: Zinc-coated, type, grade, and class as required.

**2.6 MISCELLANEOUS LUMBER**

- A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
  - 1. Framing materials shall be fire resistant treated for use in Type I and II buildings.
- B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.
  - 1. Framing materials shall be fire resistant treated for use in Type I and II buildings.

**2.7 JOINT SEALERS**

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect from manufacturer's standard colors.
- C. Elastomeric Joint Sealers: Provide the following types:
  - 1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer. Provide one of the following:
    - a. "Dow Corning 790," Dow Corning Corp.
    - b. "Silglaze II SCS 2801," General Electric Co.
    - c. "Silpruf SCS 2000," General Electric Co.
    - d. "864," Pecora Corp.
    - e. "Rhodia 5C," Rhone-Poulenc, Inc.
    - f. "Spectrem 1," Tremco, Inc.
    - g. "Spectrem 2," Tremco, Inc.
    - h. "Dow Corning 795," Dow Corning Corp.
    - i. "Rhodia 7B," Rhone-Poulenc, Inc.
    - j. "Rhodia 7S," Rhone-Poulenc, Inc.
    - k. "OmniSeal," Sonneborn Building Products Div.
  - 2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes. Provide one of the following:
    - a. "Dow Corning 786," Dow Corning Corp.
    - b. "Sanitary 1700," General Electric Co.
    - c. "898 Silicone Sanitary Sealant," Pecora Corp.
    - d. "OmniPlus," Sonneborn Building Products Div.
- D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Chem-Calk 600," Bostik Construction Products Div.
    - b. "AC-20," Pecora Corp.
    - c. "Sonolac," Sonneborn Building Products Div.
    - d. "Tremflex 834," Tremco, Inc.

**2.8 ACOUSTICAL SEALANTS**

- A. General: Penetrations by pipes through surfaces that are around and between noise critical spaces shall be sleeved, packed and sealed airtight with foam rod, non-hardening sealant and/or packing material as described herein.

- B. Foam Rod: Foam backer rod shall be closed cell polyethylene suitable for use as a backing for non-hardening sealant.
- C. Non-Hardening Sealant: Sealant for penetrations shall be non-hardening polysulphide type. Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.
- D. Packing Material: Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 pcf (40 kg/m<sup>3</sup>).

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF ACCESS DOORS**

- A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.

#### **3.2 ERECTION OF METAL SUPPORTS AND ANCHORAGE**

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor Fire Suppression materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

#### **3.3 ERECTION OF WOOD SUPPORTS AND ANCHORAGE**

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor Fire Suppression materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

#### **3.4 PREPARATION FOR JOINT SEALERS**

- A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
- B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

#### **3.5 APPLICATION OF JOINT SEALERS**

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
  - 1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
  - 2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
- B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

**3.6 PENETRATIONS**

- A. New Construction:
  - 1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support piping penetrations.
- B. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.
- C. The General Contractor will provide only those openings specifically indicated on the Architectural or Structural Drawings as being provided under the General Contractor's work.
- D. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.
- E. Floor sleeves shall be fitted with means for attachment to forms and shall be of length to extend at least two inches above the floor level.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- H. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.
- I. All openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 21 Section "Basic Fire Suppression Piping Materials and Methods

END OF SECTION

**SECTION 21 05 15 - BASIC FIRE SUPPRESSION PIPING MATERIALS AND METHODS****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section specifies piping materials and installation methods common to more than one Section of Division 21 and includes piping, joining materials, piping specialties and basic piping installation instructions.
- B. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 21 Section 210010 "General Fire Suppression Requirements" for requirements for hydraulic calculations, fire flow test data, obtaining electronic drawings files, shop drawings and record drawings.
  - 2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
  - 3. Division 21 Section 210553 "Identification for Fire Suppression Piping and Equipment" for labeling and identification of installed fire suppression equipment.
  - 4. Division 21 Section 211100 "Fire Suppression Water Service Piping" for fire suppression piping starting 5 feet outside the building to within the building.
  - 5. Division 21 Section 211200 "Fire-Suppression Standpipes" for fire-suppression standpipes inside the building.
  - 6. Division 21 Section 211313 "Water-Based Fire Suppression Systems" for fire-suppression sprinkler systems inside the building.
  - 7. Division 21 Section 213113 "Electric-Drive Centrifugal Fire Pumps" for electric-driven fire pumps.

**1.2 SUBMITTALS**

- A. Refer to Division 1 and Division 21 "General Fire Suppression Requirements" for administrative and procedural requirements for submittals.
- B. Product Data: Submit product data on the following items:
  - 1. Piping and Fittings
  - 2. Escutcheons
  - 3. Dielectric Unions and Fittings
  - 4. Sleeves and Mechanical Sleeve Seals
  - 5. Wall Pipes

**1.3 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- B. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Plumbing Refrigeration.
- C. Threaded joints shall conform to ASME B1.20.1, Pipe Threads, General Purpose and the Pipe Fitters Handbook.
- D. UL I Compliance: Fire protection system materials and components shall be Underwriter's Laboratories listed and labeled for fire service.
- E. Pipe, piping specialties and fittings shall be manufactured in plants located in the United States.

**PART 2 - PRODUCTS AND MATERIALS****2.1 GENERAL REQUIREMENTS**

- A. All fire suppression system materials and components essential to successful system operation shall be listed for their intended purpose.
- B. General: Refer to the individual piping system specification sections in Division 21 for specifications on piping and fittings relative to that particular system.

**2.2 STEEL PIPE AND FITTINGS**

- A. All piping 2-inch and smaller:
  - 1. With the use of welded or roll grooved fittings: ASTM A135 or 795, Grade A, Schedule 10 or 40, seamless or ERW, black steel pipe.
  - 2. With the use of threaded fittings: ASTM A135 or 795, Grade A, Schedule 40, seamless or ERW, black steel pipe.
- B. All piping 2-1/2" and larger: ASTM A135 or 795, Grade A, Schedule 10, ERW, black steel pipe, roll grooved ends.
- C. Piping used in dry pipe and preaction sprinkler systems shall be ASTM A135 or 795, Type E, Grade A, Schedule 40, black steel pipe, threaded or roll grooved ends.
- D. All piping on the exterior of the building shall be externally galvanized or painted.
- E. Acceptable alternatives to Schedule 40 and Schedule 10 pipe shall be manufactured to standards recognized by NFPA 13. Threaded pipe shall have a corrosion resistance rating (CRR) of 1.0 or greater. Crimp type couplings shall not be used. Threadable thinwall pipe with CRR less than 1.0 not permitted.
- F. Cast-Iron Threaded Fittings: ANSI B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- G. Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- H. Steel Couplings: ASTM A 865, threaded
- I. Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- J. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- K. Malleable- or Ductile-Iron Unions: UL 860.
- L. Cast-Iron Flanges: ASME 16.1, Class 125.
- M. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- N. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- O. Grooved-Joint, Steel-Pipe Appurtenances
  - 1. Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
  - 2. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
  - 3. Grooved mechanical couplings including gaskets used on dry-pipe systems shall be listed for dry-pipe service.



**2.3 COPPER TUBE AND FITTINGS**

- A. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- E. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

**2.4 JOINING MATERIALS**

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
  - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
  - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

**2.5 LISTED FIRE-PROTECTION VALVES**

- A. General Requirements:
  - 1. Valves shall be UL listed approved.
  - 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
- B. Check Valves:
  - 1. Description: Swing-check type, rubber-face checks unless otherwise indicated, and ends matching piping.
  - 2. Standard: UL 312.
  - 3. Pressure Rating: 250 psig minimum.
  - 4. Type: Swing check.
  - 5. Body Material: Cast iron.
  - 6. End Connections: Flanged or grooved.
- C. Bronze OS&Y Gate Valves:
  - 1. Description: Bronze body and bonnet and bronze stem.
  - 2. Standard: UL 262.
  - 3. Pressure Rating: 175 psig.
  - 4. Body Material: Bronze.
  - 5. End Connections: Threaded or grooved.
- D. Iron OS&Y Gate Valves:
  - 1. Description: Iron body and bonnet and bronze seating material.
  - 2. Standard: UL 262.
  - 3. Pressure Rating: 250 psig minimum.
  - 4. Body Material: Cast or ductile iron.
  - 5. End Connections: Flanged or grooved.
- E. Indicating-Type Butterfly Valves:
  - 1. Standard: UL 1091.
  - 2. Pressure Rating: 175 psig minimum.

3. Valves NPS 2 and Smaller:
  - a. Valve Type: Ball or butterfly.
  - b. Body Material: Bronze.
  - c. End Connections: Threaded or grooved.
4. Valves NPS 2-1/2 and Larger:
  - a. Valve Type: Butterfly.
  - b. Body Material: Cast or ductile iron.
  - c. End Connections: Flanged or grooved.
5. Valve Operation: Integral, prewired supervisory switch and visual indicating device.

## 2.6 TRIM AND DRAIN VALVES

- A. General Requirements:
  1. Standard: UL's "Fire Protection Equipment Directory" listing .
  2. Pressure Rating: 175 psig minimum.
- B. Automatic (Ball Drip) Drain Valves:
  1. Standard: UL 1726.
  2. Pressure Rating: 175 psig minimum.
  3. Type: Automatic draining, ball check.
  4. Size: NPS 3/4.
  5. End Connections: Threaded.

## 2.7 AUTOMATIC AIR RELEASE VALVE

- A. Standard: UL 2573
- B. Pressure Rating: 175 psig minimum.

## 2.8 PIPING SPECIALTIES

- A. Escutcheons: Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.
  1. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
  2. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
  3. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
  4. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.
- B. Floor Plates: Inside diameter shall closely fit pipe outside diameter. Outside diameter shall completely cover the opening in floors, walls, or ceilings.
  1. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
  2. Split-Casting Floor Plates: Cast brass with concealed hinge.
- C. Unions: Malleable-iron, Class 150 for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
- D. Dielectric Unions and Fittings: Provide factory-fabricated dielectric unions and fittings with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.
- E. Pressure Gauges
  1. Standard: UL 393.
  2. Dial Size: 3-1/2- to 4-1/2-inch diameter.
  3. Pressure Gage Range: 0 to 300 psig.

4. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
5. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.

## 2.9 PENETRATIONS

- A. Sleeves:
  1. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.
  2. Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.
  3. Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.
  4. Box Frames: Frames for rectangular openings shall be of welded 12 gauge steel attached to forms and of a maximum dimension established by the Architect. Contractor shall notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.
- B. Wall Pipes
  1. Cast-iron sleeve with integral clamping flange with clamping ring, bolts, and nuts for membrane flashing.
    - a. Underdeck Clamp: Clamping ring with setscrews.
- C. Mechanical Sleeve Seals: Modular Plumbing type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
  1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
    - a. Pressure Plates: Carbon steel or stainless steel.
    - b. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, or Stainless steel of length required to secure pressure plates to sealing elements.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

### 3.2 PIPING INSTALLATIONS

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.

- B. Coordinate installation of horizontal piping with other components. Allow sufficient space above removable ceiling panels to allow for panel removal (minimum 6" clearance).
- C. Install system such that all piping is rigidly secured and supported. All ductwork, lights, structural members and main runs of piping shall take precedence over sprinkler piping. Cutting of structural members for passage of sprinkler pipes or hangers shall not be permitted. All horizontal piping in ceiling space shall be at an elevation above the top of light fixtures and air outlets to allow for access to light fixtures and air outlets without removing horizontal piping. Route all sprinkler piping and provide all offsets, bends, and elbows around all mechanical, electrical, and structural members as required.
- D. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise. In areas with ceilings, piping shall be routed concealed, above ceiling. In areas without ceilings, piping shall extend as high as possible.
- E. Install piping free of sags and bends and with ample space between piping to permit proper insulation applications.
- F. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.
- G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- H. Support piping from structure. Do not support piping from ceilings, equipment, ductwork, conduit and other non-structural elements.
- I. Install sprinkler piping to provide for system drainage in accordance with NFPA 13. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple and cap.
- J. Coordinate pipe routing near electrical equipment in accordance with NFPA 70.
- K. Verify final equipment locations for roughing in.
- L. Deviations from approved "Working Plans" for sprinkler piping require written approval of the Authority Having Jurisdiction. Written approval shall be on file with the Engineer prior to deviating from the approved "Working Plans."
- M. Install escutcheons for exposed piping penetrations of walls, ceilings, and floors.

### 3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- C. Install unions in pipes NPS 2 and smaller, adjacent to each valve. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.
- D. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- E. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems.
- F. Non-ferrous Pipe Joints:
  - 1. Brazed and Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.9 - Standard Code for Building Services Piping.

2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
- G. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- a. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- H. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads and Pipe Fitter's Handbook. Join pipe, fittings, and valves as follows:
1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
  2. Align threads at point of assembly.
  3. Apply appropriate tape or thread compound to the external pipe threads.
  4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
  5. Damaged Threads: Do not use pipe with threads that are corroded, or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- I. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9. Align flanged surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.
- J. Mechanical Grooved Joints: Roll grooves on pipe ends dimensionally compatible with the couplings. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- K. Joints for other piping materials are specified within the respective piping system sections.

### 3.4 ALARM DEVICE INSTALLATION

- A. General: Comply with NFPA 24 for devices and methods of valve supervision.
- B. Supervisory Switches: Supervise valves in open position unless noted otherwise.
1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
  2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.
- C. Locking and Sealing: Secure unsupervised valves as follows:
1. Valves: Install chain and padlock on open OS&Y gate valve.
  2. Post Indicators: Install padlock on wrench on indicator post.
- D. Water-Flow Indicators: Install in fire suppression piping where indicated. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.
- E. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in Division 28 Sections.

### 3.5 PIPING PROTECTION

- A. Protect piping during construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at the end of each day or whenever work stops.

**3.6 PENETRATIONS**

- A. Fire suppression penetrations occur when piping penetrate concrete slabs, concrete or masonry walls, or fire / smoke rated floor and wall assemblies.
- B. Above Grade Concrete or Masonry Penetrations
1. Provide sleeves for pipes passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:
    - a. Provide schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
    - b. Provide galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 10 gauge (0.1382 inches).
    - c. Provide welded galvanized sheet metal for rectangular sleeves with the following minimum metal thickness:
      - 1) For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 18 gauge (0.052 inches).
      - 2) For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 10 gauge (0.1382 inches).
    - d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.
  2. Seal elevated floor, exterior wall and roof penetrations watertight and weathertight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of ½" of sealant.
- C. Underground, Exterior-Wall Penetrations: Install cast-iron wall pipes for sleeves. Size sleeves to allow for 1-inch (or larger, if required by the mechanical sleeve manufacturer) annular clear space between pipe and sleeve. Provide mechanical sleeve seal.
1. Use type and number of sealing elements recommended by manufacturer for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
  2. Inspect installed sleeve and sleeve-seal installations for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade to seal against hydrostatic pressure.
- D. Elevated Floor Penetrations of Waterproof Membrane:
1. Provide cast-iron wall pipes for sleeves, extend top of wall pipe minimum 1" above finish floor. Size wall pipe for minimum ½" annular space between pipe and wall pipe.
  2. Extend pipe insulation for insulated pipe through wall pipe. The vapor barrier shall be maintained. Size wall pipe for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
  3. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
  4. Secure waterproof membrane flashing between clamping flange and clamping ring. Comply with requirements for flashing specified in Division 7 Section "Sheet Metal Flashing and Trim."
  5. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.
- E. Interior Foundation Penetrations: Provide sleeves for horizontal pipe passing through or under foundation. Sleeves shall be cast iron soil pipe two nominal pipe sizes larger than the pipe served.
- F. Concrete Slab on Grade Penetrations:
1. Provide schedule 40 PVC pipe sleeves for vertical pressure pipe passing through concrete slab on grade. Sleeves shall be one nominal pipe size larger than the pipe served and two pipe sizes larger than pipe served for ductile iron pipes with restraining rods. Seal watertight with silicone caulk.

2. Provide 1/2-inch thick cellular foam insulation around perimeter of non-pressure pipe passing thru concrete slab on grade. Insulation shall extend to 2-inch above and below the concrete slab.
- G. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of 1/2-inch of sealant. Refer to Division 21 Section "Common Work Results for Fire Suppression" for materials and installation.
1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1-inch annular clear space between inside of sleeve and outside of insulation.
- H. Exterior Wall Penetrations: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of 1/2-inch of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1-inch annular clear space between inside of sleeve and outside of insulation.
- I. Fire / Smoke Rated Floor and Wall Assemblies: Seal around penetrations of fire rated assemblies to maintain fire resistance rating of assemblies. Coordinate fire ratings and locations with the architectural drawings. Install sealants in compliance with the manufacturer's UL listing. Refer to Division 21 Section "Common Work Results for Fire Suppression" for firestopping and materials.

### 3.7 ACOUSTICAL PENETRATIONS

- A. General: There shall be no direct contact of piping with shaft walls, floor slabs and/or partition. All openings around pipes in the structure surrounding the Fire Suppression equipment and surrounding noise-critical spaces shall be sealed, packed with caulking for the full depth of the penetration, as described herein. This includes all slab penetrations and penetrations of noise critical walls.
- B. Fire Sprinkler Piping
1. Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. The internal diameter of the sleeve shall be 2 inches larger than the external diameter of the pipe passing through it. After all of the piping is installed in that area, the Contractor shall check the clearance and correct it, if necessary, to within 1/2 inch. Pack the void full depth with packing material sealed at both ends, 1 inch deep, with non-hardening sealant backed by foam rod.

### 3.8 PIPE FIELD QUALITY CONTROL

- A. Testing: Refer to individual piping system specification sections.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 21 05 53 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. Extent of Fire Suppression work to be identified as required by this Section is indicated on drawings and/or specified in other Division 21 Sections.
- B. Types of identification devices specified in this Section include the following:
  - 1. Equipment labels.
  - 2. Valve tags.
  - 3. Hydraulic placards.
- C. Related Sections
  - 1. Division 21 Section 210010 "General Fire Suppression Requirements" for requirements for hydraulic calculations, fire flow test data, obtaining electronic drawings files, shop drawings and record drawings.
  - 2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
  - 3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
  - 4. Division 21 Section 211100 "Fire Suppression Water Service Piping," for fire suppression piping starting 5 feet outside the building to within the building.
  - 5. Division 21 Section 211200 "Fire-Suppression Standpipes" for fire-suppression standpipes inside the building.
  - 6. Division 21 Section 211313 "Water-Based Fire Suppression Systems" for fire-suppression sprinkler systems inside the building.
  - 7. Division 21 Section 213113 "Electric-Drive Centrifugal Fire Pumps" for electric-driven fire pumps.

**1.2 CODES AND STANDARDS**

- A. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- B. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

**1.3 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
- B. Maintenance Data: For each piping system to include in maintenance manuals.

**PART 2 - PRODUCTS****2.1 EQUIPMENT LABELS**

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, aluminum, or anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.
  - 2. Background/Letter Color: Red/White or Bare Metal/Black.
  - 3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  5. Fasteners: Stainless-steel rivets or self-tapping screws.
  6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
  2. Background/Letter Color: Red/White
  3. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch
  5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  6. Fasteners: Stainless-steel rivets or self-tapping screws.
  7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number,

## 2.2 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping-system abbreviation and 1/2-inch (13-mm) numbers.
1. Tag Material: Brass, stainless steel, aluminum or anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.
  2. Fasteners: Brass wire-link chain, beaded chain or S-hook.
  3. Valve-Tag Color: Red.
  4. Letter Color: White.

## 2.3 HYDRAULIC PLACARDS

- A. Provide hydraulic calculation placard attached to each riser in accordance with NFPA 13. Placard shall include location of design area or areas, discharge densities over the design area or areas, required flow and pressures at the base of riser, occupancy classification and maximum permitted storage height and configuration, hose stream allowance included in addition to the sprinkler demand and name of installing contractor. Information shall be permanently and clearly displayed on placard.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 EQUIPMENT IDENTIFICATION

- A. General: Install metal or plastic equipment marker on or near each major item of fire protection equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. Pumps
2. Backflow Preventers

**3.3 VALVE-TAG INSTALLATION**

- A. Install tags on valves and control devices in fire suppression systems

**3.4 LABEL INSTALLATION**

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install or permanently fasten labels on each major piece of equipment.
- D. Locate equipment labels where accessible and visible.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 21 11 00 - FIRE SUPPRESSION WATER SERVICE PIPING****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. The extent of this fire suppression water service piping shall be as specified herein. Contractor shall be responsible for preparation of design drawings, fabrication and installation for complete fire suppression water service piping for the building.
- B. This section specifies:
  - 1. Materials and equipment for fire suppression water service piping and related components starting 5-feet outside the building and the following:
    - a. Service entrance piping through floor into the building.
- C. This section includes:
  - 1. Pipe and fittings
  - 2. Valves
  - 3. Backflow preventers
  - 4. Fire department connection
  - 5. Alarm devices
  - 6. Accessories
- D. Provide facility fire suppression water service piping during construction in accordance with code.
- E. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 21 Specifications Sections, apply to this section.
- F. Related Sections:
  - 1. .
  - 2. Division 21 Section 210010 "General Fire Suppression Requirements" for requirements for hydraulic calculations, fire flow test data, obtaining electronic drawings files, shop drawings and record drawings.
  - 3. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
  - 4. Division 21 Section 210553 "Identification for Fire Suppression Piping and Equipment" for labeling and identification of installed fire suppression equipment.
  - 5. Division 21 Section 211200 "Fire Suppression Standpipes" for fire suppression standpipes inside the building.
  - 6. Division 21 Section 211313 "Water-Based Fire Suppression Systems" for fire suppression sprinkler systems inside the building.
  - 7. Division 21 Section 213113 "Electric-Drive Centrifugal Fire Pumps" for electric-driven fire pumps.

**1.2 SUBMITTALS**

- A. Submit shop drawings prepared in accordance with Division 21 Section 210010 "General Fire Suppression Requirements."
- B. Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

**1.3 QUALITY ASSURANCE**

- A. Contractor shall be responsible for all permits and fees associated with preparation and approval of Drawings and the installation and approval of the Facility Fire Suppression Water Service Piping.

- B. Regulatory Requirements:
  - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
  - 2. Comply with standards of authorities having jurisdiction for fire suppression water service piping, including materials, hose threads, installation, and testing.
- C. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- D. NFPA 24, "Private Fire Service Mains and their Appurtenances", Latest Edition. Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire suppression water service piping.

#### 1.4 DELIVERY STORAGE AND HANDLING

- A. Preparation for Transport: Prepare valves according to the following:
  - 1. Ensure that valves are dry and internally protected against rust and corrosion.
  - 2. Protect valves against damage to threaded ends and flange faces.
  - 3. Set valves in best position for handling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
  - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
  - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

#### 1.5 PROJECT CONDITIONS

- A. Interruption of Existing Fire Suppression Water Service Piping: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water distribution service according to requirements indicated:
  - 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of service without Construction Manager's written permission.

### PART 2 - PRODUCTS AND MATERIALS

#### 2.1 GENERAL

- A. Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for general piping fittings and piping specialty requirements.

**2.2 DUCTILE-IRON PIPE AND FITTINGS.**

- A. Mechanical-Joint, Cement Lined Ductile-Iron Pipe: AWWA C151/C104, with mechanical-joint bell and plain spigot end.
- B. Mechanical-Joint, Cement Lined Ductile-Iron Fittings: AWWA C110/C104, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  - 1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Flanges: ASME B16.1, Class 125, cast iron.
- D. Ductile-Iron Deflection Fittings:
  - 1. Description: Compound, ductile-iron coupling fitting with sleeve and one or two flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
  - 2. Pressure Rating: 250 psig minimum.

**2.3 SERVICE ENTRANCE ASSEMBLY**

- A. At Contractor's option, the service entrance is permitted to utilize a one-piece riser assembly to enter the building.
  - 1. Assembly shall be Ames Fire and Waterworks Series IBR or approved equivalent. In-Building Riser shall be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum working pressure 200 psi. The fitting shall have a grooved-end connection on the outlet (building) side and a CIPS coupler on the inlet (underground) side. The grooved end shall include a coupler and cap to facilitate testing of the underground piping.

**2.4 ENCASEMENT FOR PIPING**

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: Linear low-density PE film of 0.008-inch (0.20-mm) or High-density, cross-laminated PE film of 0.004-inch (0.10-mm) minimum thickness.
- C. Form: Sheet or tube.

**2.5 GATE VALVES**

- A. UL Listed Approved Gate Valves:
  - 1. UL listed , Iron, Non-rising Stem Gate Valves:
    - a. Description: Iron body and bonnet, bronze seating material, and inside screw.
    - b. Standards: UL 262 listing .
    - c. Pressure Rating: 175 psigminimum.
    - d. End Connections: Mechanical or push-on joint.
  - 2. UL-Listed Approved, Iron, OS&Y, Gate Valves:
    - a. Description: Iron body and bonnet and bronze seating material.
    - b. Standards: UL 262 listing .
    - c. Pressure Rating: 175 minimum.
    - d. End Connections: Flanged or grooved.

**2.6 CHECK VALVES**

- A. UL listed approved Check Valves:

1. Description: Swing-check type with pressure rating, rubber-face checks unless otherwise indicated, and ends matching piping.
2. Standards: UL 312 listing.
3. Pressure Rating: 175 psig minimum.

## 2.7 BACKFLOW PREVENTERS

- A. Double Check Detector Backflow Preventer Assembly:
1. Standards: ASSE 1048 and UL's "Fire Protection Equipment Directory" listing.
  2. Operation: Continuous-pressure applications.
  3. Body Material: Cast iron with interior lining complying with AWWA C550 or that is FDA approved; Steel with interior lining complying with AWWA C550 or that is FDA approved; or Stainless steel.
  4. End Connections: Threaded, flanged or grooved.
  5. Accessories:
    - a. Supervised butterfly or OS&Y gate valves. Backflow preventer and valves shall be listed as an assembly.
    - b. Bypass: With displacement-type water meter, shutoff valves, and backflow preventer.

## 2.8 FIRE DEPARTMENT CONNECTION

- A. Description: Freestanding, Siamese-type with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose connection inlet; 18-inch high brass sleeve; and round escutcheon plate.
1. Standard: UL 405.
  2. Connections: Four NPS 2-1/2 inlets and one NPS 46 outlet.
  3. Inlet Alignment: Inline Horizontal .
  4. Finish Including Sleeve: Polished chrome plated
  5. Caps: Polished chrome plated
  6. Escutcheon Plate Marking: "AUTO SPKR&STANDPIPE" as applicable.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

### 3.2 PREPARATION FOUNDATION FOR BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS

- A. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicated elevation.
- C. Pipe Beds:
1. Ductile Iron Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand backfill. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation. Provide first layer of pea gravel backfill 6-inch above pipe, tamp backfill with mechanical tamper to 85% to 95% compaction. For piping with



rock trench bottoms, provide sand pipe bed 6-inch underneath and around sides of pipe up to middle half of the pipe, including fittings.

- D. Provide backfill above top of pipe bed as required for field conditions. Refer to Division 21 Section 210010 "General Fire Suppression Requirements" for materials and methods for backfill.

### 3.3 PIPE APPLICATIONS

- A. Piping below grade: Provide cement lined ductile iron pipe and fittings with mechanical joints.

### 3.4 PIPING INSTALLATION

- A. Comply with NFPA 24 for fire service main piping materials and installation.
- B. Water main connection: Arrange with water utility company for tap of size and in location indicated in water main or tap water main according to the requirements of the water utility company.
- C. Install ductile-iron, water service piping according to AWWA C600 and AWWA M41.
  - 1. Install encasement for piping according to ASTM A 674 or AWWA C105.
- D. Bury piping with depth of cover over top of piping at least 30-inches, with top at least 12-inches below level of maximum frost penetration, and according to the following:
  - 1. Under Driveways: With at least 36-inches of cover over top.
- E. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- F. Extend fire suppression water service piping and connect to water supply source and building fire suppression water service piping systems at locations and pipe sizes indicated.
  - 1. Terminate fire suppression water service piping at building floor slab until building water piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire suppression water service piping systems when those systems are installed.
- G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- H. Comply with requirements in Section 211200 "Fire Suppression Standpipes," and Section 211313 "Water-Based Fire Suppression Systems," for fire suppression water piping inside the building.
- I. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210515 "Basic Fire Suppression Piping Materials and Methods."
- J. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210515 "Basic Fire Suppression Piping Materials and Methods."
- K. Make connections between underground and aboveground piping using an approved transition piece strapped or fastened to prevent separation.

### 3.5 JOINT CONSTRUCTION

- A. See Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for general joint construction requirements.
- B. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.
- C. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.

- D. Ductile-Iron Piping, Gasketed-Joints for Fire Service Main Piping: UL 194.
- E. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.

### **3.6 ANCHORAGE INSTALLATION**

- A. Anchorage, General: Install water distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
  - 1. Locking mechanical joints.
  - 2. Bolted flanged joints.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire suppression water service piping according to NFPA 24 and the following:
  - 1. Gasketed-Joint, Ductile-Iron, Water Service Piping: According to AWWA C600.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

### **3.7 VALVE INSTALLATION**

- A. See Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for general valve installation requirements.
- B. UL-Listed Valves Other Than Gate Valves: Comply with NFPA 24.
- C. Support valves and piping, not direct buried, on concrete piers. Comply with requirements for concrete piers in Division 03.

### **3.8 BACKFLOW PREVENTER INSTALLATIONS**

- A. Install backflow preventer at each fire protection entry in compliance with the plumbing code and Authority Having Jurisdiction. Locate in an accessible and testable location.
- B. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks.
- C. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- D. Do not install bypass piping around backflow preventers.
- E. Support NPS 2-1/2 and larger backflow preventers with pipe supports attached to the floor with anchor bolts where indicated on the drawings.
- F. Test backflow preventer per requirements of plumbing or division of cross connection control official.
  - 1. Reports: Prepare backflow preventer test reports signed by the plumbing or division of cross connection control official and turn over to the Architect upon completion of the project.

### **3.9 FIRE DEPARTMENT CONNECTION INSTALLATIONS**

- A. Install automatic (ball drip) drain valve at each check valve for fire department connection, to drain piping between fire department connection and check valve. Install drain piping to and discharge to outside building.
- B. Install connections between 18- and 36-inches above finished grade and as indicated on the Drawings.
- C. Install mechanical sleeve seal at pipe penetration in outside walls.
- D. Provide minimum 36-inch working clearance around connection for fire department access.

**3.10 FIELD QUALITY CONTROL**

- A. Flush, test, and inspect in accordance with NFPA 24.
- B. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
- C. Replace piping system components that do not pass the test procedures specified, and retest repaired portion of the system.

**3.11 IDENTIFICATION**

- A. Install continuous underground detectable warning tape during backfilling of trench for underground fire suppression water service piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

**3.12 CLEANING**

- A. Clean fire suppression water service piping as follows:
  - 1. Flush new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
  - 2. Use flushing procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
- B. Prepare reports of flushing activities.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 21 12 00 - FIRE SUPPRESSION STANDPIPES****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. The extent of the fire suppression standpipe system shall be as specified herein. Contractor shall be responsible for preparation of design drawings, hydraulic calculations, fabrication and installation for complete standpipe protection for the building.
- B. This section includes:
  - 1. Pipe and fittings
  - 2. Fire protection valves
  - 3. Hose connections
  - 4. Specialties
- C. Related Sections:
  - 1. Division 21 Section 210010 "General Fire Suppression Requirements" for requirements for hydraulic calculations, obtaining electronic drawings files, shop drawings and record drawings.
  - 2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
  - 3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
  - 4. Division 21 Section 210553 "Identification for Fire Suppression Piping and Equipment" for labeling and identification of installed fire suppression equipment.
  - 5. Division 21 Section 211100 "Fire Suppression Water Service Piping" for fire suppression piping starting 5 feet outside the building to within the building.
  - 6. Division 21 Section 211313 "Water-Based Fire Suppression Systems" for fire-suppression sprinkler systems inside the building.
  - 7. Division 21 Section 213113 "Electric-Drive Centrifugal Fire Pumps" for electric-driven fire pumps.

**1.2 DEFINITIONS**

- A. Standard Pressure Standpipe Piping: Fire suppression standpipe piping designed to operate at working pressure 175-psig maximum.

**1.3 SYSTEM DESCRIPTION**

- A. Automatic Wet-Type: Provide a complete automatic wet standpipe system as specified herein and as shown on drawings as applicable. The standpipe system shall be connected to an automatic water supply. Water shall be immediately available at all fire department hose connections at full design flow and pressure.
  - 1. Fire protection standpipe system is a Class I, Standpipe System with NPS 2-1/2 hose connections to supply water for use by fire departments and those trained in handling heavy fire streams.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Standard Pressure, Fire Suppression Standpipe System Component: Listed for 175-psig minimum working pressure.

- B. Delegated Design: Design fire suppression standpipes, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Fire suppression standpipe design shall be approved by authorities having jurisdiction.
  - 1. Minimum residual pressure at required flow at each hose-connection outlet is as follows:
    - a. NPS 2-1/2 Hose Connections: 100-psig.
  - 2. Maximum residual pressure at required flow at each hose-connection outlet is as follows unless otherwise indicated:
    - a. .
    - b. NPS 2-1/2 Hose Connections: 175-psig.
- D. Provide construction standpipe and fire protection system during construction in accordance with code.

### 1.5 SUBMITTALS

- A. Submit shop drawings prepared in accordance with NFPA 14 and as specified in Division 21 Section 210010 "General Fire Suppression Requirements."

### 1.6 QUALITY ASSURANCE

- A. Contractor shall be responsible for all permits and fees associated with preparation and approval of Drawings and the installation and approval of fire suppression standpipe system.
- B. Tests and Inspections: Arrange, test, and pay for all tests required by code and Authorities Having Jurisdiction.

### 1.7 PROJECT CONDITIONS

- A. Interruption of Existing Fire Suppression Standpipe Service: Do not interrupt fire suppression standpipe service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire suppression standpipe service according to requirements indicated:
  - 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of fire suppression standpipe service.
  - 2. Do not proceed with interruption of fire suppression standpipe service without Construction Manager's written permission.

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 EQUIPMENT

- A. All fire protection equipment shall be UL listed for its intended use and in conformance with the applicable NFPA documents.

### 2.2 PIPE AND FITTING MATERIALS

- A. Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for specifications on piping and fittings.

### 2.3 HANGERS

- A. Shall be UL-listed and shall meet requirements of NFPA 14 for type, dimension and location.

**2.4 GENERAL DUTY VALVES**

- A. Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for specifications on general duty valves.

**2.5 PIPE FITTINGS**

- A. Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for specifications on pipe fittings.

**2.6 SPECIALTY VALVES**

- A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing.
  2. Pressure Rating:
    - a. Standard Pressure Piping Specialty Valves: 175-psig minimum.
  3. Body Material: Cast- or ductile- iron.
  4. Size: Same as connected piping.
  5. End Connections: Flanged or grooved.
- B. Nonadjustable Valve Hose Connections:
1. Standard: UL 668 hose valve for connecting fire hose.
  2. Pressure Rating: 300-psig minimum.
  3. Material: Brass or bronze.
  4. Size: NPS 2-1/2.
  5. Inlet: Female pipe threads.
  6. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
  7. Pattern: Angle.
  8. Finish: Rough brass or bronze.
  9. Clearance: Minimum 12-inch clear radius around outlet to allow for wrench clearance. Provide minimum code required stairway clearance at each hose connection and standpipe.
  10. Cabinet: Provide connection installed within recessed valve cabinet unless Architectural Drawings indicate other mounting, modified with centered side inlet and 10-inch box depth. Cabinet shall have flush metal panel door, flat trim with square return, steel prime coated exterior, white enameled interior, continuous hinge, lever handle with cam catch, OSHA lettering, chrome plated steel escutcheon plate.

**2.7 ROOF MANIFOLD**

- A. Freestanding Unit: Rough brass freestanding unit with back inlet and two NPS 2-1/2-inch UL listed rough brass 300 lb. angle valves with brass cap and chain.
1. Size NPS 4x NPS 2-1/2p.

**2.8 ALARM DEVICES**

- A. General: Alarm device types shall match piping and equipment connections.
- B. Audible/Visual Alarm Notification Appliances (Horn/Strobe):
1. Standard: UL 1971 combination horn and strobe appliance.
  2. Audible/visual notification appliance shall be exterior, weatherproof with weatherproof backbox.
  3. Provide engraved lamacoid plate under Bell lettered "Building Fire Standpipe System."
- C. Water Flow Indicators:
1. Standard: UL 346.

2. Water-Flow Detector: Electrically supervised.
  3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover.
  4. Type: Paddle operated.
  5. Pressure Rating: 250-psig.
  6. Design Installation: Horizontal or vertical.
- D. Valve Supervisory Switches:
1. Standard: UL 346.
  2. Type: Electrically supervised.
  3. Components: Single-pole, double-throw switch with normally closed contacts and tamperproof cover.
  4. Design: Signals that controlled valve is in other than fully open position.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine rough-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 WATER SUPPLY CONNECTION**

- A. Connect fire suppression standpipe piping to building's fire sprinkler system piping. Comply with requirements for fire sprinkler piping in Division 21 Section 211313 "Water Based Fire Suppression Systems."

#### **3.3 PIPE APPLICATIONS**

- A. Piping Below Grade: Refer to Division 21 Section 211100 "Fire Suppression Water Service Piping."
- B. Piping Above Grade:
  1. Black steel and fittings for all fire sprinkler system piping located inside the building, not exposed to the elements.
  2. Externally galvanized piping and fittings shall be used for all fire sprinkler system piping located on the exterior of the building, exposed to the elements.

#### **3.4 PIPING INSTALLATIONS**

- A. Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for general fire suppression standpipe piping installation requirements.
- B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire suppression standpipe piping.
- C. Hangers and Supports: Comply with the requirements of NFPA 14. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Locate hangers at or directly adjacent to the joist panel points.



- D. Install pressure gauges on riser or feed main and at top of each standpipe. Provide pressure gauge with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.
- E. Install drain valves on standpipes.
  - 1. Extend drain piping to outside of building where the drain is located 60 inches or less above grade and along the exterior of the building.
  - 2. For all other locations, install a male,  $\frac{1}{2}$ -inch GHT connection on the discharge side of the drain valve.
- F. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- G. Fill wet-type standpipe system piping with water.
- H. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods"
- I. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods."

### 3.5 PIPE JOINT CONSTRUCTION

- A. Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for general fire suppression piping joint construction requirements.

### 3.6 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.
- B. Install listed fire protection shutoff valves supervised open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Provide supervised control valve at the base of each standpipe.
  - 1. The control valve shall be supervised by the building fire alarm panel
- D. Specialty Valves:
  - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

### 3.7 HOSE CONNECTION INSTALLATION

- A. Install connections between 36- and 48-inches above the floor, at each main intermediate level of each egress stairway and as indicated on the Drawings.
- B. Install freestanding hose connections for access and minimum passage restriction.
- C. Install NPS 2-1/2 hose outlet valves with brass cap and chain at each standpipe outlet for hose connections.
- D. Where pressure exceeds 175 PSI at Class I connections, provide NPS 2-1/2 UL listed pressure reducing and shutoff valve with bronze finish with brass cap and chain. Set valve to limit nozzle pressure to 150 PSI.

- E. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes. Drain piping shall be routed to the exterior of the building unless noted otherwise.
- F. Install wall-mounted-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose.

### **3.8 IDENTIFICATION**

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14 and Division 21 Section 210553 "Identification for Fire Suppression Piping and Equipment."

### **3.9 FIELD QUALITY CONTROL**

- A. Perform required tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Coordinate with fire alarm tests. Operate as required.
  - 6. Coordinate with fire pump tests. Operate as required.
  - 7. Verify that equipment hose threads are same as local fire department equipment.
- C. Replace piping system components that do not pass the test procedures specified, and retest repaired portion of the system.

### **3.10 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and associated equipment for standpipe system.

### **3.11 COMMISSIONING**

- A. Test per NFPA 14, NFPA 25 and local authorities requirements. Submit Contractor's Material & Test Certificates for Above Ground Piping. Submit certificates of completion to authority having jurisdiction and Owner.

END OF SECTION

**SECTION 21 13 13 - WATER BASED FIRE SUPPRESSION SYSTEMS****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. The extent of this fire sprinkler system shall be as specified herein. Contractor shall be responsible for preparation of design drawings, hydraulic calculations, fabrication and installation for complete fire sprinkler protection for the building.
- B. Section Includes:
  - 1. Pipes, fittings, and specialties.
  - 2. Fire protection valves.
  - 3. Sprinkler pipe fittings.
  - 4. Sprinklers.
  - 5. Alarm devices.
- C. Related Sections:
  - 1. Division 21 Section 210010 "General Fire Suppression Requirements" for requirements for hydraulic calculations, obtaining electronic drawings files, shop drawings and record drawings.
  - 2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
  - 3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
  - 4. Division 21 Section 210553 "Identification for Fire Suppression Piping and Equipment" for labeling and identification of installed fire suppression equipment.
  - 5. Division 21 Section 211100 "Fire Suppression Water Service Piping" for fire suppression piping starting 5 feet outside the building to within the building.
  - 6. Division 21 Section 211200 "Fire Suppression Standpipes" for fire-suppression standpipes inside the building.
  - 7. Division 21 Section 213113 "Electric-Drive Centrifugal Fire Pumps" for electric-driven fire pumps.

**1.2 SYSTEM DESCRIPTION**

- A. Fire protection system in the location or portion of the building is a Wet Pipe, Dry Pipe.
  - 1. Wet Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to a water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts a fusible link or destroys a frangible device. Hose connections are included if indicated.
  - 2. Dry Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed nitrogen. Opening of sprinklers releases compressed air and permits water pressure to open a dry pipe valve. Water then flows into piping and discharges from sprinklers that are open.
- B. Provide system(s) as specified herein and as shown on drawings. The sprinkler system shall be supplied by the underground as shown on the Drawings.
- C. Provide dry pipe fire protection system for non-heated spaces and other areas of building subject to freezing including the loading docks and canopies, mansards, and balconies. Portions of systems subject to freezing or temperatures below 40°F shall be protected against freezing as required by NFPA 13. The Contractor shall be responsible for repairs and for all costs incurred from damage caused by freezing of the fire protection system.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design fire suppression system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Standard Pressure, Fire Suppression System Component: Listed for 175-psig minimum working pressure.
- C. Performance Criteria
  - 1. Protect entire building, unless noted otherwise, with a sprinkler system designed in accordance with NFPA 13 for Light Hazard requirements.
  - 2. .
  - 3. Protect concourses, mechanical and electrical areas/rooms with a sprinkler system designed in accordance with NFPA 13 for Ordinary Hazard Group 1 requirements.
  - 4. Protect storage areas/rooms, unless noted otherwise, with a sprinkler system designed in accordance with NFPA 13 for Ordinary Hazard Group 2 requirement.
  - 5. Other Occupancy Hazard Classifications.
    - a. Restaurant Seating Areas: Light Hazard density with the approval of the AHJ.
    - b. Building Service Areas: Ordinary Hazard Group 1.
    - c. Suites: Ordinary Hazard, Group 1.
    - d. Ballrooms: Ordinary Hazard, Group 2.
    - e. Meeting rooms: Ordinary Hazard, Group 2.
    - f. Laundries: Ordinary Hazard, Group 1.
    - g. Machine Shops: Ordinary Hazard, Group 2.
    - h. Roof level above catwalks: Ordinary Hazard, Group 2.
    - i. Office and Public Areas: Light Hazard.
    - j. Restaurant Service Areas: Ordinary Hazard, Group 1.
  - 6. Design Criteria for Automatic-Sprinkler Piping Design:
    - a. Light Hazard Occupancy:
      - 1) Minimum Design Density: 0.10 gpm over 1,500 sq.ft. area.
      - 2) Maximum protection area per sprinkler: 225 sq.ft.
      - 3) Minimum Combined Hose Stream Demand Requirement: 100 gpm for 30 minutes.
    - b. Ordinary Hazard Group 1 Occupancy:
      - 1) Minimum Design Density: 0.15 gpm over 1,500 sq.ft. area.
      - 2) Maximum area per sprinkler: 130 sq.ft..
      - 3) Minimum Combined Hose Stream Demand: 250 gpm for 60 to 90 minutes.
    - c. Ordinary Hazard Group 2 Occupancy:
      - 1) Minimum Design Density: 0.20 gpm over 1,500 sq.ft. area.
      - 2) Maximum protection area per sprinkler: 130 sq.ft.
      - 3) Minimum Combined Hose Stream Demand: 250 gpm for 60 to 90 minutes.
    - d. Special Occupancy Hazard: Double Height entry lobby
      - 1) Minimum Design Density: 0.20 gpm over 2,000 sq.ft. area.
      - 2) Maximum protection area per sprinkler: 10' x 13' maximum spacing.
      - 3) Minimum Combined Hose Stream Demand: 250 gpm for 60 to 90 minutes.
- D. The criteria listed herein shall not preclude the use of extended coverage or special application fire sprinklers designed and installed in accordance with their listing and manufacturer's instructions.
- E. The hydraulic area of operation may not be reduced as allowed by NFPA 13 for areas utilizing quick response sprinklers in unfinished shell spaces. For all other areas, the hydraulic area of operation shall not be reduced as allowed by NFPA 13 for areas utilizing quick response sprinklers unless specifically approved by the Engineer via a formally submitted RFI.
- F. Sprinkler spacing shall conform to NFPA 13 and shall not exceed 256 SF per sprinkler in unfinished shell spaces.

- G. The hydraulic area of operation shall be increased by 30% without revising the density for areas with sloped ceilings with a pitch exceeding 1 in 6 (16.7% slope) in accordance with NFPA 13.
- H. The hydraulic area of operation shall be increased by 30% without revising the density for dry-pipe and double interlock preaction systems in accordance with NFPA 13.

#### **1.4 SUBMITTALS**

- A. Submit shop drawings prepared in accordance with NFPA 13 as specified in Division 21 Section 210010 "General Fire Suppression Requirements."

#### **1.5 QUALITY ASSURANCE**

- A. Contractor shall be responsible for all permits and fees associated with preparation and approval of Drawings and the installation and approval of a fire sprinkler system.
- B. Tests and Inspections: Arrange, test, and pay for all tests required by code and authorities having jurisdiction.

#### **1.6 PROJECT CONDITIONS**

- A. Interruption of Existing Fire Sprinkler Protection: Do not interrupt fire sprinkler system protection to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire sprinkler protection according to requirements indicated:
  - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of fire-sprinkler protection.
  - 2. Do not proceed with interruption of fire sprinkler protection without Construction Manager's written permission.

#### **1.7 COORDINATION**

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

#### **1.8 EXTRA MATERIALS**

- A. Sprinkler Wrenches: Furnish to Owner, 2 sprinkler wrenches for each type of sprinkler installed.
- B. Sprinklers: Furnish extra sprinklers of each style, type and finish included in the project as required by NFPA 13.
- C. Sprinkler Cabinet and Wrench: Provide a finished steel cabinet(s), suitable for wall mounting, with hinged cover and space for the quantity of spare sprinklers provided plus sprinkler wrench(es).
- D. Provide hydraulic calculation placard attached to each riser.

### **PART 2 - PRODUCTS AND MATERIALS**

#### **2.1 EQUIPMENT**

- A. All fire protection equipment shall be UL listed for its intended use and in conformance with the applicable NFPA documents.

**2.2 PIPE AND FITTING MATERIALS**

- A. Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for specifications on piping and fittings.

**2.3 HANGERS**

- A. Shall be UL listed and shall meet requirements of NFPA 13 for type, dimension and location.

**2.4 GENERAL DUTY VALVES**

- A. Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for specifications on general duty valves.

**2.5 SPECIALTY VALVES**

- A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing.
  2. Pressure Rating:
    - a. Standard Pressure Piping Specialty Valves: 175-psig minimum.
  3. Body Material: Cast- or ductile- iron.
  4. Size: Same as connected piping.
  5. End Connections: Flanged or grooved.
- B. Dry-Pipe Valves:
1. Standard: UL 260.
  2. Design: Differential-pressure type.
  3. Include UL 1486, quick-opening devices, trim sets for bypass, air supply, drain, priming level, alarm connections, ball drip valves, pressure gauges, drip cup assembly piped with check valve to main drain piping, priming chamber attachment, and fill-line attachment with strainer.
  4. Air-Pressure Maintenance Device:
    - a. Type: Automatic device to maintain minimum air pressure in piping.
    - b. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.
  5. Air Compressor:
    - a. Type: Oil-less, air-cooled
    - b. Standard: UL's "Fire Protection Equipment Directory" listing.
    - c. Motor Horsepower: Fractional.
    - d. Power: 120-V ac, 60 Hz, single phase, hard wired per NEC and manufacturer's requirements.
    - e. Provide combination fused disconnect switch and magnetic starter.
- C. Nitrogen Compressor:
1. SouthTek N2-Blast FPS 500, or owner approved equal.
  2. Additional Equipment:
    - a. N2Blast AutoPurge System.
    - b. BlastOff III – Early Warning System.
    - c. Quick Fill Air Compressor:
      - 1) Standard: UL's "Fire Protection Equipment Directory" Listing.
      - 2) Integral Type: Oil-less, air-cooled.
      - 3) Motor Horsepower: 2-HP.
      - 4) Power: 102-Vac, 60 Hz, single phase, hard wired per NEC, and manufacturer's requirements.
      - 5) Provide Combination fused disconnect switch and magnetic starter.

3. Optional Equipment to be owner approved:
  - a. BlastOff IV – Onboard Purity Alarm.
  - b. Quick-Check – 6 Zone Purity Manifold.
  - c. N2-Blast Preventative Maintenance Box.
- D. Air Release Valve:
  1. Provide for all wet pipe sprinkler systems utilizing metallic piping in accordance with one of the following options:
    - a. Manual ball valve with a minimum size of  $\frac{1}{2}$  inch (15 mm).
    - b. Listed and/or Factory Mutual Approved automatic valve.

## 2.6 PIPE FITTINGS

- A. Branch Outlet Fittings:
  1. Standard: UL 213.
  2. Pressure Rating: 175-psig minimum.
  3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
  4. Type: Mechanical-T and -cross fittings.
  5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
  6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
  7. Branch Outlets: Grooved, welded or threaded.
- B. Flow Detection and Test Assemblies:
  1. Standard: UL's "Fire Protection Equipment Directory" listing.
  2. Pressure Rating: 175-psig minimum.
  3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
  4. Size: Same as connected piping.
  5. Inlet and Outlet: Grooved or threaded.
- C. Sprinkler Inspector's Test Fittings:
  1. Standard: UL's "Fire Protection Equipment Directory" listing.
  2. Pressure Rating: 175-psig minimum.
  3. Body Material: Cast- or ductile-iron housing with sight glass.
  4. Size: Same as connected piping.
  5. Inlet and Outlet: Threaded.
- D. Flexible Piping Systems:
  1. At Contractor's option, UL listed and FM Global approved flexible piping connections to sprinklers may be used for both acoustical panel and gypsum board ceilings when suitable for their intended use.
  2. Description: Connections shall include a leak-tested sprinkler drop with a minimum internal corrugated hose diameter of 1 inch.
  3. Flexible piping lengths shall not exceed 6 feet.
  4. Installation shall not exceed the minimum bend radius and maximum allowable bends as specified by the manufacturer.
  5. Change in direction shall be gradual enough to allow flexible piping to bend without crimping, distorting or reducing internal diameter.

## 2.7 AUTOMATIC SPRINKLERS

- A. Sprinklers: type and style as indicated or required by application. Sprinkler operating temperatures to comply with NFPA 13. Sprinklers in Light Hazard areas shall be quick response type.
- B. General Requirements:
  1. Standard: UL's "Fire Protection Equipment Directory" listing .
  2. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

- C. Automatic Sprinklers with Heat-Responsive Element:
  - 1. Early-Suppression, Fast-Response Applications: UL 1767.
  - 2. Nonresidential Applications: UL 199.
  - 3. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Use sprinkler types below for the following applications:
  - 1. Rooms without Ceilings: Upright sprinklers.
  - 2. Rooms with Suspended Ceilings: Recessed and concealed sprinklers as indicated on drawings.
  - 3. Rooms with Gypsum Board Ceilings: Recessed and concealed sprinklers as indicated on drawings.
  - 4. Wall Mounting: Sidewall sprinklers.
  - 5. Spaces Subject to Freezing: Dry pendent or dry sidewall sprinklers as indicated on drawings.
- E. Provide sprinkler types below with finishes indicated.
  - 1. Finished Areas:
    - a. Concealed Sprinklers: Rough brass, with cover plate factory painted to match ceiling. Coordinate ceiling color with architect.
    - b. Recessed Sprinklers: white painted with white escutcheon.
    - c. Upright, Pendent, and Sidewall Sprinklers: Bright chrome, with bright chrome escutcheon.
    - d. Unfinished Areas: Rough bronze in unfinished spaces not exposed to view.
- F. Coordinate sprinkler temperature ratings near heat-producing sources in accordance with NFPA 13.
- G. Sprinklers shall be wax coated where exposed to acids, chemicals, or other corrosive fumes.
- H. Sprinkler Guards: Provide sprinkler guard where sprinklers are less than 7-feet above finished floor; where subject to physical damage, and/or where indicated on drawings. Guard shall be UL 199 listed, wire cage type with fastening device for attaching to sprinkler.
- I. Sprinkler Cabinet and Wrench: Provide a finished steel cabinet, suitable for wall mounting, with hinged cover and space for the appropriate quantity of spare sprinklers plus sprinkler wrench(es).

## 2.8 ALARM DEVICES

- A. General: Alarm device types shall match piping and equipment connections.
- B. Audible/Visual Alarm Notification Appliances (Horn/Strobe):
  - 1. Standard: UL 1971 combination horn and strobe appliance.
  - 2. Audible/visual notification appliance shall be exterior, weatherproof with weatherproof backbox.
- C. Water Flow Indicators:
  - 1. Standard: UL 346.
  - 2. Water-Flow Detector: Electrically supervised.
  - 3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory set, field-adjustable retard element to prevent false signals and tamperproof cover.
  - 4. Type: Paddle operated.
  - 5. Pressure Rating: 250 psig.
  - 6. Design Installation: Horizontal or vertical.
- D. Pressure Switches – Water Flow Alarm Detection:
  - 1. Standard: UL 346.



2. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory set, field adjustable retard element to prevent false signals and tamperproof cover.
  3. Type: Electrically supervised water flow switch with retard feature.
  4. Pressure Rating: 250 psig.
  5. Design Operation: Rising pressure signals water flow.
- E. Pressure Switches – Low/High Nitrogen Pressure Supervisory:
1. Standard: UL 346.
  2. Components: Two single-pole, double-throw circuit switches for isolated alarm contacts, 7 A, 125-V ac and 0.25 A, 24-V dc.
  3. Type: Electrically supervised pressure supervisory switch
  4. Pressure Rating: 250 psig.
  5. Design Operation: Rising pressure signals excessive supervisory gas pressure within the system piping, with lowering pressure signals lack of gas pressure within the system piping.
- F. Valve Supervisory Switches:
1. Standard: UL 346.
  2. Type: Electrically supervised.
  3. Components: Single-pole, double-throw switch with normally closed contacts and tamperproof cover.
  4. Design: Signals that controlled valve is in other than fully open position.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION GENERAL**

- A. Install in accordance with manufacturer's instructions.

#### **3.2 PREPARATION**

- A. Perform fire hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

#### **3.3 WATER SUPPLY CONNECTION**

- A. Connect sprinkler piping to water service piping for service entrance to building. Do not connect to underground supply until provided with written documentation that piping has been flushed and pressure tested in accordance with NFPA 13. Comply with requirements for exterior piping in Division 21 Section 211100 "Fire Suppression Water Service Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Division 21 Section 211100 "Fire Suppression Water Service Piping."
- C. Wet pipe systems shall be equipped with a listed relief valve not less than  $\frac{1}{2}$ -inch in size and set to operate at 175 psi or 10 psi in excess of the maximum system pressure, whichever is greater.

#### **3.4 PIPE APPLICATIONS**

- A. Piping Below Grade: Refer to Division 21 Section 211100 "Fire Suppression Water Service Piping."
- B. Piping Above Grade: Refer to Division 21 Section 210515 "Basis Fire Suppression Piping Materials and Methods."

**3.5 PIPING INSTALLATIONS**

- A. Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for general fire suppression piping installation requirements.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Hangers and Supports: Comply with the requirements of NFPA 13. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Provide protection from damage where subject to earthquake if required by the applicable building code, designed in accordance with NFPA 13. Locate hangers at or directly adjacent to the joist panel points. Provide two nuts on threaded supports to securely fasten the support.
- D. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve. Test connections may also serve as drain pipes.
- E. Install pressure gauge on the riser or feed main at or near each test connection. Provide pressure gauge with a connection not less than 1/4 inch and having a soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.
- F. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- G. Drain dry-type sprinkler system piping.
- H. Fill wet-type sprinkler system piping with water.
- I. Connect nitrogen compressor to the following piping and wiring:
  - 1. Pressure gauges and controls.
  - 2. Electrical power system.
  - 3. Fire-alarm devices, including high- and low-pressure alarm.
- J. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods"
- K. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods."

**3.6 PIPE JOINT CONSTRUCTION**

- A. Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for general pipe joint construction requirements.

**3.7 VALVE AND SPECIALTIES INSTALLATION**

- A. Install listed fire protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable water supply sources.

**3.8 SPRINKLER INSTALLATIONS**

- A. Use proper tools to prevent damage during installations.

- B. Install sprinklers in suspended ceilings in center of acoustical ceiling panels, in a symmetrical pattern with lights and outlets.
- C. Install sprinklers in a symmetrical pattern with lights and outlets in all other areas with ceilings.
- D. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- E. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.
- F. Do not install more than one sprinkler on a one inch outlet unless hydraulic calculations are included to verify performance.

### **3.9 IDENTIFICATION**

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and Division 21 Section 210553 "Identification for Fire Suppression Piping and Equipment."
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### **3.10 FIELD QUALITY CONTROL**

- A. Perform required tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Start and run compressors.
  - 6. Coordinate with fire alarm tests. Operate as required.
  - 7. Coordinate with fire pump tests. Operate as required.
  - 8. Verify that equipment hose threads are same as local fire department equipment.
- C. Replace piping system components that do not pass the test procedures specified, and retest repaired portion of the system.

### **3.11 CLEANING**

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

### **3.12 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

### **3.13 COMMISSIONING**

- A. Sprinkler Systems: Test per NFPA 13, NFPA 25 and local authorities requirements. Submit Contractor's Material & Test Certificates for Above Ground Piping. Submit certificates of completion to Authority Having Jurisdiction and Owner.
  - 1. After completion of all installation, tests, etc., and prior to the opening date, the Sprinkler Subcontractor shall instruct the building personnel in the operation of the sprinkler system. Special care shall be taken to make sure the building personnel:

- a. Will immediately recognize whether the system control valves are in an 'Open' position or a 'Closed' position.
  - b. Will know how to drain the system.
  - c. Will know how to test the flow switches, tamper switches and alarm system.
  - d. Will know how to test the dry pipe valve.
  - e. Will know how to make complete weekly inspection.
  - f. Will know how to perform periodic maintenance of the Fire Sprinkler System.
- B. Fire Alarm Equipment: Test per NFPA 25, NFPA 72 and local authorities requirements in the presence of the Owner. Submit certificates of completion to authority having jurisdiction and Owner.

END OF SECTION

**SECTION 21 31 13 - ELECTRIC-DRIVE CENTRIFUGAL FIRE PUMPS****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. The extent of this fire pump system shall be as specified herein. Contractor shall be responsible for preparation of design drawings, hydraulic calculations, fabrication and installation for complete fire pump system for the building.
- B. Section Includes:
  - 1. Horizontal split case fire pumps.
  - 2. Fire pump accessories and specialties.
  - 3. Flowmeter systems.
  - 4. Controllers for fire pump drivers.
  - 5. Pressure-maintenance pumps.
  - 6. Controllers for pressure-maintenance pumps.
  - 7. Remote alarm panels.
- C. Related Sections:
  - 1. Division 21 Section 210010 "General Fire Suppression Requirements" for requirements for hydraulic calculations, obtaining electronic drawings files, shop drawings and record drawings.
  - 2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
  - 3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
  - 4. Division 21 Section 210553 "Identification for Fire Suppression Piping and Equipment" for labeling and identification of installed fire suppression equipment.
  - 5. Division 21 Section 211100 "Fire Suppression Water Service Piping" for fire suppression piping starting 5 feet outside the building to within the building.
  - 6. Division 21 Section 211200 "Fire Suppression Standpipes" for fire-suppression standpipes inside the building.
  - 7. Division 21 Section 211313 "Water Based Fire Suppression Systems" for fire suppression sprinkler systems inside the building.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig minimum unless higher pressure rating is indicated.

**1.3 SYSTEM DESCRIPTION**

- A. General: Provide an electric, fire booster pump, complete with jockey pump, fire and jockey pump controllers and all necessary equipment and accessories to supply the sprinkler and/or standpipe system. The fire booster pump, associated equipment and piping shall be installed where indicated on the Drawings. Provide in accordance with the latest issue of NFPA 20.
- B. Pump Conditions: Remote indication of all monitor switches, circuit breaker open, low pump room temperature (below 45°F), power failure, phase reversal, pump running, and all signals required by NFPA 20. Reference: Division 26 Section "Wiring Devices."
- C. Quality Assurance: Pump manufacturer shall have unit responsibility for proper operation of the complete unit, and provide services of a factory trained technician to supervise installation, and to attend final field acceptance tests.

- D. Operation: The fire booster pump shall be connected to an automatic water supply and supply the fire sprinkler and/or standpipe system(s). Fire pump shall be automatic starting following pressure loss within the sprinkler system. All drains shall be piped to the exterior of the building.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed.
- B. Shop Drawings: For fire pumps, motor drivers, controllers, and fire pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Product Certificates: For each fire pump, from manufacturer.
- D. Source quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire pumps to include in operation and maintenance manuals.
- B. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
- C. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor-based logic controls.
- D. Field quality-control reports to include pump acceptance test documentation.

#### 1.6 QUALITY ASSURANCE

- A. Contractor shall be responsible for all permits and fees associated with preparation and approval of Drawings and the installation and approval of a fire booster pump.
- B. Tests and Inspections: Arrange, test, and pay for all tests required by code and authorities having jurisdiction.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."
- E. Source Limitations: Obtain fire pump controllers and all associated equipment from single source or producer.

#### 1.7 DELIVERY STORAGE AND HANDLING

- A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, protect controllers from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and combustible materials from inside controllers.

**1.8 PROJECT CONDITIONS**

- A. Ambient Temperature Rating: Not less than 40 deg F (5 deg C) and not exceeding 122 deg F (50 deg C) unless otherwise indicated.

**1.9 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate layout and installation of controllers with other construction including conduit, piping, fire pump equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels. Ensure that controllers are within sight of fire pump drivers.

**PART 2 - PRODUCTS****2.1 GENERAL REQUIREMENTS FOR CENTRIFUGAL FIRE PUMPS**

- A. General: UL 448, factory-assembled and -tested, electric-drive, centrifugal fire pumps capable of furnishing not less than 150 percent of rated capacity at not less than 65 percent of total rated head and with shutoff head limited to 120 percent of total rated head.
  - 1. Finish: Manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.
  - 2. Nameplate: Complete with capacities, characteristics, and other pertinent data.
- B. Base: Fabricated and attached to fire pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.

**2.2 HORIZONTALLY MOUNTED SINGLE-STAGE SPLIT-CASE FIRE PUMPS**

- A. Available Manufacturers:
  - 1. A-C Pump; ITT Industries.
  - 2. Armstrong Darling, Inc.
  - 3. Aurora Pump; Pentair Pump Group.
  - 4. Fairbanks Morse; Pentair Pump Group.
  - 5. Patterson Pump Company.
  - 6. Peerless Pump; Grundfos Group.
- B. Pump:
  - 1. Standard: UL 448, for split-case pumps for fire service.
  - 2. Casing: Axially split-case, cast iron with ASME B16.1 pipe-flange connections.
  - 3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
  - 4. Wear Rings: Replaceable bronze.
  - 5. Shaft and Sleeve: Steel shaft with bronze sleeve.
    - a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
    - b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
  - 6. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
- C. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
- D. Driver: open drip-proof, squirrel-cage, induction motor complying with NFPA 20 and NFPA 70. Include wiring compatible with controller used.
  - 1. Standard: UL 1004A.
  - 2. Type: Electric motor; NEMA MG 1, polyphase Design B.
  - 3. .

### 2.3 FIRE PUMP ACCESSORIES AND SPECIALTIES

- A. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire pump casing.
- B. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge.
- C. Relief Valves:
  - 1. Description: UL 1478, bronze or cast-iron, spring loaded; for installation in fire suppression water supply piping.
- D. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.
- E. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.
- F. Hose Valve Manifold Assembly:
  - 1. Standard: Comply with requirements in NFPA 20.
  - 2. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
  - 3. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
  - 4. Automatic Drain Valve: UL 1726.
  - 5. Manifold:
    - a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
    - b. Body: Flush type, brass or ductile iron, with number of outlets required by NFPA 20.
    - c. Nipples: ASTM A 53/A 53M, Schedule 40, galvanized steel pipe with ends threaded according to ASME B1.20.1.
    - d. Adapters and Caps with Chain: Brass or bronze, with outlet threaded according to NFPA 1963.
    - e. Escutcheon Plate: Brass or bronze; rectangular.
    - f. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963.
    - g. Exposed Parts Finish: Rough
    - h. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

### 2.4 FLOWMETER SYSTEMS

- A. Description: UL-listed, fire pump flowmeter system with capability to indicate flow to not less than 175 percent of fire pump rated capacity.
- B. Pressure Rating: 175 psig minimum.
- C. Sensor: Annubar probe, orifice plate, or venturi unless otherwise indicated. Sensor size shall match pipe, tubing, flowmeter, and fittings.
- D. Permanently Mounted Flowmeter: Compatible with flow sensor; with dial not less than 4-1/2 inches in diameter. Include bracket or device for wall mounting.
  - 1. Tubing Package: NPS 1/8 or NPS 1/4 soft copper or plastic tubing with copper or brass fittings and valves.

### 2.5 FIRE PUMP CONTROLLERS

- A. Available Manufacturers:
  - 1. Cutler-Hammer.
  - 2. Firetrol, Inc.
  - 3. Hubbell Industrial Controls, Inc.
  - 4. Joslyn Clark.
  - 5. Master Control Systems, Inc.
  - 6. Metron, Inc.
  - 7. Tornatech, Inc.



- B. General Requirements for Full-Service Controllers:
  - 1. Comply with NFPA 20 and UL 218.
  - 2. Listed by an NRTL for electric-motor driver for fire pump service.
  - 3. Combined automatic and manual operation.
  - 4. Factory assembled, wired, and tested; continuous-duty rated.
- C. Enclosure:
  - 1. Fire Pump Controllers, ATS, Remote Alarm Panels, and Low-Suction-Shutdown Panels: NEMA 250, to comply with environmental conditions at installed locations and NFPA 20.
    - a. Indoor, Dry and Clean Locations: Type 2.
  - 2. Enclosure Color: Manufacturer's standard "fire pump controller red"
  - 3. Nameplates: Comply with NFPA 20; complete with capacity, characteristics, approvals, listings, and other pertinent data.
- D. Method of Starting:
  - 1. Pressure switch actuated.
    - a. Water pressure actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire suppression piping.
    - b. Programmable minimum-run-time relay to prevent short cycling.
    - c. Programmable timer for weekly tests.
    - d. Controller Sensing Pipes: Fabricate pipe and fittings according to NFPA 20 with nonferrous-metal sensing piping, NPS 1/2, with globe valves for testing controller mechanism from system to pump controller as indicated. Include bronze check valve with 3/32-inch orifice in clapper or ground-face union with noncorrosive diaphragm having 3/32-inch orifice.
  - 2. Solid-State Controller: Reduced-voltage type.
  - 3. Emergency Start: Mechanically operated start handle that closes and retains the motor RUN contactor independent of all electric or pressure actuators.
- E. Method of Stopping: Manual
- F. Rate controllers for scheduled fire pump horsepower and short-circuit withstand rating at least equal to short-circuit current available at controller location. Take into account cable size and distance from substation or supply transformers.
- G. Method of Isolation and Overcurrent Protection: Interlocked isolating switch and non-thermal MCCB; with a common, externally mounted operating handle, and providing locked-rotor protection. Provide with a voltage surge arrestor.
- H. Door-Mounted Operator Interface and Controls:
  - 1. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
  - 2. Method of Control and Indication:
    - a. Microprocessor-based logic controller, with multiline digital readout.
    - b. Membrane keypad.
    - c. LED alarm and status indicating lights.
- I. Local and Remote Alarm and Status Indications:
  - 1. Power on.
  - 2. Motor running condition.
  - 3. Loss-of-line power.
  - 4. Line-power phase reversal.
  - 5. Line-power single-phase condition.
- J. Audible alarm, with silence push button.
- K. Manual START and STOP push buttons or switches.
- L. Nameplate: Complete with capacity, characteristics, approvals and listings, and other pertinent data.

- M. Automatic Transfer Switch (ATS)
1. Complies with NFPA 20, UL 218, and UL 1008.
  2. Integral with controller as a listed combination fire pump controller and power transfer switch.
  3. Automatically transfers fire pump controller from normal power supply to alternate power supply in event of power failure.
  4. Allows manual transfer from one source to the other.
  5. Alternate-Source Isolating and Disconnecting Means: Integral molded-case switch, with an externally mounted operating handle.
  6. Local and Remote Alarm and Status Indications:
    - a. Normal source available.
    - b. Alternate source available.
    - c. In normal position.
    - d. In alternate position.
    - e. Isolating means open.
  7. Audible alarm, with silence push button.
  8. Nonautomatic (manual, nonelectric) means of transfer.
  9. Engine test push button.
  10. Start generator output contacts.
  11. Timer for weekly generator tests.

## 2.6 PRESSURE MAINTENANCE PUMPS

- A. Available Manufacturers:
1. Aurora Pump; Pentair Pump Group.
  2. Crane Pumps & Systems, Inc.
  3. Fairbanks Morse; Pentair Pump Group.
  4. MTH Tool Co., Inc.
  5. Paco Pumps, Inc.
  6. Grundfos, Grundfos Group
- B. Description: Factory-assembled and -tested, vertical, multistage, open-line-shaft turbine pump as defined in HI 2.1-2.2 and HI 2.3; with pump motor mounted above pump head. Include base.
- C. Pump Construction:
1. Pump Head: Cast-iron, for surface discharge, with flange except connections may be threaded in sizes in which flanges are not available.
  2. Pump Head Seal: Stuffing box and stuffing.
  3. Line Shaft: Stainless steel or steel, with corrosion-resistant shaft sleeves.
  4. Line Shaft Bearings: Rubber sleeve, water lubricated.
  5. Impeller Shaft: Monel metal or stainless steel.
  6. Bowl Section: Multiple cast-iron bowls with closed-type bronze or stainless steel impellers.
- D. Motor:
1. Single speed with permanently lubricated ball bearings.
    - a. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- E. Base: Cast-iron or steel with hole for electrical cable.
- F. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

## 2.7 CONTROLLERS FOR PRESSURE-MAINTENANCE PUMPS

- A. Available Manufacturers:
1. Cutler-Hammer.
  2. Firetrol, Inc.

3. Hubbell Industrial Controls, Inc.
  4. Joslyn Clark.
  5. Master Control Systems, Inc.
  6. Metron, Inc.
- B. General Requirements for Pressure-Maintenance-Pump Controllers:
1. Type: UL 508 factory assembled, wired, and tested, across-the-line; for combined automatic and manual operation.
  2. Enclosure: UL 508 and NEMA 250, Type 2 for wall mounting.
  3. Factory assembled, wired, and tested.
  4. Finish: Manufacturer's standard color paint.
- C. Rate controller for scheduled horsepower and include the following:
1. Fusible disconnect switch.
  2. Pressure switch.
  3. Hand-off-auto selector switch.
  4. Pilot light.

## 2.8 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
1. Characteristics: Nonshrink and recommended for interior and exterior applications.
  2. Design Mix: 5000-psi, 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## 2.9 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."
1. Verification of Performance: Rate fire pumps according to UL 448.
- B. Testing: Test and inspect fire pump controllers according to requirements in NFPA 20 and UL 218.
1. Verification of Performance: Rate controllers according to operation of functions and features specified.
- C. Fire pumps will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements and for conditions affecting performance.
- B. Examine roughing-in for fire suppression piping systems to verify actual locations and size of piping connections before fire pump installation.
- C. Examine equipment before installation. Reject equipment that is wet or damaged by moisture or mold or physically damaged.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Fire Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
- B. Provide direct feed power supply to fire pump controller from power source with no fuses or breakers in the circuit. See Electrical Specifications for electrical diagram submittal requirements.
- C. Locate controller as close to motor as practical and within sight. Provide controller with suitable protection as necessary to protect against water escaping from pump or connections. Elevate controller minimum of 12-inches above finished floor.
- D. Install pumps and controllers to provide access for periodic maintenance including removal of motors, impellers, couplings, and accessories. Provide no less than minimum as recommended by manufacturer.
- E. Equipment Mounting:
  - 1. Install fire pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Division 03.
- F. Install fire pump suction and discharge piping equal to or larger than sizes required by NFPA 20.
- G. Support piping and pumps separately so weight of piping does not rest on pumps.
- H. Install valves that are same size as connecting piping. Comply with requirements for fire protection valves specified in Section 210515 "Basic Fire Suppression Piping Materials and Methods".
- I. Install pressure gauges on fire pump suction and discharge flange pressure-gauge tappings. Comply with requirements for pressure gauges specified in Section 210515 "Basic Fire Suppression Piping Materials and Methods".
- J. Install piping hangers and supports, anchors, valves, gauges, and equipment supports according to NFPA 20.
- K. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
- L. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- M. Install flowmeters and sensors. Install flowmeter system components and make connections according to NFPA 20 and manufacturer's written instructions.
- N. Install vertical-turbine, pressure-maintenance pumps according to HI 2.4.
- O. Wall-Mounting Controllers: Install controllers on walls with disconnect operating handles not higher than 79-inches above finished floor, and bottom of enclosure not less than 12-inches above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- P. Floor-Mounting Controllers: Install controllers on 4-inch nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than 12-inches above finished floor. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  - 1. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
  - 2. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 3. Install anchor bolts to elevations required for proper attachment to supported equipment.

- Q. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- R. Comply with NEMA ICS 15.

### 3.3 ALIGNMENT

- A. Align pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
- B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
- C. Align piping connections.
- D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

### 3.4 CONNECTIONS

- A. Comply with requirements for piping and valves specified in Section 210515 "Basic Fire Suppression Piping Materials and Methods". Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.
- C. Connect relief valve discharge to drainage piping or point of discharge.
- D. Provide drains for bases and seals, piped to and discharging into floor drains.
- E. Connect flowmeter system meters, sensors, and valves to tubing.
- F. Connect fire pumps and pressure-maintenance pump to their controllers.
- G. Connect controllers to their dedicated pressure-sensing lines.
- H. Provide for fire pump controller connection to building fire-alarm system. Refer to Division 28, "Fire Detection and Alarm".

### 3.5 IDENTIFICATION

- A. Identify system components. Comply with requirements for fire pump marking according to NFPA 20.

### 3.6 FIELD QUALITY CONTROL

- A. Test each fire pump with its controller as a unit. Comply with requirements for electric-motor driver fire pump controllers.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Final Checks before Startup: Perform the following preventive maintenance operations and checks:
  - 1. Lubricate oil-lubrication-type bearings.
  - 2. Disconnect coupling and check electric motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.

3. Verify that pump is free to rotate by hand. If pump is bound or if it drags even slightly, do not operate until cause of trouble is determined and corrected.
  4. Inspect and Test each controller component:
    - a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
    - b. Test insulation resistance for each element, component, connecting supply, feeder, and control circuits.
    - c. Test continuity of each circuit.
- D. Tests and Inspections:
1. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
  2. Test according to NFPA 20 for acceptance and performance testing.
  3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  5. Verify and Test each Electric-Driver Controller:
    - a. Verify that voltages at controller locations are within plus 10 or minus 1 percent of motor nameplate rated voltages, with motors off. If outside this range for any motor, notify Engineer before starting the motor(s).
    - b. Test each motor for proper phase rotation.
  6. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  7. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.
  8. Prepare test and inspection reports.
- E. Field Acceptance Tests:
1. Do not begin field acceptance testing until suction piping has been flushed and hydrostatically tested and the certificate for flushing and testing has been submitted to Engineer and authorities having jurisdiction.
  2. Prior to starting, notify authorities having jurisdiction of the time and place of the acceptance testing.
  3. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire pump test water. Hoses are for tests only and do not convey to Owner.
  4. Furnish all equipment required to conduct field acceptance tests to include play pipes, hose monsters, pitot tubes, gauges, ammeter, voltmeter, tachometer, etc.

### 3.7 ADJUSTING

- A. Adjust controllers to function smoothly and as recommended by manufacturer.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, and timers.
- C. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- D. Set field-adjustable pressure switches.

### 3.8 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

**3.9 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



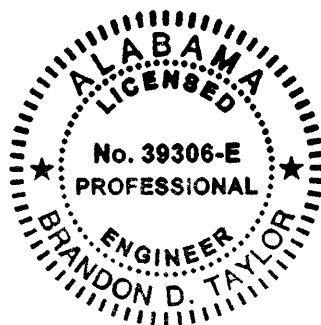
**SECTION 22 00 00 - DIVISION 22 TABLE OF CONTENTS**

**TABLE OF CONTENTS**

**DIVISION 22 - PLUMBING SPECIFICATION**

220010	GENERAL PLUMBING REQUIREMENTS
220015	COORDINATION
220500	COMMON WORK RESULTS FOR PLUMBING
220513	COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT
220515	BASIC PIPING MATERIALS AND METHODS
220519	METERS AND GAUGES FOR PLUMBING PIPING
220523	GENERAL-DUTY VALVES FOR PLUMBING PIPING
220529	HANGERS AND SUPPORTS FOR PLUMBING PIPING
220533	HEAT TRACING FOR PLUMBING PIPING
220553	IDENTIFICATION FOR PLUMBING PIPING & EQUIPMENT
220700	PLUMBING INSULATION
221100	WATER DISTRIBUTION PIPING & SPECIALTIES
221111	MECHANICALLY JOINED PLUMBING PIPING SYSTEMS
221114	STAINLESS STEEL WATER DISTRIBUTION PIPING AND SPECIALTIES
221115	CPVC WATER DISTRIBUTION SYSTEMS AND SPECIALTIES
221123	DOMESTIC WATER PUMPS
221300	SANITARY DRAINAGE & VENT PIPING & SPECIALTIES
221328	CONDENSATE PUMPS FOR HVAC EQUIPMENT
221400	STORM DRAINAGE PIPING & SPECIALTIES
221489	SUMP PUMPS
223400	FUEL FIRED DOMESTIC WATER HEATERS
224000	PLUMBING FIXTURES
227000	NATURAL GAS SYSTEMS

END OF DIVISION 22 TABLE OF CONTENTS



12/11/2024

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 00 10 - GENERAL PLUMBING REQUIREMENTS****PART 1 - GENERAL REQUIREMENTS****1.1 DESCRIPTION OF WORK**

- A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
- B. Division 22 of the Specifications and Drawings numbered with prefixes P, MP and EP, or MEP generally describe these systems, but the scope of the Plumbing work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.
- C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

**1.2 QUALITY ASSURANCE**

- A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.
- B. All work shall be installed in strict conformance with manufacturer's requirements, recommendations, and installation instructions. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.
- C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.
- D. Unless specified otherwise, manufactured items shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this project.

**1.3 CODES REFERENCES AND STANDARDS**

- A. Execute Work in accordance with the National Fire Protection Association and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.
- B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient

time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.

- C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.
- D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes:

IBC	International Building Code – 2021
IMC	International Mechanical Code – 2021
IPC	International Plumbing Code – 2021
IFGC	International Fuel Gas Code - 2021
IECC	International Energy Conservation Code – 2015
ADA	American Disabilities Act
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
AHRI	Airc Conditioning, Heating and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
ETL	Electrical Testing Laboratories
FGI	Facilities Guideline Institute
HI	Hydraulic Institute
MSS	Manufacturer’s Standardization Society of the Valve and Fitting Industry
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufactures’ Association
OSHA	Occupational Safety and Health Act
PDI	Plumbing and Drainage Institute
UL	Underwriter's Laboratories

- E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.
- F. All Plumbing work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the Plumbing work shall be provided by the Contractor.

#### 1.4 DEFINITIONS

A. General:

1. Furnish: When ‘furnish’, ‘install’, ‘perform’, or ‘provide’ is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
2. Install: The term “install” is used to describe operations at the project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”
3. Provide: The term “provide” means “to furnish and install, complete and ready for the intended use.” When ‘furnish’, ‘install’, ‘perform’, or ‘provide’ is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.

4. **Furnished by Owner or Furnished by Others:** The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
  5. **Engineer:** Where referenced in this Division, "Engineer" is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the "Architect".
  6. **AHJ:** The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
  7. **NRTL:** Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
  8. **Substitution:** Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
    - a. **Substitutions for Cause:** Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
    - b. **Substitutions for Convenience:** Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
  9. **Value Engineering:** A systematic method to improve the "value" of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.
- B. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.
- C. The following definitions apply to excavation operations:
1. **Additional Excavation:** Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
  2. **Bedding:** as used in this Section refers to the compacted sand or pea gravel installed in the bottom of a pipe trench to immediately support a pipe and cover a pipe.
  3. **Subbase:** as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
  4. **Subgrade:** as used in this Section refers to the compacted soil immediately below the slab or pavement system.
  5. **Unauthorized excavation** consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.
  6. **Building Fill:** as used in this section refers to borrowed fill material of rock 1" and larger used to fill foundation excavations.

**1.5 COORDINATION**

- A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.
- B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping and ductwork in the manner anticipated in the design.
- C. The Contractor shall confirm and coordinate the final location and routing of all mechanical, electrical, plumbing, fire protection, control and audio-visual systems with all architectural features, structural components, and other trades. The Contractor shall locate equipment, components, ductwork, piping, conduit, and related accessories to maintain the desired ceiling heights as indicated on the architectural drawings. The Contractor shall inform the Architect of any areas where conflicts may prevent the indicated ceiling height from being maintained. The Contractor shall not proceed with any installation in such areas until the architect has given written approval to proceed or has provided modified contract drawings or written instructions to resolve the apparent conflict.
- D. The Contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finishes actually installed.
- E. The Contractor shall maintain a foreman on the jobsite at all times to coordinate their work with other contractors and subcontractors so that various components of the Plumbing systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the Work in such a manner that the Work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.
- F. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and their subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

**1.6 MEASUREMENTS AND LAYOUTS**

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

**1.7 COORDINATION DRAWINGS**

- A. Coordination Drawings, General: Prepare coordination drawings according to the requirements of individual Sections. Additionally, prepare coordination drawings as required scope of installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one trade.
  - 1. Information shall be project specific and drawn accurately to a scale large enough to resolve conflicts. Do not base coordination drawings on standard dimensional data.

2. Prepare floorplans, sections, elevations, and details as needed to adequately describe relationship of various systems and components.
  3. Clearly indicate functional and spatial relationships of components of all systems specified in the Contract Documents, including but not limited to: architectural, structural, civil, mechanical, electrical, fire protection, and specialty systems.
  4. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
  5. Show location and size of access doors required for access to concealed equipment, fittings, controls, terminations, and cabling.
  6. Indicate required installation sequence to minimize conflicts between entities.
  7. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Contract Administrator indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
  8. The details of the coordination are the responsibility of the Contractor and, where indicated on the Drawings, minor adjustments in raceway routing, device placement, device type, or equipment arrangement are not to be considered changes to the Contract.
- B. Equipment Room Coordination Drawings: In accordance with the submittal procedures outlined within these Specifications, provide dimensioned layouts of electrical equipment locations within electrical rooms/closets, mechanical rooms, generator rooms, and fire pump rooms with equipment drawn to scale and identified therein.
1. Clearly identify all required working clearances and access provisions required for installation and maintenance.
  2. Equipment layouts should be arranged accounting for considerations for required door openings and the clearances required by the equipment manufacturer.
  3. Indicate path to allow for the future removal of each large piece of equipment (up to and including generators and unit sub-station transformers) without removal of non-related equipment or architectural elements.
  4. Include work provided by others routed through the equipment rooms.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
  2. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.
    - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Contract Administrator.
  3. Where the Engineer's digital data files are provided to the Contractor for use in preparing coordination digital data files, the Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings or Specifications.
  4. Submit coordination drawings in accordance with the submittal procedures outlined within these Specifications.

## 1.8 SUBMITTALS

- A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.
- B. Refer to Division 01 for acceptance of electronic submittals. If not specified by Division 01, provide electronic submittals. If Division 01 requires paper submittals, provide the quantity of submittals required, but no fewer than seven (7) sets.

- C. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Contract Administrator and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 01, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Contract Administrator's and Engineer's designated representatives. Contractor shall allow for the Engineer Review Time as specified. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.
- D. Engineer Review Time: Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time or time specified in the Engineer's Agreement with the Client, plus to/from mailing time via the Contract Administrator, plus a duplication of this time for resubmittal if required. Transmit submittals as soon as possible after Notice to Proceed and before Mechanical construction starts.
- E. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.
- F. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division as noted in each individual Section. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.
- G. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.
- H. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.
- I. Refer to individual Sections for additional submittal requirements.
- J. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- K. Submittals shall contain the following information:
  - 1. The project name.
  - 2. The applicable specification section and paragraph.
  - 3. Equipment identification acronym as used on the drawings.
  - 4. The submittal date.
  - 5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
  - 6. Submittals not so identified will be returned to the Contractor without action.
- L. The checking and subsequent acceptance by the Engineer and/or Contract Administrator of submittals shall not relieve responsibility from the Contractor for (1) deviations from Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Contract Administrator prior to implementing any deviation.
- M. Provide welders' qualification certificates.



- N. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.

### 1.9 ELECTRONIC DRAWING FILES

- A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of 200 for a drawing set up to 12 sheets and 15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

### 1.10 SUBSTITUTIONS

- A. Refer to Division 01 and General Conditions for substitutions in addition to requirements specified herein.
- B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.
- D. Request for Substitution:
  - 1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
  - 2. The burden of proof of the merit of the proposed substitution is upon the proposer.
  - 3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:
    - a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
    - b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
    - c. Proposed substitution has received necessary approvals of authorities having jurisdiction.
    - d. Same warranty will be furnished for proposed substitution as for specified Work.
    - e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
    - f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.
- E. Substitution Consideration:
  - 1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
  - 2. No substitution will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.
  - 3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
  - 4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

**1.11 OPERATION AND MAINTENANCE MANUALS**

- A. Refer to Division 01 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.
- B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.
- C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.
- D. Prior to Substantial Completion of the project, furnish to the Architect, for Engineer's review, and for the Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.
- E. Each manual shall contain data listed in Table 5.
- F. Refer to Division 01 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 01, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives.

**1.12 SPARE PARTS**

- A. Provide to the Owner the spare parts specified in the individual sections in Division 22 of this specification. Refer to Table 2 at the end of this section for a list of specification sections in Division 22 that contain spare parts requirements.
- B. Owner or Owner's representative shall initial and date each section line in Table 2 when the specified spare parts for that section are received and shall sign at the bottom when all spare parts have been received.

**1.13 RECORD DRAWINGS**

- A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.
- B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension, from column lines.
- C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.

**1.14 TRAINING**

- A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video tape the training sessions in format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

**1.15 PAINTING**

- A. Exposed ferrous surfaces, including pipe, pipe hangers, equipment stands and supports and exposed insulated piping shall be painted by the Plumbing Contractor using materials and methods as specified under Division 9 of the Specifications; colors shall be as selected by the Architect.
- B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.
- C. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

**1.16 DELIVERY STORAGE AND HANDLING**

- A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.
- B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.
- C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.
- D. The Contractor shall be responsible for the safe storage of their own tools, material and equipment.

**1.17 GUARANTEES AND WARRANTIES**

- A. Refer to Division 01 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.
- B. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.
- C. The following additional items shall be guaranteed:
  - 1. Piping shall be free from obstructions, holes or breaks of any nature.
  - 2. Insulation shall be effective.
  - 3. Proper circulation of fluid in each piping system.
- D. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.
- E. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.
- F. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed to the Owner and stating the commencement date and term. Refer to Table 3 at the end of this section for a list of specification sections in Division 22 that contain special warranties.

**1.18 TEMPORARY FACILITIES**

- A. Refer to Division 01 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.
- B. Temporary Utilities: The types of services required include, but are not limited to, water, sewerage, surface drainage and gas. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.
  - 1. Water: Premises are supplied with water services which may be used in this work: Contractor shall make their own arrangements for water services.
  - 2. Sewer Sediment: Maintain sewers and temporary connecting sewers in a clean, nonclogged condition during construction period.
- C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.
  - 1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.

**1.19 PRO ECT CONDITIONS**

- A. Conditions Affecting Excavations: The following project conditions apply:
  - 1. Maintain and protect existing building services which transit the area affected by selective demolition.
  - 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
- B. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.
- C. Use of explosives is not permitted.
- D. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

**PART 2 - PRODUCTS AND MATERIALS****2.1 SOIL MATERIALS**

- A. Provide clean sand, pea gravel or flowable fill material (per the geotechnical engineer's or structural engineer's recommendations).
- B. Subbase Material: Where applicable, provide natural soils with 10% by volume of rocks less than 2" diameter or artificially crushed aggregate. Corrosive fill materials shall not be utilized. When CL clay, rock, or gravel is used, it shall not be larger than 2 inches in any dimension and be free of debris, waste, frozen materials, vegetable and other deleterious matter.

**EXECUTION**

## 2.2 PERMITS

- A. Secure and pay for permits required in connection with the installation of the Plumbing Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

## 2.3 EXISTING UTILITIES

- A. Schedule and coordinate with the Utility Company, Owner and with the Engineer connection to, or relocation of, or discontinuation of normal utility services from existing utility lines. Premium time required for any such work shall be included in the bid.
- B. Existing utilities damaged due to the operations of utility work for this project shall be repaired to the satisfaction of the Owner or Utility Company without additional cost.
- C. Utilities shall not be left disconnected at the end of a work day or over a weekend unless authorized by representatives of the Owner or Engineer.
- D. Repairs and restoration of utilities shall be made before workmen leave the project at the end of the workday in which the interruption takes place.
- E. Contractor shall include in their bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

## 2.4 EXCAVATION AND BACKFILLING

- A. Refer to Division 01, Division 02, and Division 31, Geotechnical Soils Report and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.
- B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this Division. Excavation shall be in conformance with applicable Division and section of the General Specifications.
- C. Roads, alleys, streets and sidewalks damaged during this work shall be restored to the satisfaction of Authorities Having Jurisdiction.
- D. Trenches close to walks or columns shall not be excavated without prior consultation with the Architect.
- E. Erect barricades around excavations. Provide an adequate number of amber lights on or near the work and keep them burning from dusk to dawn. The Contractor shall be held responsible for any damage that any parties may sustain due to neglecting the necessary precautions when performing the work.
- F. Slope sides of excavations to comply with local, state and federal codes and ordinances. Shore and brace as required for stability of excavation.
- G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
  - 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- H. Install sediment and erosion control measures in accordance with local codes and ordinances.
- I. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and trenches.
  - 1. Do not allow water to accumulate in excavations and trenches. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.

2. Establish and maintain temporary drainage ditches and other diversions outside excavation and trench limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.
- J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
  2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- K. Excavation for Underground Tanks, Basins, and Plumbing Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
  2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.
- L. Trenching: Excavate trenches for Plumbing installations as follows:
1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.
  2. Excavate trenches to depth indicated or required for piping to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
  3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
  4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of pipe. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and pipe.
  5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.
- M. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.
- N. Bedding:
1. Fill bottom of pipe trench and fill unevenness with compacted bedding material to ensure continuous bearing of the pipe barrel on the bearing surface. Additional bedding installation requirements are in the following piping specifications. Compact bedding as described below:
  2. Fill bottom of equipment trench and fill unevenness with compacted sand backfill to ensure continuous bearing of the equipment on the bearing surface. Compact bedding as described below.
- O. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
  2. Under building slabs, use drainage fill materials.
  3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
  4. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support after installation and testing of piping and prior to backfilling and placement of roadway subbase. Coordinate with AHJ for colored concrete requirements.

5. Other areas, use excavated or borrowed materials.
- P. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
  2. Removal of concrete formwork.
  3. Removal of shoring and bracing, and backfilling of voids.
  4. Removal of trash and debris.
- Q. Drainage Fill: Where building fill is used in lieu of natural soils, provide drainage fill as subbase material. Provide filter fabric material to line the trench to support the bedding material and subbase materials to ensure that backfill materials will not segregate within the trench nor create voids and sags within the pipe trench.
- R. Placement and Compaction: Place subgrade backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- S. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- T. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.
- U. Compaction: Place bedding backfill materials in maximum layers of not more than 6 inches loose depth for material compacted by hand-operated tampers. Place subbase backfill materials in maximum layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
1. Use of pneumatic backhoe as compaction method is not allowed as an acceptable process for compaction of excavations or trenches.
  2. For vertical and/or diagonal pipe installations greater than ½" rise/lf, thoroughly support pipes from permanent concrete structures or undisturbed earth at no less than 10-foot intervals, while placing backfill materials, so that pipes are not deflected, crushed, broken, or otherwise damaged by the backfill placement or settlement.
  3. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
  4. Place backfill and/or drainage fill materials evenly adjacent to structures, piping, and equipment to required elevations. Coordinate with Architect and/or Civil Engineer backfill requirements prior to installation. Prevent displacement of pipes and equipment by carrying material uniformly around them to approximately same elevation in each layer or lift.
  5. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 or ASTM D 698 and not less than the following percentages of relative density, determined in accordance with ASTM D 4253, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
    - a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.

- b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
  - c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
- V. Subsidence: Where subsidence occurs at Plumbing installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.
- W. Additional Excavation: Where additional excavation may be required due to unsuitable bearing materials encountered, notify the architect immediately for resolution.

## 2.5 CUTTING AND PATCHING

- A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.
- B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.
- C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work.
- D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.
- E. Patch around openings to match adjacent construction, including fire ratings, if applicable.
- F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.
- G. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Architect.

## 2.6 CLEANING

- A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Plumbing Contractor shall cooperate in maintaining reasonably clean premises at all times.
- B. Immediately prior to the final inspection, the Plumbing Contractor shall clean material and equipment installed under the Plumbing Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

## 2.7 SUBSTANTIAL COMPLETION REVIEW

- A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:
  - 1. Submit complete Operation and Maintenance Manuals.
  - 2. Submit complete Record Drawings.
  - 3. Perform special inspections. Refer to Table 4 at the end of this section for a list of specification sections in Division 22 that contain special inspection requirements.
  - 4. Start-up testing of systems.
  - 5. Removal of temporary facilities from the site.
  - 6. Comply with requirements for Substantial Completion in the "General Conditions".



- B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days notice prior to the review.
- C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.
- D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.
- E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, The Contractor shall reimburse the Architect/Engineer for time and expenses incurred for the visit.
- F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.
- G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.
- H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. The Contractor shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION

TABLE 1: PLUMBING SPECIFICATION SHOP DRAWING SUBMITTAL REQUIREMENTS

SPECIFICATION NUMBER/TITLE		CODE DESIGNATION
220010	General Plumbing Requirements	NONE
220015	Coordination	NONE
220500	Common Work Results For Plumbing	A, B, G, M
220513	Common Motor Requirements For Plumbing Equipment	B
220515	Basic Piping Materials And Methods	B, G
220516	Expansion Fittings And Loops For Plumbing Piping	A, B, F
220519	Meters And Gauges For Plumbing Piping	B, H
220523	General-Duty Valves For Plumbing Piping	B
220529	Hangers And Supports For Plumbing Piping	B, F, G, H
220533	Heat Tracing For Plumbing Piping	A, B, E, F
220550	Vibration Isolation For Plumbing Piping & Equipment	A, B, C, F, I, J
220553	Identification For Plumbing Piping & Equipment	B, L, M
220700	Plumbing Insulation	B, M
221100	Water Distribution Piping & Specialties	B, G, H
221111	Mechanically Joined Plumbing Piping Systems	B, G, H
221114	Stainless Steel Water Distribution Piping and Specialties	B, G, H
221115	CPVC Water Distribution Systems & Specialties	B, G, H
221123	Domestic Water Pumps	A, B, C, E
221300	Sanitary Drainage & Vent Piping & Specialties	B
221328	Condensate Pumps for HVAC Equipment	B, C, E
221400	Storm Drainage Piping & Specialties	B
221489	Sump Pumps	A, B, C, E
223400	Fuel Fired Domestic Water Heaters	B, C, E, F, H, K
227000	Natural Gas Systems	A, B, C, D, F, G

## CODED LEGEND

A	Shop Drawings
B	Product Data and equipment weights
C	Performance Data, Curves, Certificates and Test Data
D	Coordination Drawings
E	Wiring Diagrams and short circuit current ratings
F	Installation Instructions
G	Welder's Certificates
H	Certificates
I	Calculations
J	Special Inspections
K	Special Warranties
L	Material Samples
M	Schedules
N	Recommended Spare Parts List

TABLE 2: SPARE PARTS REQUIREMENTS FOR PLUMBING EQUIPMENT

<u>SECTION NUMBER</u>	<u>RECEIVED/DATE/INITIAL</u>
220553	Identification For Plumbing Piping & Equipment
221100	Water Distribution Piping & Specialties
221111	Mechanically Joined Plumbing Piping Systems
221123	Domestic Water Pumps
221489	Sump Pumps
224000	Plumbing Fixtures
227000	Natural Gas Systems

Owner's Signature

TABLE 3: SPECIAL WARRANTY REQUIREMENTS FOR PLUMBING EQUIPMENT

<u>SECTION NUMBER</u>	<u>RECEIVED/DATE/INITIAL</u>
223400	Fuel Fired Domestic Water Heaters

TABLE 4: SPECIAL INSPECTION REQUIREMENTS FOR PLUMBING EQUIPMENT

<u>SECTION NUMBER</u>	<u>COMPLETED/DATE/INITIAL</u>
220550	Vibration Isolation For Plumbing Piping & Equipment

TABLE 5: PLUMBING SPECIFICATION OPERATION AND MAINTENANCE SUBMITTAL REQUIREMENTS

SPECIFICATION NUMBER/TITLE		CODE DESIGNATION
220500	Common Work Results For Plumbing	B
220513	Common Motor Requirements For Plumbing Equipment	B
220515	Basic Piping Materials And Methods	B
220516	Expansion Fittings And Loops For Plumbing Piping	A, B
220519	Meters And Gauges For Plumbing Piping	B, G, I
220523	General-Duty Valves For Plumbing Piping	B, H, I
220529	Hangers And Supports For Plumbing Piping	B
220533	Heat Tracing For Plumbing Piping	B, C, E, G, I
220550	Vibration Isolation For Plumbing Piping & Equipment	A, B, C
220553	Identification For Plumbing Piping & Equipment	B
220700	Plumbing Insulation	B
221100	Water Distribution Piping & Specialties	A, B, F, H, I
221111	Mechanically Joined Plumbing Piping Systems	A, B, F, H, I
221114	Stainless Steel Water Distribution Piping and Specialties	A, B, F, H, I
221115	CPVC Water Distribution Systems & Specialties	A, B, F, H, I
221123	Domestic Water Pumps	B, C, D, E, G, H, I
221300	Sanitary Drainage & Vent Piping & Specialties	A, B, F
221328	Condensate Pumps for HVAC Equipment	B, C, D
221400	Storm Drainage Piping & Specialties	A, B, F
221489	Sump Pumps	B, C, D, E, G, H, I
223400	Fuel Fired Domestic Water Heaters	B, C, D, E, G, H, I
224000	Plumbing Fixtures	B, E, H, I
227000	Natural Gas Systems	A, B, C, H

## CODED LEGEND

A	As-Built Drawings
B	Product Data
C	Performance Data, Capacities, Curves and Certificates
D	Wiring Diagrams
E	Operating Instructions
F	Test Reports
G	Warranties
H	Recommended Spare Parts List
I	Service and Maintenance Instructions

**SUBSTITUTION REQUEST FORM**

To Project Engineer: \_\_\_\_\_ Request # (GC Determined): \_\_\_\_\_

Project Name: \_\_\_\_\_

Project No/Phase: \_\_\_\_\_ Date: \_\_\_\_\_

Specification Title: \_\_\_\_\_

Section Number: \_\_\_\_\_ Page: \_\_\_\_\_ Article/Paragraph: \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_

Manufacturer: \_\_\_\_\_ Model No.: \_\_\_\_\_

Address: \_\_\_\_\_ Phone: \_\_\_\_\_

History:  New product  1-4 years old  5-10 years old  More than 10 years old

Differences between proposed substitution and specified Work: \_\_\_\_\_

Point-by-point comparative data attached – REQUIRED BY ENGINEER  
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached:  Drawings  Product Data  Samples  
 Tests  Reports  Other: \_\_\_\_\_

Reason for not providing specified item: \_\_\_\_\_

Similar Installation:  
Project: \_\_\_\_\_ Architect: \_\_\_\_\_

Address: \_\_\_\_\_ Owner: \_\_\_\_\_

\_\_\_\_\_ Date Installed: \_\_\_\_\_

Proposed substitution affects other parts of Work:  No  Yes; explain: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

**Substitution Certification Statement:**

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

- ▲ A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
- B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
- C. Proposed substitution does not affect dimensions and functional clearances.
- D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
- E. Same warranty will be furnished for proposed substitution as for specified Work.
- F. Same maintenance service and source of replacement parts, as applicable, is available.
- G. Proposed substitution will not adversely affect other trades or delay construction schedule.
- H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

\_\_\_\_\_  
Submitting Contractor                      Date                      Company

**Manufacturer's Certification of Equal Quality:**

I \_\_\_\_\_ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

\_\_\_\_\_  
Manufacturer's Representative                      Date                      Company

**Engineer Review and Recommendation Section**

Recommend Acceptance       Yes       No  
Additional Comments:       Attached       None

**Acceptance Section:**

\_\_\_\_\_  
Contractor Acceptance Signature                      Date                      Company

\_\_\_\_\_  
Owner Acceptance Signature                      Date                      Company

\_\_\_\_\_  
Architect Acceptance Signature                      Date                      Company

\_\_\_\_\_  
Engineer Acceptance Signature                      Date                      Company



**SECTION 22 00 15 - COORDINATION****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section specifies the basic requirements for electrical components which are an integral part of packaged plumbing equipment. These components include, but are not limited to factory furnished motors, starters, and disconnect switches furnished as an integral part of packaged plumbing equipment.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for plumbing equipment are scheduled on the Drawings.
- C. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

**1.2 SUBMITTALS**

- A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification Sections.

**1.3 QUALITY ASSURANCE**

- A. Electrical components and materials shall be UL labeled.
- B. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section and Division 26.

**PART 2 - PRODUCTS AND MATERIALS****2.1 GENERAL**

- A. The Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Plumbing Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, the Plumbing Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.
- B. Refer to Division 26, "Common Work Results for Electrical" for specification of motor connections
- C. Refer to Division 26, "Enclosed Switches and Circuit Breakers" for specification of disconnect switches.

**PART 3 - EXECUTION****3.1 CONTRACTOR COORDINATION**

- A. Unless otherwise indicated, all motors, equipment, controls, etc. shall be furnished, set in place and wired in accordance with Table 1. Any items not listed but shown on the drawings shall be considered part of the Contract Documents and brought to the attention of the Architect.

- B. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

TABLE 1: ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

ITEM	FURN BY	SET BY	POWER WIRING	CONTROL WIRING
Equipment motors	DIV 22	DIV 22	DIV 26	---
Factory furnished motor starters, contactors and disconnects	DIV 22	DIV 26	DIV 26	DIV 23
Loose motor starters, disconnect switches, thermal overloads and heaters.	DIV 26	DIV 26	DIV 26	DIV 23
Factory assembled control panels	DIV 22	DIV 26	DIV 26	DIV 23
Control relays and transformers	DIV 22	DIV 22	DIV 26	DIV 23
Thermostats (line voltage)	DIV 22	DIV 22	DIV 26	---
Time switches	DIV 22	DIV 22	DIV 26	DIV 23
Remote pressure switches (booster pumps)	DIV 22	DIV 22	---	DIV 23
Temperature control panels	DIV 22	DIV 22	DIV 26	DIV 23
Variable speed drives	DIV 22	DIV 22	DIV 26	DIV 23
Motor and solenoid operated valves	DIV 22	DIV 22	DIV 23	DIV 23

DIV 22 Plumbing Contractor

DIV 26 Electrical Contractor

DIV 23 Building Automation System Contractor, refer to Division 23 Section "Direct-Digital Control for HVAC".

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes limited scope general construction materials and methods for application with Plumbing installations as follows:
1. Access panels and doors in walls, ceilings, and floors for access to Plumbing materials and equipment.
  2. Plumbing equipment nameplate data.
  3. Concrete for bases and housekeeping pads.
  4. Non-shrink grout for equipment installations.
  5. Sleeves for Plumbing penetrations.
  6. Miscellaneous metals for support of Plumbing materials and equipment.
  7. Wood grounds, nailers, blocking, fasteners, and anchorage for support of Plumbing materials and equipment.
  8. Joint sealers for sealing around Plumbing materials and equipment.
- B. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 7 Section "Penetration Firestopping" for material and methods for firestopping systems.
  2. Division 22 Section "Basic piping Materials and Methods" for materials and methods for mechanical sleeve seals.
  3. Division 22 Section "Sanitary Drainage and Vent Piping and Specialties" for indirect drain piping and installation requirements.
  4. Division 23 Section "Direct Digital Controls for HVAC" for integration with building automation system of leak detection system "Water Present" alarm.
  5. Division 26 Section "Common Work Results for Electrical" required electrical devices.
  6. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

**1.2 SUBMITTALS**

- A. General: Submit the following in accordance with Division 01 and Division 22 Section "General Plumbing Requirements".
1. Product data for the following products:
    - a. Access panels and doors.
    - b. Through and membrane-penetration firestopping systems.
    - c. Joint sealers.
  2. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for Plumbing materials and equipment.
  3. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.
  4. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
    - a. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 01 Section "Summary of Work."
  5. Through and Membrane Penetration Firestopping Systems Product Schedule: Submit a schedule for each piping system penetration that includes UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.
    - a. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit

illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

### 1.3 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
  - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
  - 1. Provide UL Label on each fire-rated access door.
- C. Through and Membrane Penetration Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

### 1.4 NOISE CRITICAL SPACES

- A. Many areas of the building, referred to as "noise-critical spaces", require special attention (special acoustical provisions and restrictions). The table below designates the noise-critical spaces; noise levels due to equipment, ductwork, grilles, registers, terminal devices, diffusers, etc., shall permit attaining sound pressure levels in all 8 octave bands in occupied spaces conforming to RC levels per ASHRAE handbook as indicated.

<u>Space</u>	<u>RC Levels</u>
Sound/Lighting Control Rooms	25
A/V Spaces	25
TV Production Studio	25
Meeting/Banquet Rooms	30
Conference Rooms	30

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 ACCESS TO EQUIPMENT

- A. Manufacturer:
  - 1. Bar-Co., Inc.
  - 2. Elmdor Stoneman.
  - 3. JL Industries
  - 4. Jay R. Smith Mfg. Co.
  - 5. Karp Associates, Inc.
  - 6. Milcor
  - 7. Nystrom Building Products
  - 8. Wade
  - 9. Zurn
- B. Access Doors:

1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section "Identification for Plumbing Piping" for labeling of access doors.
2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
3. Access doors must be of the proper construction for type of construction where installed.
4. The exact location of all access doors shall be verified with the Architect prior to installation.
5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
  - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
  - b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
  - c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
  - a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
8. Locking Devices: Flush, screwdriver-operated cam locks.
9. Locking Devices: Where indicated on the drawings or where access panels are installed in locations accessible to the public, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.

## 2.2 PLUMBING EQUIPMENT NAMEPLATE DATA

- A. For each piece of power operated Plumbing equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

## 2.3 CONCRETE EQUIPMENT BASES HOUSEKEEPING PADS

- A. Provide concrete equipment bases and housekeeping pads for various pieces of floor mounted Plumbing equipment.. Concrete equipment bases/housekeeping pads shall generally conform to the shape of the piece of equipment it serves with a minimum 4" margin around the equipment and supports.
- B. Form concrete equipment bases and housekeeping pads using framing lumber or steel channel with form release agent. Chamfer top edges and corners. Trowel tops and sides of each base/pad to a smooth finish, equal to that of the floors.
- C. Concrete equipment bases and housekeeping pads shall be made of a minimum 28 day, 4000 psi concrete conforming to American Concrete Institute Standard Building Code for Reinforced Concrete (ACI 318-99) and the latest applicable recommendations of the ACI standard practice manual. Concrete shall be composed of cement conforming to ASTM C 150 Type I, aggregate conforming to ASTM C33, and potable water. All exposed exterior concrete shall contain 5 to 7 percent air entrainment.
- D. Unless otherwise specified or shown on the structural drawings, reinforce equipment bases and housekeeping pads with No. 4 reinforcing bars conforming to ASTM A 615 or 6x6 – W2.9 x W2.9 welded wire mesh conforming to ASTM A185. Reinforcing bars shall be placed 24" on center with a minimum of two bars each direction.

- E. Provide galvanized anchor bolts for all equipment placed on concrete equipment bases and housekeeping pads or on concrete slabs. Anchor bolts size, number and placement shall be as recommended by the Manufacturer of the equipment.
- F. Concrete equipment bases and housekeeping pads shall have minimum heights in accordance with the following table:

Equipment	Minimum Height
Water Heaters, Water Softeners and Equipment Less than or equal to 20 tons and Other Equipment Not Listed	3-1/2"

## 2.4 GROUT

- A. Provide nonshrink, nonmetallic grout conforming to ASTM C 1107, Grade B, in premixed and factory-packaged containers.
- B. Grout shall have post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement characteristics and shall be as recommended by manufacturer for interior and exterior applications.
- C. Grout shall have 5,000 psi, 28-day compressive strength design mix.

## 2.5 PENETRATIONS

- A. Sleeves:
  1. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.
  2. Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.
- B. Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.
- C. Box Frames: Frames for rectangular openings shall be of welded 12 gauge steel attached to forms and of a maximum dimension established by the Architect. Contractor shall notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

## 2.6 DRIP PANS

- A. Drip pans for pipes in protected areas shall be 20 gauge galvanized steel with 2" lapped and soldered joints. Drip pan shall have a depth of 2" and a width of 6" in addition to the diameter of the associated pipe. Provide 3/4" galvanized pipe with male NPT outlet at low point of drip pan.
- B. Drip pan supports shall be 1/4" X 2" galvanized bar stock welded to the drip pan without holes.

## 2.7 LEAK DETECTION SYSTEM

- A. Leak detection system with Rope style leak sensor and controller capable of connecting to a building automation system with audible and visual alarms for leak detection and cable failure in



all drip pans unless otherwise noted on drawings. Provide with factory 24V DC power supply with power plug, sensing cables, and accessories.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. RLE Technologies #LD1000

## 2.8 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, welded.
- E. Fasteners: Zinc-coated, type, grade, and class as required.

## 2.9 JOINT SEALERS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect from manufacturer's standard colors.
- C. Elastomeric Joint Sealers: Provide the following types:
  1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer. Provide one of the following:
    - a. "Dow Corning 790," Dow Corning Corp.
    - b. "Silglaze II SCS 2801," General Electric Co.
    - c. "Silpruf SCS 2000," General Electric Co.
    - d. "864," Pecora Corp.
    - e. "Rhodia 5C," Rhone-Poulenc, Inc.
    - f. "Spectrem 1," Tremco, Inc.
    - g. "Spectrem 2," Tremco, Inc.
    - h. "Dow Corning 795," Dow Corning Corp.
    - i. "Rhodia 7B," Rhone-Poulenc, Inc.
    - j. "Rhodia 7S," Rhone-Poulenc, Inc.
    - k. "Omniseal," Sonneborn Building Products Div.
  2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, metal or porcelain plumbing fixtures and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes. Provide one of the following:
    - a. "Dow Corning 786," Dow Corning Corp.
    - b. "Sanitary 1700," General Electric Co.
    - c. "898 Silicone Sanitary Sealant," Pecora Corp.
- D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent. Provide one of the following:
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Chem-Calk 600," Bostik Construction Products Div.
    - b. "AC-20," Pecora Corp.
    - c. "Sonolac," Sonneborn Building Products Div.
    - d. "Tremflex 834," Tremco, Inc.

**2.10 ACOUSTICAL SEALANTS**

- A. General: Penetrations by pipes through surfaces that are around and between noise critical spaces shall be sleeved, packed and sealed airtight with foam rod, non-hardening sealant and/or packing material as described herein.
- B. Foam Rod: Foam backer rod shall be closed cell polyethylene suitable for use as a backing for non-hardening sealant.
- C. Non-Hardening Sealant: Sealant for penetrations shall be non-hardening polysulphide type. Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.
- D. Packing Material: Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 pcf (40 kg/m<sup>3</sup>).

**2.11 FIRESTOPPING**

- A. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E 814, or other NRTL acceptable to AHJ. Manufactured by:
  - 1. 3M Corp., Fire Barrier Sealant
  - 2. Hilti
  - 3. Owens Corning, Firestopping Insulation.
  - 4. Pecora, AC-20 FTR
  - 5. RectorSeal
  - 6. Specified Technologies Inc.,
  - 7. United States Gypsum Company SHEETROCK Firecode Compound
  - 8. Tremco, Tremstop Fyre-Sil.

**PART 3 - EXECUTION****3.1 INSTALLATION GENERAL**

- A. Install leak detection systems, access doors and sealants in accordance with manufacturer's installation instructions.

**3.2 INSTALLATION OF ACCESS DOORS**

- A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.

**3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGE**

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor Plumbing materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

**3.4 PREPARATION FOR JOINT SEALERS**

- A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.

- B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

### 3.5 APPLICATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
  - 1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
  - 2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
- B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

### 3.6 PENETRATIONS

- A. New Construction:
  - 1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support piping or ductwork penetrations.
- B. Construction in Existing Facilities:
  - 1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Architect, Owner, or both. Seal sleeves and sleeve seals into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Architect.
- C. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.
- D. The General Contractor will provide only those openings specifically indicated on the Architectural or Structural Drawings as being provided under the General Contractor's work.
- E. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.
- F. Floor sleeves shall be fitted with means for attachment to forms and shall be of length to extend at least two inches above the floor level.
- G. Cut sleeves to length for mounting flush with both surfaces of walls.
- H. Extend sleeves installed in floors 2 inches above finished floor level.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- J. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.
- K. All openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 22 Section "Basic Piping Materials and Methods".

### 3.7 DRIP PANS

- A. Provide drip pans in locations indicated on drawings.
- B. Provide drip pans for piping directly above a two hour rated ceiling of an elevator machine room.

- C. Provide drip pans, only with written approval obtained prior to installation, installed beneath piping above electrical rooms, telecom rooms, data rooms, servers or any other protected area not clearly indicated by drawings.
- D. Provide drip pan supports every 4'-0". Provide ¼" galvanized threaded rods through bar stock on each side of the drip pan and attached with 2 nuts per rod. Attach rods to structure with MSS SP-58 compliant components.
- E. Connect ¾" type "L" copper indirect drain line to drip pan outlet. Route and discharge to receptor with air gap outside of the protected area.
- F. Install leak detection rope in a zig-zag pattern covering entire length and width of the drip pan. Secure rope to pan per manufacturers recommendations.
- G. Mount leak detection controller on wall adjacent to exit of the room above which the drip pan is located unless otherwise indicated on drawings indicated on drawings.
- H. Coordinate disconnect and power supply for leak detection system and 120V dedicated receptacle adjacent to controller with Division 26. Power wiring and receptacles are specified in Division 26 Section "Common Work Results for Electrical" Disconnects are specified in Division 26 Section "Enclosed Switches and Circuit Breakers"
- I. Coordinate interlock of "Water Present" alarm and "Cable Fault alarm with Building Automation System. Refer to Division 23 Section "Direct Digital Controls for HVAC" for integration with building automation system and low voltage power wiring.

### 3.8 LEAK DETECTION SYSTEM FOR WATER HEATERS

- A. Provide leak detection rope all around perimeter of water heater drip pan. Secure rope to pan per manufacturers recommendations.
- B. Mount leak detection system controller where indicated on drawings.
- C. Interlock control panel with building automation system for alarm signal for "Leak at Water Heaters" and "Cable Fault" alarm. Upon receiving leak alarm signal from control panel, building automation system shall energize motorized ball valve "MBV" to close. Motorized ball valve "MBV" is indicated and specified on the drawings. Refer to Division 23 Section "Direct Digital Controls for HVAC" for integration with building automation system and low voltage power wiring.

### 3.9 ACOUSTICAL PENETRATIONS

- A. General: There shall be no direct contact of piping with shaft walls, floor slabs and/or partition. All openings around pipes in the structure surrounding the plumbing equipment and surrounding noise-critical spaces shall be sealed, packed with caulking for the full depth of the penetration, as described herein. This includes all slab penetrations and penetrations of noise critical walls.
- B. Domestic Water, Sewer, Drain and Vent Piping
  - 1. Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. The internal diameter of the sleeve shall be 2 inches larger than the external diameter of the pipe passing through it. After all of the piping is installed in that area, the Contractor shall check the clearance and correct it, if necessary, to within 1/2 inch. Pack the void full depth with packing material sealed at both ends, 1 inch deep, with non-hardening sealant backed by foam rod.

END OF SECTION

**SECTION 22 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes the following:
  - 1. Single phase electric motors.
  - 2. Three phase electric motors.

**1.2 SUBMITTALS**

- A. General: Submit the following in accordance with conditions of contract and Division 1 specification Sections.
  - 1. Product Data: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.

**1.3 QUALITY ASSURANCE**

- A. All motors shall be UL listed.

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. Century
- B. General Electric
- C. Westinghouse
- D. Baldor
- E. Gould

**2.2 GENERAL CONSTRUCTION AND REQUIREMENTS**

- A. Motors Less Than 250 Watts, for Intermittent Service: Provide equipment manufacturer's standard. Motor's need not conform to these specifications.
- B. Electrical Service: All motors shall be supplied in accordance with the following voltage and phase unless noted otherwise on the Drawings.
  - 1. Motors 3/4 HP and Larger: 480 volts, three phase, 60 Hz.
  - 2. Motors 1/2 HP and Smaller: 120 volts, single phase, 60 Hz.
- C. Type:
  - 1. Open drip-proof except where noted otherwise.
  - 2. Motors: Design for continuous operation in 40 degrees C environment.
  - 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
  - 4. Motors with frame sizes 254T and larger: Energy Efficient Type.
- D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

- E. Wiring Terminations:
  - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
  - 2. For fractional horsepower motors, provide flexible conduit connection in end frame. Maximum length of flexible conduit shall be five feet.

### **2.3 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS**

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

### **2.4 SINGLE PHASE POWER - CAPACITOR START MOTORS**

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated ball bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

### **2.5 THREE PHASE POWER - SQUIRREL CAGE MOTORS**

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
- E. Insulation System: NEMA Class B or better.
- F. Drip-proof Enclosure: NEMA Service Factor.
- G. All motors controlled by variable frequency controllers shall have a 1.15 Service Factor.
- H. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- I. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- J. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Division 16 - Motor Controlling Equipment.

- K. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- L. Sound Power Levels: To NEMA MG 1.
- M. Variable Frequency Drive Motors: Motors controlled by variable frequency drives shall be rated for voltage peaks and minimum rise times in accordance with NEMA MG1, Part 31.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Inverter-Duty Motors: Class B temperature rise; Class F insulation.
  - 3. Grounding: Provide shaft grounding system equal to AEGIS SGR Bearing Protection Ring, Inpro/Seal Current Diverter Ring (CDR) or approved equal. Install system in accordance with manufacturer's recommendations.
- N. Nominal Efficiency: Motors shall have minimum efficiency meeting the requirements of the Energy Policy Act of 1992 and as scheduled at full load and rated voltage when tested in accordance with IEEE 112.
- O. Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

## 2.6 CAPACITORS

- A. Furnish capacitors for power factor correction as specified herein on motors furnished under Division 22 that are not connected to variable frequency drives. KVAR size shall be as required to correct motor power factor to 90 percent or better and shall be installed on all motors 1 horsepower and larger, that have an uncorrected power factor of less than 85 percent at rated load.
- B. Features:
  - 1. Individual unit cells.
  - 2. All welded steel housing.
  - 3. Each capacitor internally fused.
  - 4. Non-flammable synthetic liquid impregnated.
  - 5. Craft tissue insulation.
  - 6. Aluminum foil electrodes.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Single phase motors for pumps and air compressors: Capacitor start type.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation.
- C. Check line voltage and phase and ensure agreement with nameplate.

**3.3 NEMA OPEN MOTOR SERVICE FACTOR SCHEDULE**

HP	3600 RPM	1800 RPM	1200 RPM	900 RPM
1/6-1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15
3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
1.5-150	1.15	1.15	1.15	1.15

**3.4 PERFORMANCE SCHEDULE THREE PHASE - OPEN DRIP-PROOF**

HP	RPM(Sync)	NEMA Frame	Minimum Percent Efficiency	Minimum Power Factor
1	1200	145T	80	72
1-1/2	1200	182T	84	73
2	1200	184T	85.5	75
3	1200	213T	86.5	60
5	1200	215T	87.5	65
1	1800	143T	82.5	84
1-1/2	1800	145T	84	85
2	1800	145T	84	85
3	1800	182T	86.5	86
5	1800	184T	87.5	87
1-1/2	3600	143T	82.5	85
2	3600	145T	84	87
3	3600	145T	84	85
5	3600	182T	85.5	86
7-1/2	3600	184T	87.5	88
<b>10</b>	<b>3600</b>	<b>213T</b>	<b>88.5</b>	<b>86</b>
15	3600	215T	89.5	89

**3.5 PERFORMANCE SCHEDULE: THREE PHASE-ENERGY EFFICIENT, TOTALLY ENCLOSED, FAN COOLED**



HP	RPM(Sync)	NEMA Frame	Minimum Percent Efficiency	Minimum Power Factor
1	1200	145T	80	72
1-1/2	1200	182T	85.5	65
2	1200	184T	86.5	68
3	1200	213T	87.5	63
5	1200	215T	87.5	66

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 05 15 - BASIC PIPING MATERIALS AND METHODS****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section specifies piping materials and installation methods common to more than one Section of Division 22 and includes joining materials, piping specialties and basic piping installation instructions.
- B. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 22 Section "Common Work Results for Plumbing," for materials and methods for sleeve materials.

**1.2 DEFINITIONS**

- A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content  $\leq 0.25\%$  per Safe Drinking Water Act as amended January 4th 2011 Section 1417.

**1.3 SUBMITTALS**

- A. Refer to Division 1 and Division 22 Section "General Plumbing Requirements" for administrative and procedural requirements for submittals.
- B. Product Data: Submit product data on the following items:
  - 1. Escutcheons
  - 2. Dielectric Unions
  - 3. Dielectric Waterway Fittings
  - 4. Dielectric Flanges and Flange Kits
  - 5. Mechanical Sleeve Seals
  - 6. Wall Pipes
  - 7. Strainers
  - 8. Flexible Connectors
- C. Quality Control Submittals:
  - 1. Submit welders' certificates specified in Quality Assurance below.
- D. Submit certification that specialties and fittings for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.
- E. Submit a schedule of dissimilar metal joints and dielectric waterway fittings, unions, flanges or flange kits. Include joint type materials, connection method and proposed dielectric waterway fittings, unions and flanges to isolate dissimilar metals. Include minimum and maximum torque requirements for flange connections to valves. Refer to the individual piping system specification sections in Division 22 for specifications for piping materials and fittings relative to that particular system and additional requirements.
- F. Submit certification that fittings and specialties are manufactured in plants located in the United States or certified that they comply with applicable ANSI and ASTM standards.

**1.4 QUALITY ASSURANCE**

- A. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

- B. Welding procedures and testing shall comply with ANSI Standard B31.9 - Standard Code for Building Services Piping and The American Welding Society, Welding Handbook.
- C. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Plumbing Refrigeration.
- D. Pipe specialties and fittings shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.
- E. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution.

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide piping materials and specialties from one of the following:
  - 1. Pipe Escutcheons:
    - a. AWI Manufacturing.
    - b. Keeney Manufacturing Company
    - c. Wal-Rich Corp.
    - d. Jones Stephens Corp.
  - 2. Dielectric Waterway Fittings:
    - a. Elster Perfection Corporation.
    - b. Grinnell Mechanical Products; Tyco Fire Products LP
    - c. Precision Plumbing Products, Inc.
  - 3. Dielectric Unions:
    - a. JOMAR International
    - b. Smith Cooper International
    - c. Watts Regulator Co.
    - d. Zurn Industries
  - 4. Dielectric Flanges and Flange Kits:
    - a. Advance Products & Systems
    - b. Calpico, Inc.
    - c. Pipeline Seal & Insulator, Inc.
    - d. Tampa Rubber and Gasket Co., inc.
    - e. Watts Industries Inc.; Water Products Div.
    - f. Zurn Industries, Inc.; Wilkins Div.
  - 5. Strainers – 2" and smaller:
    - a. Apollo
    - b. Hammond
    - c. Milwaukee
    - d. NIBCO
  - 6. Strainers – 2-1/2" and larger:
    - a. Metraflex Co.
    - b. Watts Regulator Co.
    - c. Zurn Industries, Inc.; Wilkins Div.
  - 7. Mechanical Sleeve Seals:
    - a. Advance Products & Systems
    - b. Calpico, Inc.
    - c. GPT Industries/Link Seal
    - d. Metraflex Co.
    - e. Proco Products, Inc.
  - 8. Metal Flexible Connectors:
    - a. United Flexible, Inc.
    - b. Hyspan

- c. Mason Industries, Inc.
  - d. Mercer Rubber Co.
  - e. Metraflex Co.
  - f. Proco Products, Inc.
  - g. Resistoflex
  - h. Tyler Pipe; Gustin-Bacon Div.
9. Rubber Flexible Connectors:
- a. General Rubber Corp.
  - b. Mason Industries, Inc.
  - c. Mercer Rubber Co.
  - d. Metraflex Co.
  - e. Proco Products, Inc.
  - f. Uniflex, Inc.
10. Wall Pipes
- a. Josam Mfg. Co.
  - b. Smith (Jay R) Mfg. Co.
  - c. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
  - d. Watts Industries, Inc.
  - e. Zurn Industries, Inc.; Hydromechanics Div.

## 2.2 PIPE AND FITTINGS

- A. Refer to the individual piping system specification sections in Division 22 for specifications on piping and fittings relative to that particular system.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

## 2.3 JOINING MATERIALS

- A. Refer to individual Division 22 Piping Sections for special joining materials not listed below.
- B. Welding Materials: AWS D10.12; Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.
- C. Brazing Materials: AWS A5.8; Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.
- D. Soldering Materials: ASTM B32; Refer to individual piping system specifications for solder appropriate for each respective system.
- E. Gaskets for Flanged Joints: ASME B16.21; Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

## 2.4 PIPING SPECIALTIES

- A. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated and of depth adequate to conceal protruding piping. Outside diameter shall completely cover the opening in floors, walls, or ceilings.
- B. Unions:
  - 1. Malleable-iron, Class 150 for low pressure service and class 300 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

2. Bronze, Class 125, with lead free cast bronze body meeting ASTM B584, for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; solder or female threaded ends.
- C. Dielectric Unions: Factory-fabricated with lead free cast bronze body meeting ASTM B584 and galvanized steel body with plastic dielectric gasket, class 125 for low pressure service and class 250 for high pressure service, and appropriate end connections for the pipe materials in which installed (screwed or soldered) to effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.
- D. Dielectric Waterway Fittings: Electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.
- E. Dielectric Flanges and Flange Kits:
  1. Full faced gasket with same outside diameter and bolt hole arrangement as the flange. Pressure rating of 200psi for low pressure service and 400 psi for high pressure service at a continuous operating temperature of 180F.
  2. Steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.
  3. Lead free cast bronze meeting ASTM B584, class 125 solder type or cast iron class 125 threaded type for low pressure service and bronze class 250 solder type or cast iron class 250 threaded type for high pressure service.
- F. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens for 4" and smaller shall be Type 304 stainless steel mesh with 0.062" perforations and screens for 5" and larger shall be Type 304 stainless steel, with 0.125" perforations.
  1. For low pressure applications, cast iron strainers shall have 125 psi working pressure rating and cast bronze strainers shall have 150 psi working pressure rating. For high pressure applications, cast iron strainers shall have 250 psi working pressure rating and cast bronze strainers shall have 300 psi working pressure rating.
  2. Solder Ends, 2" and Smaller: Lead free cast bronze body meeting ASTM B584, screwed screen retainer with centered blowdown fitted with pipe plug.
  3. Threaded Ends, 2" and Smaller: Cast bronze body, screwed screen retainer with centered blowdown fitted with pipe plug.
  4. Flanged Ends, 2-1/2" and Larger: Cast-iron body, with FDA fused epoxy coating, bolted screen retainer with off-center blowdown fitted with pipe plug.
- G. Mechanical Sleeve Seals: Modular Plumbing type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- H. Flexible Connectors: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections.
  1. Stainless-Steel-Hose, Flexible Connectors: For 2" and smaller, corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include ANSI 150# 304 stainless-steel nipples with screwed connections, welded to hose.
  2. Bronze Hose, Flexible Connectors: For 2" and smaller, corrugated bronze inner tubing covered with bronze wire braid. Include ANSI 150# brass nipples with screwed connections, braised to hose.
  3. Stainless-Steel-Hose, Flexible Connectors: For 2-1/2" and larger, corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include ANSI 150# 304 stainless-steel nipples or flanges, welded to hose.

## 2.5 WALL PIPES

- A. Cast-iron sleeve with integral clamping flange with clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

## 2.6 WALL SLEEVES

1. Steel sleeve of schedule 40 pipe meeting ASTM A53B with 2" wide metal plate meeting ASTM A36 welded all around. Hot dip galvanized inside and out.

## PART 3 - EXECUTION

### 3.1 INSTALLATION GENERAL

- A. Install in accordance with manufacturer's installation instructions.

### 3.2 PREPARATION

- A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

### 3.3 INSTALLATIONS

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.
- B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise.
- C. Install piping free of sags and bends and with ample space between piping to permit proper insulation applications.
- D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.
- E. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- G. Support piping from structure. Do not support piping from ceilings, equipment, ductwork, conduit and other non-structural elements.
- H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.
- I. Verify final equipment locations for roughing in.

### 3.4 PIPING PROTECTION

- A. Protect piping during construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

**3.5 PENETRATIONS**

- A. Plumbing penetrations occur when piping penetrate concrete slabs, concrete or masonry walls, or fire / smoke rated floor and wall assemblies.
- B. Provide escutcheons for exposed pipe penetrations of interior floors, walls, ceilings and under cabinets and millwork. Use deep pattern escutcheons where required.
- C. Above Grade Concrete or Masonry Penetrations
  - 1. Provide sleeves for pipes passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:
    - a. Provide schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
    - b. Provide galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 10 gauge (0.1382 inches).
    - c. Provide welded galvanized sheet metal for rectangular sleeves with the following minimum metal thickness:
      - 1) For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 18 gauge (0.052 inches).
      - 2) For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 10 gauge (0.1382 inches).
    - d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.
  - 2. Extend pipe insulation for insulated pipe through floor, wall and roof penetrations, including fire rated walls and floors. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
  - 3. Seal elevated floor, exterior wall and roof penetrations watertight and weathertight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of ½" of sealant.
- D. Underground, Exterior-Wall Penetrations: Provide galvanized steel wall sleeve. Wall sleeve is not required for existing concrete walls with core drilled penetrations. Size wall sleeves to allow for 1-inch or larger, if required by the mechanical sleeve seal manufacturer) annular clear space between pipe and sleeve. Provide mechanical sleeve seal.
  - 1. Use type and number of sealing elements recommended by manufacturer for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
  - 2. Verify sleeve and mechanical sleeve seal installations for damage and faulty work. Verify watertight integrity of sleeves and mechanical sleeve seals installed below grade to seal against hydrostatic water pressure. If sleeve and or sleeve seal are not watertight, provide new wall sleeve and mechanical sleeve seal.
- E. Elevated Floor Penetrations of Waterproof Membrane:
  - 1. Provide cast-iron wall pipes for sleeves, extend top of wall pipe minimum 1" above finish floor. Size wall pipe for minimum ½" annular space between pipe and wall pipe.
  - 2. Extend pipe insulation for insulated pipe through wall pipe. The vapor barrier shall be maintained. Size wall pipe for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
  - 3. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
  - 4. Secure waterproof membrane flashing between clamping flange and clamping ring. Comply with requirements for flashing specified in Division 7 Section "Sheet Metal Flashing and Trim."
  - 5. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.



- F. Interior Foundation Penetrations: Provide sleeves for horizontal pipe passing through or under foundation. Sleeves shall be cast iron soil pipe two nominal pipe sizes larger than the pipe served.
- G. Concrete Slab on Grade Penetrations:
  - 1. Provide schedule 40 PVC pipe sleeves for vertical pressure pipe passing through concrete slab on grade. Sleeves shall be one nominal pipe size larger than the pipe served and two pipe sizes larger than pipe served for ductile iron pipes with restraining rods. Seal water-tight with silicone caulk.
  - 2. Provide ½" thick cellular foam insulation around perimeter of non-pressure pipe passing thru concrete slab on grade. Insulation shall extend to 2" above and below the concrete slab.
- H. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and pipe , using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
  - 1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
- I. Exterior Wall Penetrations: Seal annular space between sleeve and pipe, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant. Cover exterior sealant with grout, minimum ½" thick and paint grout to match exterior color, with color selection by the architect. Refer to Division 07 Section "Joint Sealants" for materials and installation.
  - 1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
- J. Fire / Smoke Rated Floor and Wall Assemblies: Seal around penetrations of fire rated assemblies to maintain fire resistance rating of fire-rated assemblies. Coordinate fire ratings and locations with the architectural drawings. Install sealants in compliance with the manufacturer's UL listing. Refer to Division 22 Section "Common Work Results for Plumbing" for firestoppings and materials.

### 3.6 FITTINGS AND SPECIALTIES

- A. Use fittings for all changes in direction and all branch connections.
- B. Remake leaking joints using new materials.
- C. Install components with pressure rating equal to or greater than system operating pressure.
- D. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, mixing valve, backflow preventer and elsewhere as indicated.
- E. Install unions at the final connection to each piece of equipment adjacent to each isolation valve or valve assembly for connections 2" and smaller. Install unions where indicated elsewhere on the drawings.
- F. Install flanges at the final connection to each piece of equipment, adjacent to each isolation valve or valve assembly in piping 2-1/2" and larger. Install flanges at each valve 2-1/2" and larger.
- G. Install dielectric unions for piping 2" and smaller to connect piping materials of dissimilar metals in dry piping systems (gas) for copper or brass connected to carbon steel, cast or ductile iron.
- H. Install dielectric flanges for piping 2-1/2" and larger to connect piping materials of dissimilar metals in dry piping systems (gas) for copper or brass connected to carbon steel, cast or ductile iron.
- I. Install dielectric unions for piping 2" and smaller to connect piping materials of dissimilar metals in wet piping systems (water) (except do not install dielectric unions in concealed spaces, instead,

install dielectric waterway fittings) for copper or brass connected to carbon steel, cast or ductile iron.

- J. Install dielectric flanges for piping 2-1/2" and larger to connect piping materials of dissimilar metals in wet piping systems (water) (except do not install dielectric unions in concealed spaces, instead, install dielectric waterway fittings) for copper or brass connected to carbon steel, cast or ductile iron.
- K. Install dielectric waterway fittings for piping 2" and smaller for copper or brass pipe connections to carbon steel equipment connections.
- L. Install dielectric flanges for piping 2-1/2" and larger for copper or brass pipe connections to carbon steel equipment connections, steel, ductile iron or cast iron valves and fittings.
- M. Dielectric Flange Installation:
  - 1. Provide brass nipples between the equipment connection and dielectric flange for screwed connections. Provide an iron flange for the equipment side and a bronze flange for the copper or brass piping side of the joint.
  - 2. Provide a bronze flange for the copper or brass piping connection to a cast iron, ductile iron or steel flange.
  - 3. Provide full face gasket with pressure rating equal to system served.
  - 4. At each bolt provide, steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.

### 3.7 JOINTS

- A. Steel Pipe Joints:
  - 1. Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed.
  - 2. Pipe Larger Than 2":
    - a. Weld pipe joints (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31.
    - b. Weld pipe joints of exterior water service pipe in accordance with AWWA C206.
    - c. Install flanges on all valves, apparatus, and equipment. Weld pipe flanges to pipe ends in accordance with ASME B31.9 Code for Building Services Piping. Clean flange faces and install gaskets. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.
- B. Non-ferrous Pipe Joints:
  - 1. Brazed And Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.9 - Standard Code for Building Services Piping and ANSI B9.1 - Standard Safety Code for Plumbing Refrigeration.
  - 2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emory cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
- C. Joints for other piping materials are specified within the respective piping system Sections.

### 3.8 FLEXIBLE CONNECTORS

- A. Install flexible connectors for piping system connections on equipment side of shutoff valves for all Plumbing equipment, pumps, and where indicated on Drawings.
  - 1. Install stainless steel connectors for domestic water copper equipment connections 2" and smaller.

2. Install bronze connectors for non-domestic water copper equipment connections 2" and smaller.
  3. Install flanged stainless steel connectors for flanged equipment connections 2-1/2" and larger.
- B. Install connectors according to manufacturer's recommendations.

### **3.9 PIPE FIELD QUALITY CONTROL**

- A. Testing: Refer to individual piping system specification sections.
- B. Inspection Report Form: Refer to the inspection report form at the end of this section for inspection data to be completed for each piping system. Submit completed forms to the Owner and Engineer.

END OF SECTION

PLUMBING & PLUMBING PIPING SYSTEMS  
INSPECTION REPORT FORM

Project Name:  
Project No:  
General Contractor:  
Inspection Date:

Contractor Project No.  
  
Temperature:

System Inspected

Building:  
Location/Description:  
Service:

Inspection Results

Time of Inspection:

Approval to Insulate:    Y    N  
Approval to backfill    Y    N

Approval to Cover in Wall:    Y    N

Signatures

Witness:  
Witness:  
Witness:

Representing:  
Representing:  
Representing:

Remarks

Contractor Supervisor's signature:

**SECTION 22 05 19 - METERS AND GAUGES FOR PLUMBING PIPING****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes the following types of meters and gauges:
1. Temperature gauges and fittings.
  2. Pressure gauges and fittings.

**1.2 SUBMITTALS**

- A. General: Submit the following in accordance with conditions of Contract and Division 1 Specification Sections.
1. Product data for each type of meter and gauge. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.
  2. Product certificates signed by manufacturers of meters and gauges certifying accuracy under specified operating conditions and products' compliance with specified requirements.
  3. Maintenance data for each type of meter and gauge for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Glass Tube Industrial Thermometers:
    - a. H. O. Trerice Co.
    - b. Marshalltown Instruments, Inc.
    - c. Miljoco Corporation
    - d. Weiss Instruments, Inc.
    - e. Weksler Instruments Corp.
    - f. Winters Instruments
  2. Thermometer Wells: Same as for thermometers.
  3. Pressure Gauges:
    - a. Ametek, U.S. Gauge Div.
    - b. Ashcroft Dresser Industries Instrument Div.
    - c. Ernst Gage Co.
    - d. H. O. Trerice Co.
    - e. Marsh Instrument Co., Unit of General Signal.
    - f. Marshalltown Instruments, Inc.
    - g. Miljoco Corporation
    - h. Weiss Instruments, Inc.
    - i. Weksler Instruments Corp.
    - j. WIKA Instruments Corp.
    - k. Winters Instruments
  4. Pressure Gauge Accessories: Same manufacturers as for pressure gauges.

**2.2 THERMOMETERS GENERAL**

- A. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.
- B. Scale range: Temperature ranges for services listed as follows:
  - 1. Domestic Hot Water: 30 to 240 deg with 2-degree scale divisions (0 to 115 deg C with 1-degree scale divisions).
  - 2. Domestic Cold Water: 0 to 100 deg F with 2-degree scale divisions (minus 18 to 38 deg C with 1-degree scale divisions).

**2.3 GLASS TUBE INDUSTRIAL THERMOMETERS**

- A. Case: Die cast, aluminum finished, in baked epoxy enamel, glass front, spring secured, 9 inches long.
- B. Adjustable Joint: Finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- C. Tube: Non-red color reading, non-toxic organic spirit-filled glass tube, magnifying lens.
- D. Scale: Satin-faced, nonreflective aluminum, with permanently etched markings.
- E. Stem: Copper-plated steel, aluminum or brass, for separable socket, length to suit installation.

**2.4 THERMOMETER WELLS**

- A. Thermometer Wells: Brass or stainless steel, pressure rated to match piping system design pressure; with 2-inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap.

**2.5 PRESSURE GAUGES**

- A. Type: General use, ASME B40.1, Grade A, phosphor bronze bourdon-tube type, bottom connection.
- B. Case: Cast aluminum or stainless steel case, glass lens, 4-1/2-inches diameter.
- C. Connector: Brass, 1/4-inch NPS.
- D. Scale: White coated aluminum, with permanently etched markings.
- E. Accuracy: Plus or minus 1 percent of range span.
- F. Range: Conform to the following:
  - 1. All fluids: 2 times operating pressure.
- G. Liquid-Filled: Provide liquid filled gauges where specified in Part 3 of this section.

**2.6 PRESSURE GAUGE ACCESSORIES**

- A. Snubber: 1/4-inch NPS brass bushing with corrosion-resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure.

**PART 3 - EXECUTION****3.1 THERMOMETERS INSTALLATION**

- A. Install in the following locations and elsewhere as indicated:
  - 1. At inlet and outlet of each domestic water heater.

2. At inlet and outlet of each thermal storage tank.
- B. Thermometer Wells: Install in piping tee where thermometers are indicated, in vertical position. Fill well with oil or graphite and secure cap.

### **3.2 INSTALLATION OF PRESSURE GAUGES**

- A. Install in the following locations, and elsewhere as indicated:
1. Provide liquid-filled gauge at suction and discharge of each pump.
  2. At discharge of each pressure-reducing valve.
  3. At building water service entrance.
- B. Pressure Gauge Needle Valves: Install in piping tee with snubber.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 22 05 23 - GENERAL DUTY VALVES FOR PLUMBING PIPING****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes general duty valves common to most plumbing water distribution piping systems.
  - 1. Special purpose valves are specified in individual piping system specifications.
- B. Contractors Option:
  - 1. The Division 22 contractor may provide mechanically joined plumbing piping systems to connect mechanical joints, couplings, fittings, valves and related components as an option in lieu of, in whole or in part, copper sweat, brazing, threaded or flanged piping methods. Mechanically joined plumbing piping systems to connect plumbing piping where used shall be provided in compliance with specification Section 221111 "Mechanically Joined Plumbing Piping Systems".

**1.2 DEFINITIONS**

- A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content  $\leq 0.25\%$  per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

**1.3 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
  - 1. Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.
- B. Submit certification that valves for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.

**1.4 QUALITY ASSURANCE**

- A. Single Source Responsibility: Provide products specified in this section from the same manufacturer where products are available and conform to the specification requirements.
- B. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the MSS Standard Practices below:
  - 1. MSS SP 67 "Butterfly Valves"
  - 2. MSS SP 70 "Gray Iron Gate Valves, Flanged and Threaded Ends"
  - 3. MSS SP 71 "Gray Iron Swing Check Valves, Flanged and Threaded Ends"
  - 4. MSS SP 72 "Ball Valves with Flanged or Butt Welding Ends"
  - 5. MSS SP 80 "Bronze Gate, Globe, Angle and Check Valves"
  - 6. MSS SP 85 "Gray Iron Globe and Angle Valves, Flanged and Threaded Ends"
  - 7. MSS SP 110 "Ball Valves, Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends"
  - 8. MSS SP 125 "Check Valves: Gray Iron and Ductile Iron, In-Line, Spring Loaded, Center-Guided"

9. MSS SP 139 "Copper Alloy Gate, Globe, Angle and Check Valves for Low Pressure/Low Temperature Plumbing Applications"
- D. Valves shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.
- E. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of valves containing no more than 0.25% lead by weight compliance for valves for domestic water distribution.

## **PART 2 - PRODUCTS AND MATERIALS**

### **2.1 MANUFACTURERS**

- A. Manufacturer: Subject to compliance with requirements, provide products from one of the manufacturers listed in valve schedule.

### **2.2 VALVE FEATURES GENERAL**

- A. Valve Design: Rising stem or rising outside screw and yoke stems.
  1. Non-rising stem valves may be used where headroom prevents full extension of rising stems.
- B. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.
- C. Sizes: Same size as upstream pipe, unless otherwise indicated.
- D. Operators: Provide the following special operator features:
  1. Handwheels, fastened to valve stem, for valves other than quarter turn.
  2. Lever handles, on quarter-turn valves 6-inch and smaller.
  3. Gear drive operators, on quarter-turn valves 8-inch and larger.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- F. End Connections: As indicated in the valve specifications.
  1. Threads: Comply with ANSI B1.20.1.
  2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.
  3. Solder-Joint: Comply with ANSI B16.18.
    - a. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

### **2.3 GATE VALVES**

- A. Gate Valves, 2-1/2-Inch and Larger: Meeting MSS SP-70 and lead free with FDA epoxy coating; Class 125, 200-psi CWP, iron body, lead free bronze mounted, with body and bonnet conforming to ASTM A 126 Class B; with lead free brass stem, with flanged ends, non-asbestos composition packing, and two-piece packing gland assembly.

### **2.4 BALL VALVES**

- A. Ball Valves, 2 Inch and Smaller: Meeting MSS SP 110, Class150, 600-psi CWP; two-piece construction; with ASTM B 584 cast lead free bronze, full port, blowout-proof stem and chrome-plated lead free brass ball with replaceable "Teflon" or "TFE" seats and seals, solder ends and vinyl-covered steel handle.

**2.5 GLOBE VALVES**

- A. Globe Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 300-psi CWP; body, disc and screwed bonnet of ASTM B 584 lead free cast bronze; brass replaceable composition disc and stem of ASTM B 283 alloy C46400 naval brass, brass packing gland, with solder ends, non-asbestos composition packing, and malleable iron handwheel.
- B. Globe Valves, 2-1/2-Inch and Larger: Meeting MSS SP-85; Class 125, 200-psi CWP; iron body and bolted bonnet conforming to ASTM A 126, Class B; with FDA epoxy coating, outside screw and yoke, lead free bronze mounted, lead free bronze shaft, flanged ends, and non-asbestos composition packing, and two-piece backing gland assembly.

**2.6 BUTTERFLY VALVES**

- A. Butterfly Valves, 2-1/2-Inch and Larger: Meeting MSS SP-67 and lead free; 200-psi CWP; lug-type body constructed of ductile iron conforming to ASTM A 536. Provide valves with field replaceable EPDM sleeve/seat, aluminum-bronze disc, 416 stainless steel stem, and EPDM O-ring stem seals. Provide lever operators, (10 position minimum), with lock and stops with locks for sizes 2-1/2 through 6 inches and gear operators with position indicator for sizes 8 inch and larger. Drill and tap valves on dead-end service or requiring additional body strength. Valves must be rated for dead end service at 150 psi with no downstream flange required.

**2.7 CHECK VALVES**

- A. Swing Check Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 200-psi CWP, body and cap of ASTM B 584 cast lead free bronze; with horizontal swing, Y-pattern, disc and disc holder of ASTM B 283 alloy C46400 naval brass; solder ends. Provide valves capable of being reground while the valve remains in the line.
- B. Swing Check Valves, 2-1/2-Inch and Larger: Meeting MSS SP-71 and lead free; Class 125 200-psi CWP, cast iron body and bolted cap conforming to ASTM A 126, Class B; with FDA epoxy coating, horizontal swing, lead free bronze disc with lead free bronze disc face ring, and bronze seat ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.
- C. Wafer Check Valves: Meeting MSS SP 125, Class 125, 200-psi CWP, lead free cast-iron body, with FDA epoxy coating, replaceable bronze seat, and non-slam design lapped and balanced twin bronze flappers and stainless steel trim and torsion spring. Provide valves designed to open and close at approximately one foot differential pressure.
- D. Lift Check Valves, 2-Inch and Smaller: Meeting MSS SP-139; 250-psi CWP, body, disc holder and cap of ASTM B 584 cast lead free bronze; horizontal or angle pattern, lift-type valve, with stainless steel spring, renewable "Teflon" disc and solder ends. Provide valves capable of being refitted and ground while the valve remains in the line.
- E. Silent Check Valves, 2-1/2" and Larger: Meeting MSS SP 125, Class 125, 200-psi CWP, lead free cast-iron body, enamel coating, stainless steel spring, 316 stainless steel set screws, Buna-N O-ring, lead free bronze seat and disc.

**PART 3 - EXECUTION****3.1 INSTALLATIONS**

- A. Install valves in accordance with manufacturer's installation instructions.
- B. Locate valves for easy access and provide separate support where necessary. Provide access doors and fire rated access doors as required.

- C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.
- D. Install three-valve bypass around each pressure reducing valve using throttling-type valves.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. Installation of Check Valves: Install for proper direction of flow as follows:
  1. Swing Check Valves: Horizontal position with hinge pin level.
  2. Wafer Check Valves: Horizontal or vertical position, between flanges.
  3. Lift Check Valve: With stem upright and plumb.

### 3.2 VALVE ENDS SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
  1. Copper Tube Size, 2-Inch and Smaller: Solder ends.
  2. Copper Tube Sizes 2-1/2 Inch and Larger: Flanged ends.

### 3.3 VALVE PRESSURE TEMPERATURE CLASSIFICATION SCHEDULES

- A. Domestic Hot and Cold Water Service

<u>VALVE TYPE</u>	<u>2" AND SMALLER</u>	<u>2-1/2" AND LARGER</u>
Ball	150	200
Butterfly	N/A	200
Gate	N/A	125
Globe	125	125
Check	125	125

### 3.4 VALVE SCHEDULE

- A. Gate Valves - 2-1/2 inch and larger:

<u>MANUFACTURER</u>	<u>OS&amp;Y RS</u>	<u>NRS</u>
Apollo	611F-LFA	610F-LFA

- B. Ball Valves (full port) – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>	<u>THREADED ENDS</u>
Apollo (Conbraco)	77C-LF-200	77C-LF-100
Hammond	UP8311A	UP8301A
Milwaukee	UPBA-450	UPBA-400
NIBCO	S-585-80-LF	T-585-80-LF

- C. Globe Valves - 2-1/2 inch and larger:

<u>MANUFACTURER</u>	<u>STRAIGHT BODY</u>	<u>ANGLE BODY</u>
Apollo	711F-LFA	N/A

## D. Globe Valves – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>
Apollo	120S-LF
Hammond	UP-418
Milwaukee	UP1502
NIBCO	S113

## E. Butterfly Valves (aluminum-bronze disc) - 2-1/2 inch and larger:

<u>MANUFACTURER</u>	<u>LEVER</u>	<u>GEAR</u>
Apollo (Conbraco)	LD141 xx BE1	LD141 xx BE2
Hammond	6411-01	6411-03
NIBCO	LD-2000-3	LD-2000-5
Watts	XXBF-03-121-15	XBF-03-121-1G
xx	Valve Size	

## F. Swing Check Valves – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>	<u>THREADED ENDS</u>
Apollo	161S-LF	161T-LF
Milwaukee	UP1509	UP509
NIBCO	S-413-Y-LF	T-413-Y-LF

## G. Swing Check Valves - 2-1/2 inch and larger – Class 125:

<u>MANUFACTURER</u>	<u>Flanged Ends</u>
Apollo	910F-LFA

## H. Wafer Check Valves – Class 125:

<u>MANUFACTURER</u>	<u>MODEL</u>
Apollo	910WB-LF

## I. Lift Check Valves – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>	<u>THREADED ENDS</u>
Hammond	UP947	UP943
Milwaukee	UP1548T	UP548T
NIBCO	S-480-Y-LF	T-480-Y-LF

## J. Silent Check Valves – 2-1/2" and larger

<u>MANUFACTURER</u>	<u>MODEL</u>
NIBCO	F-910-LF

**3.5 APPLICATION SCHEDULE**

- A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.
- B. Domestic Water Systems: Use the following valve types:
  - 1. Gate Valves, 2-1/2" and larger: Class 125 with cast-iron body.
  - 2. Ball Valves, 2" and Smaller: Class 150, 600-psi CWP, with stem extension if installed in insulated pipe.
  - 3. Globe Valves, 2" and smaller: Class 125, with cast bronze body and bronze or teflon disc.
  - 4. Globe Valves, 2-1/2" and larger: Class 125, with cast iron body and bronze or teflon disc.
  - 5. Butterfly Valves, 2-1/2" and larger 200-psi working pressure with cast or ductile iron body
  - 6. Swing Check, 2" and smaller: Class 125, cast bronze, with rubber seat.
  - 7. Check Valves, 2-1/2" and larger: Class 125, swing or wafer type as indicated.

**3.6 FIELD QUALITY CONTROL**

- A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

**3.7 ADJUSTING AND CLEANING**

- A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.
- B. Inspect valves for leaks after piping systems have been tested and put into service, but before final adjusting and balancing. Adjust or replace packing, as required, on valves with leaks. Replace valve if leak persists.

END OF SECTION

**SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Support and attachment components.
- B. Horizontal-piping hangers and supports.
- C. Shields
- D. Vertical piping clamps
- E. Pipe alignment guides.
- F. Pipe anchors.
- G. Pre-engineered roof supports
- H. Anchors and fasteners.
- I. Miscellaneous materials.
- J. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 22 Section "Plumbing Insulation", for high density insulation for protecting insulation vapor barrier and materials and methods for piping hanger installations.
  - 2. Division 22 "Water Distribution Piping and Specialties", for pipe hanger types and spacing for horizontal and vertical domestic water distribution and heat traced piping of sizes and materials indicated.
  - 3. Division 22 "Sanitary Drainage & Vent Piping and Specialties", for pipe hanger types and spacing for heat traced and cold sanitary piping of sizes and materials indicated.
  - 4. Division 22 "Storm Drainage & Piping and Specialties", for pipe hanger types and spacing for horizontal and vertical storm drainage piping of sizes and materials indicated.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

**1.3 SUBMITTALS**

- A. Product Data : Provide manufacturer's standard catalog pages and data sheets for each type of hanger and support. Include a hanger and support schedule showing manufacturer's figure number, size, location, and features for each hanger and support. Submit style and type to Structural Engineer for approval prior to installation.

- B. Product Certificates: Signed by the manufacturer of hangers and supports certifying the products meet the specified requirements.
- C. Welder Certificates: Signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.
- D. Maintenance Data: For inclusion in Operating and Maintenance manual specified in Division 01 and Division 22 Section "General Plumbing Requirements."
- E. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution. Include dimensions, weights, required clearances, and method of assembly.
  - 1. Application of protective inserts, and shields at pipe hangers for each type of insulation and hanger.
- F. Installer's Qualifications: Include evidence of compliance with specified requirements.
- G. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Deferred Submittals: Submit signed and sealed drawings that indicate the design and installation requirements of pre-engineered roof supports can withstand the design criteria listed in this specification. Include installation requirements for anchoring to the roof structure. The Engineer is not responsible and will not provide the seal and signature. Deliver submittal to the local AHJ for approval prior to installation of the contractor provided, pre-engineered roof supports.

#### **1.4 QUALITY ASSURANCE**

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Field-Welding:
  - 1. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
  - 2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
  - 3. Qualify welding processes and welding operators in accordance with ASME BPVC Section IX, "Welding and Brazing Qualifications."
- D. Flame/Smoke Ratings: Provide hangers and supports with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- F. Deferred Submittals: Signed and sealed by a professional engineer or National Institute for Certification in Engineering Technologies (NICET) stamp and signature. The professional engineer shall be licensed in the same state in which the project is located.

#### **1.5 DELIVERY STORAGE AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

#### **1.6 DEFINITIONS**

- A. Terminology used in this Section is defined in MSS SP-90.



**PART 2 - PRODUCTS AND MATERIALS****2.1 SUPPORT AND ATTACHMENT COMPONENTS**

- A. General Requirements:
1. Comply with MSS SP-58.
  2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of work.
  3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
  4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
  5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
  6. Materials: Products and materials listed in this specification are based on indoor, dry locations. Use corrosion resistant materials suitable for the environment where installed.
    - a. Indoor Dry Locations: Painted carbon steel, galvanized steel or zinc-plated steel. Where supports will be field painted in exposed locations, provide carbon steel.
    - b. Indoor Damp or Wet Locations: Galvanized steel or type 304 stainless steel.
    - c. Hydrotherapy pool environments: Type 316 stainless steel.
    - d. Outdoor Locations: Galvanized steel or type 304 stainless steel.
    - e. Dielectrics Barriers: Provide dielectric barriers between metallic supports and metallic piping and associated items of dissimilar type. Acceptable barriers include rubber, or copper-plated coatings where attachments are in direct contact with copper.
    - f. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    - g. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
    - h. Stainless Steel: Type 304 or 316 in accordance with ASTM A240.
- B. Metal Channel (Strut) Framing Systems:
1. Manufacturers:
    - a. Cooper B-Line.
    - b. Ferguson Enterprises/FNW.
    - c. PHD Manufacturing.
    - d. Thomas & Betts Corporation.
    - e. Unistrut, a brand of Atkore International Inc.
    - f. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
  2. Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
  3. Comply with MSS SP-69, Type 59, MSS SP-89, and MFMA-4. Welds shall comply with AWS D1.1.
  4. Channel Material:
    - a. Indoor Dry Locations: Galvanized steel or zinc-plated steel.
    - b. Indoor Damp or Wet Locations: Galvanized steel or type 304 stainless steel.
    - c. Outdoor Locations: Galvanized steel or type 304 stainless steel.
    - d. Natatorium or other treated pool environments: Type 316 stainless steel.
    - e. All nuts, brackets, and clamps shall have the same finish as the channel.
  5. Minimum Channel Thickness: Steel sheet, 14 gage, 0.0747 inch.
  6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height with factory-punched attachment holes.
  7. Provide plastic galvanic isolators for connecting bare copper pipe for use with pre-engineered support strut system where indicated.

- C. Hanger Rods:
1. Material:
    - a. Indoor Dry Locations: Zinc-plated steel.
    - b. Indoor Damp or Wet Locations or Outdoor Locations: Zinc-plated steel or type 304 stainless steel.
    - c. Natatorium or other treated pool environments: Type 316 stainless steel.
  2. Threaded both ends or continuously threaded.
  3. Minimum Size: Reference piping specification sections for rod thicknesses.
  4. Threaded Rods: Threaded rods are not allowed for floor supports except when the maximum length of the rod is less than 12". Threaded rod sizes shall be the same size diameter as specified for pipe hanger rods based upon pipe size being supported. Refer to system piping specification sections for rod size requirements.

## 2.2 HORIZONTAL PIPING HANGERS AND SUPPORTS

- A. MANUFACTURERS
1. ASC Engineered Solutions.
  2. Cooper B-Line, Inc.
  3. Elite Components
  4. ERICO/Michigan Hanger Co./Caddy
  5. Ferguson/FNW.
  6. Halfen-DEHA.
  7. Hilti.
  8. National Pipe Hanger Corporation.
  9. PHD Manufacturing.
  10. Power-Strut.
  11. Unistrut.
- B. Single Hangers:
1. Split Ring: Carbon steel, adjustable swivel, split ring type.
  2. Split Ring 2 inch and smaller: Copper alloy, split ring type.
  3. Clevis Hanger: Carbon steel, adjustable, clevis type.
  4. Roll Support Hanger: Adjustable steel yoke, cast iron roll.
- C. Trapeze and Strut-mounted Supports:
1. Two-piece clamp: Designed for use with channel strut, held in place at channel shoulder when clamp attachment nut is tightened.
  2. Roll Support: Adjustable cast iron roll attached to metal channel strut framing system with brackets and nuts.
- D. Hangers and strut-mounted supports with pre-manufactured polymer inserts:
1. Manufacturers:
    - a. ASC Engineered Solutions.
    - b. Holdrite.
    - c. Klo-Shure.
  2. Strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts designed to receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation. Metal shields are not required with clevis hangers of this type.
- E. Spring Hangers:
1. Reference Section "Vibration Isolation for Plumbing Piping and Equipment" for spring isolation hangers.
- F. Wall Supports:
1. Two-hole strap, galvanized steel or copper to suit pipe material. Provide rigid insulation between strap and pipe to maintain continuous insulation and vapor barrier where required.

2. Welded steel bracket reinforced with angle or strut. Support pipe from bracket using horizontal pipe hanger or support appropriate for the pipe type.
- G. Floor Supports:
1. Pipe Saddle: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  2. Roller Support: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- H. Pre-Insulated Supports:
1. Manufacturers:
    - a. Aeroflex USA, Inc.
    - b. ASC Engineered Solutions
    - c. Armacell.
    - d. Buckaroos, Inc.
    - e. Cooper B-Line, Inc.
    - f. Pipe Shields, Inc.
  2. General Construction and Requirements:
    - a. Flexible elastomeric insulation with integral high-density pipe support insert shall conform to ASTM C534, Type I.
    - b. Surface Burning Characteristics: Assembly shall have a flame spread index/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
    - c. Waterproof calcium silicate insulation shall conform to ASTM C795.
    - d. Rigid phenolic foam insulation shall conform to ASTM C1126, Type III.
    - e. Insulation inserts shall be surrounded by a 360 degree jacket or shield.
  3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

**2.3 SHIELDS**

- A. Insulation Protection Shield:
1. Sheet metal construction, meeting SP-58 Type 40, of 18 gauge for 5-1/2" inside dimension and smaller, 16 gauge for 6-1/2" to 10-3/4" inside dimension 14 gauge for 11-3/4" to 17" inside dimension, and 12 gauge for 18" to 28" inside dimension.
  2. Shield shall cover half of the circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.
  3. Lengths for pipes greater than 2 inches: Minimum 8 inch long section at each support.
  4. For pipes 2 inch and smaller using fiberglass or flexible elastomeric insulation without pre-insulated supports, provide insulation protection shields installed between hanger and pipe which meets the following minimum length requirements:

Pipe Size (NPS)	Insulation Thickness (inches)	Minimum Shield Length, (in) Hanger Spacing, (ft)					
		5	6	7	8	9	10
≤ 1	0.5	5	6	8	-	-	-
	1	3	5	5	-	-	-
	1.5	3	5	5	-	-	-
	2	3	3	3	-	-	-
	3	3	3	3	-	-	-
≤ 2	0.5	8	8	11	11	12	14
	1	5	6	8	9	11	11
	1.5	5	6	8	8	9	9
	2	5	5	6	6	8	8
	3	5	5	6	6	6	8

- B. 360° Insulation Protection Shield: Shield shall cover all of the circumference of the pipe with two half circumference sections held together with bolts and nuts and shall be of length indicated by manufacturer for pipe size and thickness of insulation.
- C. Plastic Shields:
  - 1. Manufacturers:
    - a. Armacell.
    - b. Eaton.
    - c. Hydra-Zorb.
    - d. PHD Manufacturing.
    - e. Zsi Foster.
  - 2. Polymer-based, snap-on or clip-on design, with non-adhesive surface and lip to allow lateral movement of piping without damaging insulation, field-paintable.

## 2.4 VERTICAL-PIPING SUPPORTS

- A. Manufacturers:
  - 1. ASC Engineered Solutions.
  - 2. Cooper B-Line, Inc.
  - 3. Halfen-DEHA.
  - 4. Hilti.
  - 5. ERICO/Michigan Hanger Co.
  - 6. National Pipe Hanger Corporation.
  - 7. PHD Manufacturing.
  - 8. Power-Strut.
  - 9. Unistrut.
- B. Components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.
  - 1. Components shall have galvanized coatings where installed for piping and equipment that will not have factory applied or field-applied finish.
  - 2. Pipe attachments shall be copper-plated or have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
  - 3. Components as listed below shall be made of 304 stainless steel where installed in corrosive environments and/or where indicated on the drawings.
- C. Riser Clamps with pre-manufactured polymer insert:
  - 1. Manufacturers:
    - a. Hydra-Zorb; Titan Riser Clamp.
    - b. National Pipe Hanger.
    - c. Pipe Hangers, Inc.
- D. Riser clamp with pre-manufactured polymer inserts designed to withstand vertical loading and receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation.

## 2.5 PIPE ALIGNMENT GUIDES

- A. Factory fabricated, constructed of cast semi-steel or heavy fabricated steel when applied to steel pipe and copper when applied to copper. Guide shall consist of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.
  - 1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
  - 2. Pipe Diameter 10 inches and Larger: Roller type.
  - 3. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.

**2.6 PIPE ANCHORS**

- A. Pre-Insulated Anchors: Galvanized steel or stainless steel assembly with high density insulation insert and no metal-to-metal contact.
- B. Anchor Clamps: Assembly with multi-piece clamp, constructed of compatible material with piping or with dielectric barrier.

**2.7 PRE-ENGINEERED ROOF PIPE SUPPORTS**

- A. Manufacturers:
  - 1. Airtec.
  - 2. ASC Engineered Solutions.
  - 3. Cooper B-Line, Inc.
  - 4. Elite Components.
  - 5. ERICO/Michigan Hanger Co./Caddy.
  - 6. Ferguson/FNW.
  - 7. Miro.
  - 8. PHP Systems/Design.
  - 9. PHD Manufacturing.
  - 10. Roof Top Blox.
  - 11. Unistrut, a brand of Atkore International Inc.
  - 12. Zsi Foster.
- B. General: Pre-engineered devices with embedded pipe support fixtures as specified.
- C. Pedestals: Steel pedestals with thermoplastic or rubber base with the following dimensions:
  - 1. Up to 12 inch strut length support: 18 inch x 18 inch.
  - 2. Up to 16 inch strut length support: 24 inch x 18 inch.
  - 3. Up to 24 inch strut length support: 30 inch x 18 inch.
  - 4. Thickness: Minimum 3/16 inch thick.
- D. Block Bases: Closed-cell polyethylene blocks with the following dimensions.
  - 1. Length: Nominal 10 inch, 12 inch, 16 inch, or 24 inch
  - 2. Width: Nominal 4 inches.
- E. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
- F. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

**2.8 ANCHORS AND FASTENERS**

- A. Manufacturers:
  - 1. Hilti, Inc.
  - 2. Illinois Tool Works, Inc.
  - 3. Phillips.
  - 4. Powers Fasteners, Inc.
  - 5. Rawl.
  - 6. Simpson Strong-Tie Company Inc.
- B. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
  - 1. Concrete: Use preset concrete inserts or expansion anchors.
  - 2. Solid or Grout-Filled Masonry: Use expansion anchors.
  - 3. Hollow Masonry: Use toggle bolts.
  - 4. Hollow Stud Walls: Use toggle bolts.
  - 5. Steel: Use beam clamps.

6. Sheet Metal: Use sheet metal screws.
  7. Wood: Use wood screws.
  8. Plastic and lead anchors are not permitted.
  9. Hammer-driven anchors and fasteners are permitted only as follows:
    - a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction.
    - b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction.
- D. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
1. Comply with MFMA-4.
  2. Channel Material: Use galvanized steel.
  3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
  4. Spot Inserts: Carbon steel with zinc plating or galvanized steel body and base plate, with protective sleeve for anchor rod insert, sized to accommodate anchor rod dimensions.
  5. Manufacturers:
    - a. Same as manufacturer of metal channel (strut) framing system.
    - b. DeWalt "Bang-It" concrete inserts.
- E. Beam Clamps: MSS SP-58 C-Type or adjustable, Types 19 through 23, 25 or 27 through 30 based on required load.
1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
  2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- F. Vibration Isolation Anchors: Reference Division 22 Section "Vibration Isolation for Plumbing Piping and Equipment" for vibration isolation anchors.

## 2.9 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Malleable Iron: ASTM A47
- G. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 INSTALLATION GENERAL

- A. Install hangers and supports in accordance with manufacturer's installation instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

### 3.3 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58 unless indicated otherwise.
- B. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
- C. Space attachments within maximum piping span length specified in Division 22 piping sections.
- D. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- E. Install hangers, supports, clamps and attachments to support piping properly from building structure.
- F. Do not attach to ceilings, equipment, ductwork, conduit and other non-structural elements such as floor and roof decking.
- G. Hanger and clamps sizing:
  - 1. Cold Piping: Provide pipe hangers sized for the pipe outside diameter plus insulation thickness.
  - 2. Hot Piping: Provide pipe hangers sized for the pipe outside diameter.
  - 3. Vertical Piping: Provide clamps sized for the pipe outside diameter and extend clamp through insulation.
  - 4. Refer to Division 22 Section "Plumbing Insulation" for definition of hot and cold piping and required insulation thickness.
- H. Where several pipes can be installed in parallel and at the same elevation, Contractor has option to provide metal channel strut framing. Install supports with maximum spacing specified within Division 22 piping sections.
  - 1. Space strut framing at the required distance for the smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
  - 2. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
    - a. Uninsulated Copper Pipe: Install with plastic galvanic isolators
    - b. Insulated Tube or Pipe: Install with 360° insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 22 Section "Plumbing Insulation".
- I. Install building attachments within concrete or to structural steel.
  - 1. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping as specified in Division 22 piping sections.
  - 2. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.
- J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Provide two nuts on threaded supports to securely fasten the support.

- K. Install appropriate types of hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
- L. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.
- N. Insulated Piping: Comply with the following installation requirements.
  - 1. Riser Clamps: Attach riser clamps to piping with riser clamps projecting through insulation. Do not use riser clamps to support horizontal, insulated piping. Seal insulation for hot piping and protect vapor barrier for cold piping as specified in Division 22 Section "Plumbing Insulation".
    - a. Contractor's Option: Provide riser clamps with pre-manufactured polymer insert for cold piping 2-1/2 inches and larger.
  - 2. Insulation Protection Shield: Install insulation protection shield with high density insulation insert where vapor barrier is indicated, sized for the insulation thickness used as specified in Division 22 Section "Plumbing Insulation". Do not use polymer-based shields for hot piping.
    - a. Exception for horizontal cold-piping with fiberglass or flexible elastomeric insulation 2 inch and smaller: Rest fiberglass insulated pipe on hanger shield with length specified for pipe size and insulation thickness to prevent puncture or other damage.
  - 3. Contractor's Option: Provide pre-engineered thermal hanger inserts for piping insulated with flexible elastomeric insulation at pipe supports for piping 2-1/2 inches and larger.
  - 4. Contractor's Option: Provide strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts.
- O. Strut Framing Systems: Channel strut systems can be used at the Contractors option in lieu of individual hangers for horizontal pipes. Arrange for grouping of parallel runs of horizontal piping. Space channel strut systems at the required distance for the smallest pipe supported. Provide channel gauge and hanger rods per the manufacturer's recommendations for the piping supported. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
  - 1. Uninsulated Copper Pipe: Install with plastic galvanic isolators
  - 2. Insulated Tube or Pipe: Install with 360 degree insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 22 Section "Plumbing Insulation".
- P. Vertical Piping Risers:
  - 1. Reference Section "Vibration Isolation for Plumbing Piping and Equipment" for piping riser supports.
- Q. Pre-Engineered Roof Pipe Supports: Set supports on an 18" X 18" x 3/16" thick roof walkway material compatible with the roof material.

### 3.4 INSTALLATION OF PIPE ALIGNMENT GUIDES

- A. Install pipe alignment guides on piping that adjoins expansion joints, as required by expansion joint manufacturer, and elsewhere as indicated on plans and specification sections to eliminate binding and torsional stress on piping systems. Install guides per ASME B31.9 unless noted otherwise. Install pipe insulation at guide to not interfere with movement of pipe within the guide.
- B. Install guide to accommodate 1/2 the thermal movement at the adjacent expansion joint.
- C. Anchor to building substrate.



**3.5 INSTALLATION OF ANCHORS**

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS Standards D1.1.
- C. Spacing: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

**3.6 INSTALLATION OF PRE-ENGINEERED ROOF PIPE SUPPORTS**

- A. Install pre-engineered roof pipe supports to rest on the roofing membrane without attachment to the roof structure or penetration through the roofing assembly.
- B. Install pre-engineered roof pipe supports anchored to the roof structure.
  - 1. Install supports to meet the specified design criteria.
    - a. Building Design Risk Category: II III or IV .
    - b. Design Wind Speed: XXX mph.
  - 2. Coordinate with the pre-engineered roof pipe support manufacturer to anchor the pipe supports directly to the roof structure in accordance with the manufacturer's installation instructions or provide intermediate pipe supports engineered to meet the design criteria.
  - 3. Submit design and installation requirements as a Deferred Submittal.

**3.7 EQUIPMENT SUPPORTS**

- A. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
- B. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls.
- C. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
- D. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- E. Preset Concrete Inserts and Expansion Anchors: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
  - 1. Where concrete slabs form finished ceiling, locate anchors flush with slab surface.
- F. Secure fasteners according to manufacturer's recommended torque settings.
- G. Remove temporary supports.
- H. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- I. Grouting: Place grout under supports for piping and equipment.

**3.8 METAL FABRICATION**

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours welded surfaces to match adjacent contours.

### 3.9 FIELD QUALITY CONTROL

- A. Examine support and attachment components for damage and defects.
- B. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces. Comply with Division 09 Section "Painting."
  - 1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- E. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.
- F. Correct deficiencies and replace damaged or defective support and attachment components.

### 3.10 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Provide the following acceptable hangers and supports for each type of piping system. Hangers and supports may be single type or strut-mounted:
- C. Single Hangers:
  - 1. All pipe sizes 1-1/2 inch and less:
    - a. Band hanger.
    - b. Swivel split ring.
    - c. Clevis hanger.
  - 2. Cold and Hot pipe sizes 2 to 4 inches: Clevis hanger.
  - 3. Cold and Hot pipe sizes 6 inches and greater: Roll support hanger.
  - 4. All drainage pipe sizes: Clevis hanger.
- D. Trapezes and Strut-mounted Supports:
  - 1. All pipe sizes less than 6 inches: Two-piece clamp.
  - 2. Pipe sizes 6 inches and greater: Roll support.
- E. Wall Supports:
  - 1. Pipe sizes 3 inches and less:
    - a. Two-hole strap mounted to wall.
    - b. Welded steel bracket with reinforced angle or strut.
  - 2. Pipe sizes 4 inch and greater:

- c. U-bolt
  - d. Welded steel bracket with reinforced angle or strut.
- F. Floor Supports:
- 1. Pipe sizes 4 inch and less: Pipe saddle.
  - 2. Pipe sizes 6 inch and greater: Roll support.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 05 33 - HEAT TRACING FOR PLUMBING PIPING****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes pipe freeze protection system, grease waste temperature maintenance system, and installation instructions.
- B. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 22 Section "Plumbing Insulation" for piping insulation and installation requirements.
  - 2. Division 23 Section "Direct-Digital Control for HVAC" for interlock of alarms with building automation system and alarm wiring.
  - 3. Division 26 Section "Common Work Results for Electrical" required electrical devices.
  - 4. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

**1.2 SUBMITTALS**

- A. Refer to Division 1 and Division 22 Section "General Plumbing Requirements" for administrative and procedural requirements for submittals.
- B. Product Data: Submit product data on the following items:
  - 1. Pipe Freeze Protection System
  - 2. Grease Waste Flow Maintenance
- C. Submit complete heat trace calculations and drawings including:
  - 1. Floor plans designating pipes to be heat traced
  - 2. Control panel quantities and locations
  - 3. Pipe heat loss and required heat trace cable watts per foot and number of runs
  - 4. Total cable length, maximum cable length and required number of circuits
  - 5. Electrical requirements

**1.3 QUALITY ASSURANCE**

- A. Pipe freeze protection system shall be listed and classified by Underwriter's Laboratories, Inc. as suitable for purpose intended.

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. Manufacturer: System components shall be factory tested with manufacturers' standard tests to ensure that all devices, components, and systems are in proper working order before shipment. Coordinate with Division 23 contractor to provide single manufacturer for all Division 22 and Division 23 heat trace components. Subject to compliance with requirements, provide piping materials and specialties from one of the following:
  - 1. Pipe Freeze Protection System and Grease Waste Flow Maintenance
    - a. Chromalox
    - b. Nextron
    - c. Nelson
    - d. Tyco Thermal Controls/Raychem
    - e. Thermon

**2.2 PIPE FREE HE PROTECTION SYSTEM AND GREASE WASTE FLOW MAINTENANCE**

- A. In general the system shall include the following items:
1. Heating cable control panel.
  2. Transformer(s).
  3. Outdoor ambient thermostat(s). Pipe mounted temperature sensor.
  4. Junction boxes.
  5. Parallel circuit heating cable.
  6. Branch circuit wiring and conduit.
  7. Other items necessary for a complete system.
- B. Heating Cable and Accessories:
1. Parallel circuit, jacketed cable, self-limiting, designed to operate on voltage as specified on the drawings. Cable shall consist of two nickel-copper bus wires embedded in parallel in a self regulating polymer core. Cable shall be capable of varying its output along its length. Provide wattage as required for piping and insulation involved per manufacturer's recommendations.
  2. Heating cable shall be covered by a polyolefin dielectric jacket.
  3. Heating cable shall be grounded with a braid of tinned copper.
  4. Where indicated on the drawings, heating cable shall have polyolefin outer jacket for protection against aqueous inorganic chemicals. Where indicated on the drawings, heating cable shall have fluoropolymer outer jacket for protection against organic chemicals or corrosives.
  5. Termination fittings for direct connection to junction boxes.
  6. Junction Boxes: Junction boxes shall be NEMA 4X Watertight, even where located indoors.
- C. Control Panel:
1. NEMA 4X Fiberglass Reinforced Plastic enclosure for outdoor installation with hinged access door with window and furnished with the following:
  2. Microprocessor based controller with LED display with keypad interface and non-volatile memory.
  3. Ground fault circuit protection capable of checking heating cable circuit faults
  4. LED Indicator Lights: Current mode, heater on, alarm conditions and receive / transmit data.
  5. Alarm Conditions: RTD failure, high/low temperature, high/low current, hi/low resistance and high/low voltage, ground fault alarm, trip, loss of programmed values and electromechanical relay failure.
  6. Alarm Contacts: One single pole single throw rated at 0.75 amp 120 to 277 volt relay and one dry pilot duty only relay rated at 48 VAC / DC 50 milliamps, 10VA maximum resistive switching
  7. Power strip for connecting 277 volt single phase at 30 amps maximum.
  8. Temperature Control Sensors: Total of two three wire 100 Ohm RTD's with 10 foot long stainless steel sheath, ambient temperature range of  $-76^{\circ}\text{F}$  to  $1058^{\circ}\text{F}$  with an accuracy of  $\pm 3^{\circ}\text{F}$  and a repeatability of  $\pm 3^{\circ}\text{F}$ .
- D. Temperature Control Sensor
1. Provide outdoor ambient thermostat with adjustable contacts set to close on decreasing temperature.
  2. Provide pipe mounted sensor with adjustable setpoint set to close on decreasing temperature.

**PART 3 - EXECUTION****3.1 PIPE FREEZE PROTECTION AND GREASE WASTE FLOW MAINTENANCE SYSTEM INSTALLATION**

- A. Furnish and install a pipe freeze protection system and grease waste flow maintenance to prevent the following piping from freezing, and to maintain proper flow in grease waste systems where located in unheated areas:
1. Domestic water piping.
  2. Sanitary P-traps.
  3. Horizontal and vertical storm piping
  4. Architectural sheet metal downspouts
- B. Installation:
1. Cut cable to length as required to suit pipe lengths and watt per foot requirements.
  2. Install and test heating cable after pipe is pressure tested and before pipe is insulated.
  3. Secure cable to pipe with cable ties or belts and install according to manufacturer's instructions.
  4. Install cable on piping in accordance with manufacturer's recommendations for a minimum ambient temperature of minus 20 degrees F.
  5. For grease waste maintenance, install cable on piping in accordance with the manufacturer's recommendations for a minimum maintenance temperature.
  6. Install junction boxes where necessary.
  7. Install control panels at the locations indicated.
  8. For plastic piping, apply heating cable using aluminum tape.
- C. Connections:
1. Electrical wiring and connections are specified in Division 26 Section "Common Work Results for Electrical".
  2. Coordinate interlock of heat trace system control panel alarm conditions with the building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".
- D. Insulation:
1. Install and test electric heat trace prior to installation of insulation. Insulation is specified in Division 22 section "Plumbing Insulation".
- E. Factory Tests:
1. Conduct manufacturers' standard tests on all system components to assure that all devices, components, and systems are in proper working order before shipment.
- F. Field Tests:
1. Before and after installation of the thermal insulation, test heating cable with megohmmeter between the heating cable bus wires and metallic braid. Minimum insulation resistance shall be 20 megohms regardless of length.
  2. Submit test report of megohmmeter readings to the Owner.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 22 05 50 - VIBRATION ISOLATION FOR PLUMBING PIPING AND EQUIPMENT****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. It is the intent of this specification to provide vibration isolation supports for Plumbing equipment as scheduled at the end of this Section.
- B. This work shall include all materials and labor required for the installation of the vibration isolation devices.
- C. Vibration isolators shall be selected by the weight distribution to produce reasonably uniform deflection. Deflections shall be as noted on the equipment schedule included at the end of this Section.
- D. All vibration isolation equipment shall be furnished by one manufacturer unless specifically approved otherwise in writing by the Engineer.
- E. All vibration isolation devices shall be treated for corrosion resistance using galvanization for exterior applications and painting for interior applications.
- F. Related Sections:
  - 1. Division 22 Section "Common Work Results for Plumbing" for materials and methods for concrete equipment pads.
  - 2. Division 22 Section "Basic Piping Material and Methods," for materials and methods for flexible connectors.
  - 3. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hangers and supports.
  - 4. Division 22 Section "Domestic Water Pumps," for materials and methods for domestic booster pumps.

**1.2 WORK INCLUDED**

- A. Provide complete vibration isolation systems as shown or specified and in accordance with the requirements of the Contract Documents. System shall be complete with:
  - 1. Foundations, vibration isolation, and supports for rigidly supported equipment.
  - 2. Vibration Isolation

**1.3 CONTRACTOR S RESPONSIBILITY**

- A. Consult all other Section to determine the extent of work specified elsewhere but related to this Section. This work shall be properly coordinated to produce an installation satisfactory to the Owner. The Contractor shall be responsible for verifying the completeness of the isolation installation and the overall suitability of the equipment to meet the intent of this specification. Any additional equipment needed to meet the intent of this specification, even if not specifically mentioned herein or in the Contract Documents, shall be provided by the Contractor without claim for additional payment.
- B. Performance or waiving of inspection, testing or surveillance for any portion of the Work shall not relieve the Contractor of the responsibility to conform strictly to the Contract Documents. The Contractor shall not construe performance or waiving of inspection, testing or surveillance by the Owner or Architects to relieve the Contractor from total responsibility to perform in strict accordance with the Contract Documents.

**1.4 MANUFACTURER S RESPONSIBILITIES**

- A. Manufacturer of vibration isolation equipment shall have the following responsibilities:
  - 1. Determine vibration isolation for all equipment and systems in accordance with the local governing code.
  - 2. Provide piping and equipment isolation systems as scheduled or specified.
  - 3. Guarantee specified isolation system deflection.
  - 4. Provide installation instructions, drawings and field supervision to assure proper installation and performance.
  - 5. The vibration isolation systems shall be guaranteed to have deflection indicated on the schedule on the drawings. Mounting sizes shall be determined by the mounting manufacturer, and the sizes shall be installed in accordance with the manufacturer's instructions.
  - 6. The vibration isolator vendor shall ensure that all equipment to be isolated has sufficient support structure to distribute equipment loads onto isolators. Where additional support structure is required, this shall be provided by vibration isolator vendor.

**1.5 SUBMITTALS**

- A. Submittal data shall show type, size, and deflection of each isolator proposed. Include clearly outlined procedures for installing and adjusting the isolators.
- B. Submit a vibration isolation system schedule indicating the following:
  - 1. Manufacturer, type, model number, size
  - 2. Height when uncompressed and static deflection of each isolation element
  - 3. Spring constant of each isolation element
  - 4. Estimated imposed load on each isolation element
  - 5. Spring o.d., free operating, and solid heights
  - 6. Design of supplementary bases.
  - 7. Layout of isolator hangers, mounts, and other elements shown on an outline of the isolated equipment, including complete details of attachment to load-bearing structure or supplementary framing.
  - 8. Piping isolators shown and identified on piping layout drawings.
  - 9. All concrete foundations and supports (and required reinforcing and forms) will be furnished and installed by another trade. However, this trade shall furnish shop drawings showing adequate concrete reinforcing steel details and templates for all concrete foundations and supports, and all required hanger bolts and other appurtenances necessary for the proper installation of the Contractor's equipment. Although another trade will complete all concrete work, all such work shall be shown in detail on the shop drawings, prepared by this trade which drawings shall be submitted showing the complete details of all foundations including necessary concrete and steel work, vibration isolation devices, etc.

**1.6 QUALITY ASSURANCE**

- A. It is the objective of this Specification to provide for the control of vibration due to the operation of machinery or equipment, and/or due to interconnected piping or conduit.
- B. The installation of all vibration isolation systems shall be under the supervision of the manufacturer's representative.

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. All vibration isolation equipment and materials shall be provided by a single manufacturer. The following manufacturers are approved provided systems are in compliance with the specified design and performance requirements:
1. Amber Booth.
  2. Kinetics Noise Control.
  3. Mason Industries, Inc.
  4. Vibration Eliminator Co., Inc.
  5. Vibration Mounting and Controls.

**2.2 GENERAL**

- A. All equipment provided for vibration isolation shall be new and manufactured specifically for the purpose intended.

**2.3 VIBRATION ISOLATORS****A. GENERAL**

1. The static deflection of isolators shall be as given in the equipment schedule and specified below. The isolator schedule shall take precedence.
2. Vibration isolator sizes and layout shall be determined by the vibration isolator supplier.
3. All vibration isolators shall have either known undeflected heights or calibration markings so that, after adjustment, the amount of deflection can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.
4. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer, and must be linear over a deflection range of not less than 50% above the design deflection.
5. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than  $\pm 10\%$ .
6. All neoprene mountings shall have a Shore hardness of 30 to 60  $\pm 5$ , or as specified herein, after minimum aging of 20 days or corresponding over-aging.
7. Housed or caged spring isolators are not acceptable.
8. Where steel spring isolation systems are described in the specifications, the mounting assemblies shall utilize bare springs with the spring diameter not less than 0.8 of the loaded operating height of the spring. Each spring isolator shall be designed and installed so that the ends of the spring remain parallel during and after the spring installation. All isolators shall operate in the linear portion of their load versus deflection curve and have 50% excess capacity without becoming coil bound.
9. All mounting systems exposed to weather and other corrosive environments shall be protected with factory corrosion resistance. All metal parts of mountings (except springs and hardware) shall be hot dip galvanized. Springs shall be cadmium plated and neoprene coated. Nuts and bolts shall be cadmium plated.

**B. ISOLATOR TYPE WP**

1. Type WP (Waffle Pads) shall be 5/16 inch thick neoprene pads ribbed or waffled on both sides. The pads shall be manufactured with bridge bearing quality neoprene, and selected for a maximum durometer of 50 and designed for 15% strain. Where required, steel load-spreading plates shall be incorporated between the equipment and the neoprene pad.
2. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.

3. (Type WP: Mason Industries Type W or as approved.)
- C. ISOLATOR TYPE MWP
1. Type MWP (Metal and Waffle Sandwich Pads) shall consist of two 5/16 inch thick ribbed or waffle neoprene pads sandwiching a 16 gauge stainless steel shim plate. The pad shall be manufactured with bridge bearing quality neoprene, and selected for a maximum durometer of 50 and designed for 15% strain.
  2. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660, or as approved) shall be installed under the bolt head between the steel washer and the base plate.
  3. (Type MWP: Mason Industries Type WSW or as approved.)
- D. ISOLATOR TYPE DDNM
1. Type DDNM (Double Deflection Neoprene Mounts) shall be laterally stable, double deflecting, molded neoprene isolators. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed and bolt holes shall be provided in the base. The mounts shall have leveling bolts rigidly secured to the equipment.
  2. The isolator shall be manufactured with bridge bearing quality neoprene, and selected for a maximum durometer of 50 and designed for 15% strain. DDNM mounts shall be selected for a static deflection of 3/8 inch unless otherwise specified.
  3. (Type DDNM: Mason Industries Type ND or as approved.)
- E. ISOLATOR TYPE DDNH
1. Type DDNH (Double Deflection Neoprene Hangers) shall consist of a molded neoprene isolating element in a steel hanger box. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30 degree arc. When installed, the hanger box shall be allowed to rotate through a full 360 degrees without encountering any obstructions.
  2. The isolator shall be manufactured with bridge bearing quality neoprene, and selected for a maximum durometer of 50 and designed for 15% strain. Unless otherwise specified, the static deflection of DDNH hangers shall be 0.3 inches.
  3. (Type DDNH: Mason Industries Type HD or as approved.)
- F. ISOLATOR TYPE SPNM
1. Type SPNM (Spring and Neoprene Mounts) shall have a free-standing and laterally stable steel spring without any housing. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall be not less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection.
  2. Unless otherwise specified, the minimum static deflection of SPNM isolators for equipment mounted on grade slabs shall be 1 inch, and the minimum static deflection for equipment mounted above grade level shall be 2 inches.
  3. Two Type WP isolation pads sandwiching a 16 gauge stainless or galvanized steel separator plate shall be bonded to the isolator baseplate.
  4. Unless otherwise specified, isolators need not be bolted to the floor for indoor installations. If the base plates are bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.
  5. (Type SPNM: Mason Industries Type SLFH or as approved.)
- G. ISOLATOR TYPE SPNH
1. Type SPNH (Spring and Neoprene Hangers) shall consist of a steel spring in series with a neoprene isolating element. The spring shall have a minimum additional travel to solid equal to 50% of the specified deflection. The neoprene element shall have a static deflection of not less than 0.3 inches with a strain not exceeding 15%.

2. Unless otherwise specified, the static deflection of SPNH hangers shall be 2 inches.
  3. Spring diameter and hanger box hole size shall be large enough to permit the hanger rod to swing through a 30 degree arc. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked, and the hanger box shall be allowed to rotate through a full 360 degree arc without encountering any obstructions.
  4. (Type SPNH: Mason Industries Type 30N or as approved.)
- H. BASE TYPE CIB
1. Inertia base Type CIB (Concrete Inertia Base) shall have an integral rectangular structural steel form into which concrete is poured.
  2. Perimeter members shall be beams of depth equal to 10% of the longest span of the base, but not more than 12 inches nor less than 6 inches deep. Forms shall include motor slide base and all reinforcing steel. Where anchor bolt locations fall in concrete, the reinforcing steel shall include drilled members with sleeves welded below the steel to accept the anchor bolts. Height saving steel brackets shall be used in all mounting locations.
  3. When the concrete base is "T" shaped, isolators shall be located under the projections as well as under the main body in order to prevent cantilever distortion.
  4. The structural perimeter frame, mounting templates, height saving brackets, and spring system shall be provided as an assembly by the vibration control vendor.
  5. (Base Type CIB: Mason Industries Type KSL or as approved)
- I. NEOPRENE MOUNTING SLEEVES
1. Neoprene mounting sleeves for hold-down applications of equipment with vibration isolators shall be Uniroyal Type 620/660 or as approved.
- J. PIPE FLEXIBLE CONNECTORS
1. Refer to Section "Basic Piping Materials and Methods" for requirements for flexible pipe connectors.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. All equipment, piping, etc. shall be mounted on or suspended from approved foundations and supports, all as specified herein, or as shown on the drawings.
- B. All floor-mounted equipment shall be erected on concrete equipment pads over the complete floor area of the equipment, unless otherwise specified herein. Refer to Section "Common Work Results for Plumbing" for concrete equipment pad requirements. These pads shall be integrally keyed to structural slab. Wherever vibration eliminating devices and/or concrete inertia blocks are specified, these items shall, in all cases, be mounted on concrete equipment pads unless otherwise specified herein.
- C. Furnish and install neoprene mounting sleeves for hold-down bolts to prevent any metal to metal contact.
- D. All equipment shall be provided with lateral restraining isolators as required to limit horizontal motion to 1/4" maximum, under all operating conditions. Lateral restraining isolators shall have the same static deflection as the vertical isolators for the equipment being isolated.
- E. Unless otherwise indicated, all equipment mounted on vibration isolators shall have a minimum operating clearance of 2 inches between the bottom of the equipment or inertia base (and height-saving bracket) and the concrete equipment pad (or bolt heads) beneath the equipment. The clearance shall be checked by the Contractor to ensure that no material has been left to short-circuit the vibration isolators. There shall be a minimum 4 inch clearance between isolated

equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.

- F. Piping or plumbing equipment shall be supported from building structure, not hung from or supported on other equipment, pipes, or ductwork.
- G. Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping, and blocked-up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims.
- H. All plumbing equipment not specifically identified in this specification that contains rotating or vibrating elements, and any associated electrical apparatus installed by this division that contains transformers or inductors shall be installed on Type DDNM neoprene isolators as appropriate.
- I. All wiring connections to plumbing equipment on isolators shall be made with a minimum 18 inch long flexible conduit in a "U" shaped loop.
- J. Elastomeric isolators that will be exposed to temperatures below 32 degrees F shall be fabricated from natural rubber instead of neoprene.
- K. Springs shall be designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.
- L. Springs shall be sized to be non-resonant with equipment forcing frequencies or support structure natural frequencies.
- M. Refer to Vibration Isolation Schedule at the end of this Section.

### 3.2 INLINE PUMPS

- A. Inline pumps shall be supported on Type SPNH spring isolators. Provide flexible pipe couplings on each side of pump. The vertical load shall be carried by the supports, not by the flexible couplings.

### 3.3 DOMESTIC BOOSTER PUMPS

- A. Packaged domestic booster pumps installed on slab on grade shall be bolted and grouted thru their factory provided equipment frames to equipment pads and be provided with vibration isolators as scheduled in the table at the end of this section.

### 3.4 SUPPORT OF PIPING

- A. The following water and condensate piping shall be resiliently supported:
  - 1. Piping within 50 feet of connected rotating equipment.
  - 2. Piping installed below or adjacent to noise sensitive areas.
- B. Pipes connected to equipment installed on spring vibration isolators shall be suspended or supported by Type SPNM or Type SPNH isolators. Provide vibration isolation anchors and guides as specified elsewhere in this section. The first isolator both upstream and downstream of equipment on springs shall have a static deflection equal to 1.5 times that of the equipment isolators, up to a maximum of 2 inches. The static deflection of the remaining pipe isolators shall be 1 inch.
- C. Piping that is connected only to machinery installed on neoprene isolators shall be either supported from the floor on Type DDNM mounts or suspended from the structure on Type DDNH hangers.
- D. Where a pipe run connects multiple items of equipment in the mechanical room the pipe isolators for the entire run shall be chosen to suit the connected equipment of greatest static deflection.

- E. Resilient diagonal mountings or other approved devices shall be provided as required to limit piping motion due to equipment startup or shut down, to a maximum of 1/8".
- F. Water piping hanger rod isolators shall contain a steel spring in series with a 1/4" acoustical neoprene pad within a steel box retainer. The hanger rod isolator assembly shall be rigidly supported from the spring sub-assembly and shall not contact the steel box retainer. Clearances in the isolator design shall be capable of accepting a 15 degree misalignment in any direction from the vertical.
- G. The steel spring element of the assembly shall be designed to have a minimum surge frequency of 340 HZ and a minimum deflection of 3/4".
- H. Hanger rod isolators for steam and condensate piping including steam pressure reducing valve stations shall be supported by means of neoprene-in-shear mountings providing a minimum static deflection of 1/2".
- I. Where supplementary steel is required to support piping, the supplementary steel shall be sized so that maximum deflection between supports does not exceed 0.08" and shall be resiliently supported from the building structure with mountings as described above. Supported piping from the supplementary steel shall be rigidly suspended or supported.
- J. Pre-compressed type hanger rod isolators shall be provided for all water piping greater than 12" diameter and all supplementary steel supports. The pre-compression shall be factory set at 75% of rated deflection.
- K. Where isolated water piping 8" and larger is supported directly below exposed steel beams, attachment to the beam shall be made by means of welded channel beam attachments located directly under the web of the beam. For piping 6" and smaller, beam clamps may be used in lieu of welding subject to approval of beam clamp selection.
- L. Except as noted elsewhere in this section, all 2-inch and smaller domestic water piping that is installed outside equipment rooms shall be isolated from the structure with sponge neoprene, felt or glass/mineral fiber sleeves between the pipe and pipe clamp or with Type WP pads between the clamp and the structure. The sleeve shall be not less than 1/8-inch in thickness when compressed.

### 3.5 PIPING ANCHORS GUIDES AND SUPPORTS

- A. General: Pipe riser guides, anchors and supports including piping anchors in mechanical equipment rooms or occupied spaces shall be isolated from the building structure such that there shall be no direct metal to metal contact of the piping with the building structure.
- B. Piping Anchors and Guides
  1. The all directional pipe anchor isolation mountings shall consist of a telescoping arrangement of two sizes of steel tubing separated by a minimum of 1/2" thick heavy duty neoprene and canvas duct isolation pad. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction. The allowable load on the isolation material shall not exceed 500 psi.
  2. Steel guides shall be welded to the pipe at a maximum spacing of 90°. The outside diameter of the opposing guide bars shall be smaller than the inside diameter of the pipe riser clamp in accordance with standard field construction practice. Each end of the pipe guide shall be rigidly attached to an all directional pipe anchor isolation mounting which in turn, shall be rigidly fastened to the steel framing within the shaft.
  3. Low temperature piping guides shall be constructed with a 360 degree 10 gauge metal sleeve around the piping. The thermal insulation requirements for the piping shall be provided between the piping and the sleeve. Heavy duty neoprene and canvas duct isolation pad of thickness equal to thermal insulation requirements shall space the metal sleeve away from the piping with urethane or other suitable thermal insulation provided in the voids between the pipe-sleeve and isolation pan material. The metal sleeve outside

diameter shall be smaller than the pipe riser clamp inside diameter in accordance with standard field construction practice. The pipe riser clamp shall be rigidly attached to the steel framing within the shaft.

C. Piping Supports:

1. Piping supports within shafts shall be provided with suitable bearing plates and two layers 1/4" thick ribbed or waffled neoprene pad loaded for 50 psi maximum. The isolation pads shall be separated with 1/4" steel plate. The isolation pads shall be Type WP or approved equal.
2. Piping isolation supports at the base of risers shall be two layers of 1/2" thick heavy duty neoprene and canvas duct isolation pad separated by 1/4" thick steel plate. Suitable bearing plates sized to provide a pad loading of 500 psi maximum shall be provided. The stanchion between the pipe and isolation support shall be welded to the pipe and welded or bolted to the isolation support. The isolation support shall be bolted to the floor slab with resilient sleeves and washers. All pipe support resilient materials shall be HL Mason Industries, Inc., or as approved.

### 3.6 FLEXIBLE PIPING CONNECTORS

- A. Flexible piping connectors shall be installed to connect piping diameter 2" or greater to reciprocating or rotating equipment.

### 3.7 PIPE RISER SUPPORTS

- A. Where pipes rise in a vertical chase and are supported from a structure with type SPNH or DDNH isolators and require lateral bracing, neoprene riser guides shall be mounted around the pipe to limit lateral movement and to prevent direct contact with the supporting structure.
- B. Support vertical pipe risers subjected to thermal expansion and/or contraction with spring isolators and central anchors designed to ensure loading within design limits at support points. Perform design calculations for sizing the riser supports incorporating the initial load, initial deflection, change in deflection, final load and change in load at support locations. Design calculations must include anchor loads when installed, cold filled and at operating temperature and pipe stress at end connections and branch locations. Design system for an initial spring deflection of at least 4 times the thermal movement. Design must be stamped and signed by a licensed professional engineer.

### 3.8 WIRING

- A. All wiring connections to plumbing equipment on vibration isolators (either spring or neoprene type) shall be made with a minimum 18 inch long flexible conduit in a "U" shaped loop. This Contractor shall coordinate wiring connections with the Electrical Contractor.

### 3.9 FIELD QUALITY

- A. Contractor shall work in accord with best trade practices, shall fabricate and install all items in accordance with manufacturer's recommendations and Architect's directions, and shall consult with trades doing adjoining work in order to provide an installation of first class quality.

### 3.10 ADJUSTMENT AND TESTING

- A. Site Access: During installation of equipment, Contractor shall arrange for access as necessary for inspection of isolation and noise control equipment by Architect and the Contractor's representatives.
- B. Contractor's Vibration Isolation Report: The vibration isolation vendor shall inspect and approve the installation of the vibration isolators and shall submit a report to the Architect which verifies



that all of the isolation equipment has been properly installed and that the installation is in full conformance with the specification. The report shall record the vibration isolator identification and model or type. For isolators containing steel springs the report shall also record the size and uncompressed height, design static deflection and measured static deflection of the isolators provided.

- C. Consultant's Inspection: Upon completing installation and adjustment for suitable operation of all work specified under this section, the Contractor shall notify the Architect in writing. The letter shall certify that all work specified under this section is complete, operational and adjusted in every respect, and that all work is ready for the completion checkout. The notification letter shall be accompanied by the vibration isolation report.

### 3.11 GUARANTEE

- A. If, in the actual installation, any equipment fails to meet the vibration control requirements specified herein, that equipment shall be corrected or replaced without claim for additional payment, inclusive of all labor and material costs. Such corrective measures shall be done within a time schedule specified by the Owner.

### 3.12 SCHEDULE OF VIBRATION ISOLATORS

EQUIPMENT	BASE TYPE	ISOLATOR TYPE	STATIC DEFLECTION
In-Line Pumps □ HP & Larger		SPNH	1.75"
Domestic Booster Pumps (Slab on Grade)	Equipment Pad	MWP	0.25
Piping		Isolation as per specification.	

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. Extent of Plumbing work to be identified as required by this Section is indicated on drawings and/or specified in other Division 22 Sections.
- B. Types of identification devices specified in this Section include the following:
  - 1. Plastic Pipe Markers
  - 2. Plastic Tape
  - 3. Underground-Type Plastic Line Marker
  - 4. Valve Tags
  - 5. Valve Schedule Frames
  - 6. Engraved Plastic-Laminate Signs
  - 7. Plastic Equipment Markers
  - 8. Plasticized Tags

**1.2 CODES AND STANDARDS**

- A. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

**1.3 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
- B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.
- C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.
- D. Maintenance Data: Include product data and schedules in Maintenance Manuals as specified in Division 1 and Section "General Plumbing Requirements."

**1.4 SPARE PARTS**

- A. Furnish minimum of 5% extra stock of each plumbing identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.
  - 1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

**PART 2 - PRODUCTS AND MATERIALS****2.1 ACCEPTABLE MANUFACTURERS**

- A. Manufacturer: Subject to compliance with requirements, provide plumbing identification materials of one of the following:
1. Advanced Graphic Engraving, LLC.
  2. Brady Co.
  3. Brimar Industries, Inc.
  4. Craftmark.
  5. Kolbi Pipe Marker Co.
  6. Seton

**2.2 PLUMBING IDENTIFICATION MATERIALS**

- A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 22 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

**2.3 PLASTIC PIPE MARKERS**

- A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1
- B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1
- C. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F (52 degrees C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.
- D. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
  2. Adhesive lap joint in pipe marker overlap.
  3. Laminated or bonded application of pipe marker to pipe (or insulation).
  4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".
- E. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
1. Laminated or bonded application of pipe marker to pipe (or insulation).
  2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2" wide; full circle at both ends of pipe marker, tape lapped 3".
  3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.
- F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.
- G. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with names as shown or specified.
- H. Lettering: Comply with piping system nomenclature as specified, scheduled, or shown, and abbreviate only as necessary for each application length.

**2.4 PLASTIC TAPE**

- A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.
- B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2-1/2" wide tape for larger pipes.
- C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

**2.5 UNDERGROUND-TYPE PLASTIC LINE MARKER**

- A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of service of buried pipe.
  - 1. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

**2.6 VALVE TAGS**

- A. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
  - 1. Provide 1-1/2" diameter tags, except as otherwise indicated.
  - 2. Fill tag engraving with black enamel.
- B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

**2.7 CEILING TACKS**

- A. Description: Steel with 3/4" diameter color coded head.
- B. Color:
  - 1. Comply with ANSI A13.1, except where another color selection is indicated.

**2.8 ACCESS PANEL MARKERS**

- A. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

**2.9 VALVE SCHEDULE FRAMES**

- A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

**2.10 ENGRAVED PLASTIC-LAMINATE SIGNS**

- A. General: Provide engraving stock melamine plastic laminate, complying with ASTM D 709, in the sizes and thickness indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for plumbing fastening except where adhesive mounting is necessary because of substrate.
- B. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.

- C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

## 2.11 PLASTIC EQUIPMENT MARKERS

- A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code:
  - 1. Green: Cooling equipment and components.
  - 2. Yellow: Heating equipment and components.
  - 3. Yellow/Green: Combination cooling and heating equipment and components.
  - 4. Brown: Energy reclamation equipment and components.
  - 5. Blue: Equipment and components that do not meet any of the above criteria.
  - 6. For hazardous equipment, provide colors and designs recommended by ANSI A13.1.
- B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
  - 1. Name and plan number.
  - 2. Equipment service.
  - 3. Design capacity.
  - 4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.
- C. Size: Provide 2-1/2" x 4" markers for control devices, dampers, and valves; and 4-1/2" x 6" for equipment.

## 2.12 PLASTICIZED TAGS

- A. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing. Tags shall be minimum 3-1/4" x 5-5/8" in size, provided with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

## 2.13 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in plumbing identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of plumbing systems and equipment.
  - 1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

## PART 3 - EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished plumbing spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

### 3.2 PIPING SYSTEM IDENTIFICATION

- A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
  - 1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.

- B. Application: Provide piping system identification for the following systems:
1. Domestic cold water piping.
  2. Domestic hot water piping.
  3. Domestic hot water recirculating piping.
  4. Non potable water piping
  5. Lawn irrigation piping.
  6. Sanitary and waste piping.
  7. Storm water piping.
  8. Vent piping.
  9. Insulated and non-insulated storm water piping.
  10. Sump pump discharge
  11. Natural gas piping.
- C. Location: Install pipe markers and color bands in the following locations where piping is exposed to view, concealed only by a removable ceiling system, installed in machine rooms, installed in accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
1. Within 5 feet of each valve and control device.
  2. Within 5 feet of each branch, excluding take-offs less than 25 feet in length for fixtures; mark flow direction of each pipe at branch connection.
  3. Within 5 feet where pipes pass through walls, floors or ceilings or enter non-accessible enclosures. Provide identification on each side of wall, floor or ceiling.
  4. At access doors, manholes and similar access points which permit view of concealed piping.
  5. Within 5 feet of major equipment items and other points of origination and termination.
  6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment where there are more than two piping systems or pieces of equipment.

### 3.3 UNDERGROUND PIPING IDENTIFICATION

- A. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

### 3.4 VALVE IDENTIFICATION

- A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibbs, and shut-off valves at plumbing fixtures and similar rough-in connections of end-use fixtures and units.
- B. List each tagged valve in valve schedule for each piping system. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.
1. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.

### 3.5 CEILING TACK INSTALLATION

- C. Install ceiling tacks to locate valves above lay-in panel ceilings. Locate in corner of panel closest to equipment.

**3.6 PLUMBING EQUIPMENT IDENTIFICATION**

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of plumbing equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
  2. Meters, gauges, thermometers and similar units.
  3. Pumps
  4. Water heaters, tanks and pressure vessels.
  5. Strainers, water treatment systems and similar equipment.
- B. Optional Sign Types: Where lettering larger than 1" height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at Installer's option.
- C. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.
- D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
1. Optional Use of Plasticized Tags: At Installer's option, where equipment to be identified is concealed above acoustical ceilings or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).
  2. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at Installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

END OF SECTION



**SECTION 22 07 00 - PLUMBING INSULATION****PART 1 - GENERAL REQUIREMENTS****1.1 SECTION INCLUDES**

- A. Piping Insulation.
- B. Equipment Insulation.

**1.2 RELATED REQUIREMENTS**

- A. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields and high-density insulation inserts.

**1.3 DEFINITIONS**

- A. Cold Pipe: Piping that carries fluid with a minimum operating temperature less than 60 degrees F.
- B. Hot Pipe: Piping that carries fluid with a minimum operating temperature greater than 105 degrees F.
- C. Cold Equipment: Equipment that carries fluids with a minimum operating temperature less than 60 degrees F.
- D. Hot Equipment: Equipment that carries fluids with a minimum operating temperature greater than 105 degrees F.
- E. Exposed: Insulation that is visible from the occupied space.
- F. Exposed to Weather: Insulation that is exposed to potential damage caused by weather, including sunlight, moisture, wind, and solar radiation.
- G. Exterior: Locations outside of or within the building envelope (walls, roof, floors, etc) as defined by the architectural drawings and specifications.
- H. NAIMA: North American Insulation Manufacturers Association

**1.4 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of Plumbing insulation.
- B. Insulation Schedule: Include product name, conductivity k-value, thickness, and furnished accessories for each service.
- C. Maintenance Data: Submit maintenance data and replacement material lists for each type of Plumbing insulation. Include this data and product data in maintenance manual.
- D. Manufacturer's Instructions: Include installation instructions for storage, handling, protection, examination, preparation, and installation of the product.

**1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualification: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.

- B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- C. Flame/Smoke Ratings: Provide composite plumbing insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.
  - 1. Exception: Exterior plumbing insulation may have flame spread index of 75 and smoke developed index of 150.

## 1.6 DELIVERY STORAGE AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage; store in original wrapping.

## 1.7 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

## PART 2 - PRODUCTS

### 2.1 PIPING INSULATION MATERIALS

- A. Mineral Fiber (rock, slag, or glass):
  - 1. Manufacturers:
    - a. CertainTeed Corp.
    - b. Knauf Insulation
    - c. Johns Manville
    - d. Owens Corning
  - 2. Insulation: ASTM C547, Type I or II, rigid mineral fiber, pre-formed for the application.
    - a. K-value: ASTM C518 or C177, maximum 0.24 at 75 degrees F.
    - b. Minimum Service Temperature: 0 degrees F
    - c. Maximum Service Temperature: 850 degrees F for Type I, 1200 degrees F for Type II.
    - d. Density: Between 3 to 6 pounds per cubic foot for Type I, between 6 to 8 pounds per cubic foot for Type II.
  - 3. Factory Applied Jacket: ASTM C1136, Type I.
    - a. All-Service Jacket (ASJ): Paper/Foil/Scrim, water vapor permeance of 0.02 perms and self-sealing lap.
    - b. Poly ASJ: Paper/Foil/Scrim with polymer coating, water vapor permeance of 0.01 perms and self-sealing lap.
    - c. Color: White.
- B. Flexible Elastomeric:
  - 1. Manufacturers:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. K-Flex USA.
  - 2. Insulation: ASTM C534, Grade I, flexible elastomeric cellular rubber insulation, pre-formed for the application.
    - a. K-value: ASTM C518 or C177, maximum 0.28 at 75 degrees F.
    - b. Minimum Service Temperature: Minus 297 degrees F

- c. Maximum Service Temperature: 220 degrees F for Grade I, 300 degrees F for Grade II.
  - 3. Factory Applied Jacket:
    - a. Polymeric Coating: Multi-ply, polymeric blend coating, 16 mils thick, designed to prevent damage to underlying insulation from sunlight, installation, and physical abuse, with water vapor permeance of 0.03 perms. Reference Jacket requirements in Part 3 of this specification for application of this jacket.
  - C. Field-Applied Jacket:
    - 1. Semi-rigid PVC: One-piece, pre-molded PVC cover conforming to ASTM D1784, including factory-furnished, pre-cut insulation blanket inserts for fittings.
      - a. Outdoor Applications: Provide minimum 30 mils thickness and UV protection.
      - b. Manufacturers:
        - 1) Johns Manville Zeston PVC Jacketing and 2000 Series Fitting Covers
        - 2) Proto Corp LoSmoke PVC Jacketing and Pro Fitting Covers.
        - 3) Or approved equal.
    - 2. Rigid Aluminum Shell: One-piece, pre-formed cover conforming to ASTM C1729 with weather-proof construction. Shell shall have the following minimum thickness based on the outer insulation diameter:
 

Outer Insulation Diameter (in)	Minimum Aluminum Jacket Thickness, (in)	
	Non-Rigid Insulation	Rigid Insulation
Finish		
≤ 8	0.016	0.016
Stucco		
12	0.020	0.016
Stucco		
≤ 24	0.024	0.016
Stucco		
    - a. Banding:
      - 1) For piping less than or equal to 8 inches, provide 0.020 inch thick, 3/4 inch wide aluminum bands.
      - 2) For piping larger than 8 inches, provide 0.020 inch thick, 3/4 inch wide stainless steel bands.
  - 3. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW, or approved equal.
    - a. Water Vapor Transmission: 0.0 perms per ASTM E96.
    - b. Puncture Resistance: Minimum 65 pounds per ASTM D1000.
- D. Pipe Insulation Accessories: Provide staples, bands, wires, cement, and other appurtenances as recommended by insulation manufacturer for applications indicated.
- E. Adhesives, Sealers, Mastics, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.
  - 1. Lagging Adhesive: Comply with MIL-A-3316C, Class 1, Grade A. Provide Foster 30-36, Childers CP-50AHV2, or equal.
  - 2. Weather Barrier Breather Mastic: Permeance shall be 1.0 perms or less at 62 mils dry per ASTM E96, Procedure B. Provide Foster 46-50, Childers CP-10/11 or equal.
  - 3. Solvent-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 35 mils dry per ASTM F 1249.
  - 4. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance in accordance with ASTM C755 for insulation application. Provide Foster 30-80, Childers CP-38, or equal.

Table: Recommended Maximum Permeance of Water Vapor Retarders (Note 1)

Insulation Application	Insulation Permeability, Less than 4.0 perm-in. (Note 2)	Insulation Permeability, 4.0 or greater perm-in. (Note 2)

	Vapor Retarder perms	Vapor Retarder perms
Pipe and vessels (33 F to ambient)	0.05	0.05
Pipe and vessels (-40 F to 32 F)	0.02	0.02

## Notes:

1. Water vapor permeance of the vapor retarder in perms when tested in accordance with Test Methods E96.
  5. Water vapor permeability of the insulation material when tested in accordance with Test Methods E96.
- F. Insulation Diameters: Comply with ASTM C585 for inner and outer diameters of rigid thermal insulation.
- G. Pipe, Valve and Fitting Covers: Comply with ASTM C450 for fabrication of fitting covers for pipe, valves and fittings.
- H. High Density Insulation Billets:
1. Calcium Silicate: ASTM C533 and C795.

**2.2 EQUIPMENT INSULATION MATERIALS**

- A. Flexible Mineral Fiber (rock, slag, or glass):
1. Manufacturers:
    - a. CertainTeed Corp.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Owens Corning.
  2. Insulation: ASTM C553, Type I and II or ASTM C547 Type II, flexible mineral fiber blanket.
    - a. K-value: ASTM C518 or C177, maximum 0.31 at 75 degrees F.
    - b. Minimum Service Temperature: Minus 20 degrees F
    - c. Maximum Service Temperature: 450 degrees F for ASTM C553 Types I and II, 1200 degrees F for ASTM C547 Type II.
    - d. Density: Minimum 1.5 pounds per cubic foot.
  3. Factory Applied Vapor Barrier Jacket: ASTM C1136, Type II.
    - a. All-Service Jacket (ASJ): Paper/Foil/Scrim, water vapor permeance of 0.02 perms.
    - b. Color: White.
- B. Flexible Removeable and Reusable Blanket Insulation:
1. Manufacturers:
    - a. Auburn Manufacturing.
    - b. Approved equal.
  2. Insulation: ASTM C553, Type V, flexible, noncombustible.
    - a. Comply with ASTM C1695.
    - b. K-value: ASTM C518 or C177, maximum 0.37 at 100 degrees F.
    - c. Minimum Service Temperature: 32 degrees F
    - d. Maximum Service Temperature: 500 degrees.
- C. Rigid Mineral Fiber (rock, slag, or glass):
1. Manufacturers:
    - a. Johns Manville.
    - b. Knauf Insulation.
    - c. Owens Corning.
  2. Insulation: ASTM C612, Type IA or IB, rigid mineral fiber board.
    - a. K-value: ASTM C518 or C177, maximum 0.25 at 75 degrees F.
    - b. Minimum Service Temperature: 0 degrees F
    - c. Maximum Service Temperature: 450 degrees.
    - d. Density: Minimum 3.0 pounds per cubic foot.
  3. Factory Applied Vapor Barrier Jacket: ASTM C1136, Type II.

- a. All-Service Jacket (ASJ): Paper/Foil/Scrim, water vapor permeance of 0.02 perms.
  - b. Color: White.
- D. Flexible Elastomeric:
- 1. Manufacturers:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. K-Flex USA.
  - 2. Insulation: ASTM C534, Grade I or II, flexible elastomeric cellular rubber insulation, sheet form.
    - a. K-value: ASTM C518 or C177, maximum 0.28 at 75 degrees F.
    - b. Minimum Service Temperature: Minus 40 degrees F
    - c. Maximum Service Temperature: 220 degrees F for Grade I, 300 degrees F for Grade II.
- E. Field-Applied Jacket:
- 1. Aluminum: ASTM B209, 3003 alloy, H-14 temper, with 3-mil thick polyfilm moisture barrier to interior surface.
    - a. Thickness: 0.032 inch sheet.
    - b. Finish: Smooth.
    - c. Joining: Longitudinal slip joints and 2 inch laps.
    - d. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel.
  - 2. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW, or approved equal.
    - a. Water Vapor Transmission: 0.0 perms per ASTM E96.
    - b. Puncture Resistance: Minimum 65 pounds per ASTM D1000.
- F. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors, stud pins, and other appurtenances as recommended by insulation manufacturer for applications indicated.
- G. Adhesives, Sealers, Mastics, and Protective Finishes: Provide cements, adhesives, coating, sealers, mastics, and protective finishes as recommended by insulation manufacturer for applications indicated.
- 1. Mineral Fiber Lagging Adhesive: Comply with ASTM C916, Type 2 or MIL-A-3316C, Class 2, Grade A. Provide Foster 85-60, Childers CP-127, or equal water-based adhesive.
  - 2. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 47 mils dry per ASTM E96. Provide Foster 30-80, Childers CP-38, Design Polymerics 3040, or equal.
  - 3. Lagging Adhesive: Comply with MIL-A-3316C, Class 1, Grade A. Provide Foster 30-36. Childers CP-50AHV2 or equal.
  - 4. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Test piping and ductwork for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

**3.2 PROTECTION AND REPLACEMENT**

- A. Provide all required protection for insulation (installed and uninstalled) throughout the duration of construction to avoid exposure to plaster, dust, dirt, paint, moisture, deterioration, and physical damage.
- B. Repair existing plumbing insulation that is damaged during this construction period. Use insulation of same type and thickness as existing insulation. Install new jacket lapping and sealed over existing.
- C. Replace damaged insulation which cannot be repaired satisfactorily at no additional expense to the Owner, including insulation with vapor barrier damage and insulation that has been exposed to moisture during shipping, storage, or installation. Drying the insulation is not acceptable. Dry surfaces prior to installation of new insulation that replaces the damaged or wet insulation.

**3.3 INSTALLATION GENERAL**

- A. Install in accordance with manufacturer's installation instructions.
- B. Install in accordance with NAIMA National Insulation Standards.

**3.4 PLUMBING PIPING SYSTEM INSULATION**

- A. Maintain continuous thermal and vapor-retarder integrity throughout entire installation and protect it from puncture and other damage.
- B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- D. Exposed Piping: Locate insulation and cover seams in least visible locations.
- E. Cold Piping Insulation:
  - 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
  - 2. Provide with factory applied vapor barrier jacket.
  - 3. Provide high density insulation material under supports or pre-insulated supports. Protect insulation with shields to prevent puncture or other damage. Refer to Section "Hangers and Supports for Plumbing Piping" for pre-insulated supports and insulation shields. and for exception where high density insulation inserts are not required.
  - 4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
  - 5. Secure all-service jacket with self-sealing longitudinal laps.
- F. Butt pipe insulation tightly at insulation joints. Apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture infiltration.
- G. Hot Piping Insulation:
  - 1. Insulate entire system, including fittings, valves, unions flanges, strainers, flexible connections, pump bodies, and expansion joints.
  - 2. Provide jackets without vapor barrier. Jackets with factory applied vapor barrier are allowed.
  - 3. Provide high density insulation material or pre-insulated supports where supports are installed outside of the insulation. Protect insulation with shields to prevent puncture or other damage. Refer to Section "Hangers and Supports for Plumbing Piping" for pre-

- insulated supports and insulation shields and for exception where high density insulation inserts are not required.
4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
  5. Secure all-service jacket with self-sealing longitudinal laps.
  6. Butt pipe insulation tightly at insulation joints and wrap insulation around supports. Apply 3 inch wide vapor barrier tape or band over joint.
- H. Exterior piping:
1. Encase exterior piping insulation with aluminum weather-proof jackets.
  2. Insulate exterior cold water and non-potable water piping as previously described.
  3. Insulate and heat trace exterior sanitary p-traps, sanitary, grease waste, storm, and overflow storm piping as described below. Refer to Division 22 Section "Heat Tracing for Plumbing Piping" for heat trace system material and installation requirements.
    - a. Fiberglass: 2" thickness.
- I. Interior piping with heat trace:
1. Insulate and heat trace grease waste piping and grease waste P-traps as described below. Refer to Division 22 Section "Heat Tracing for Plumbing Piping" for heat trace system material and installation requirements.
    - a. Fiberglass: 2" thickness.

### 3.5 EQUIPMENT INSULATION

- A. Cold Equipment (Below Ambient Temperature):
1. Application Requirements: Insulate the following cold equipment:
    - a. Drip pans under chilled equipment.
    - b. Roof drain bodies.
  2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:
    - a. Fiberglass: 2" thick for cold surfaces above 35 degrees F (2 degrees C) and 3" thick for surfaces 35 degrees F (2 degrees C) and lower.
    - b. Flexible Elastomeric: 1" thick.
- B. Hot Equipment (Above Ambient Temperature):
1. Application Requirements: Insulate the following hot equipment:
    - a. Hot water storage tanks.
    - b. Condensate pumps.
  2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:
    - a. Fiberglass: 2" thick, except 3" thick for steam-jacketed heat exchangers.
    - b. Flexible Elastomeric: 1" thick for equipment operating up to 180 degrees F (82 degrees C). and 300F (149C) for high-temperature formula for 181 degrees F and higher.

### 3.6 INSTALLATION OF PIPING INSULATION

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Maintain continuous thermal and vapor-retarder integrity throughout entire installation unless otherwise indicated.
- C. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

- D. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- E. Clean and dry pipe surfaces prior to insulating.
- F. Pipe insulation:
  - 1. Insulate all cold piping to prevent moisture condensation on exterior surfaces.
  - 2. Provide high density insulation material under supports or pre-insulated supports. Refer to Division 22 Section "Hangers and Supports for Plumbing Piping" for pre-insulated supports.
  - 3. Protect insulation with shields to prevent puncture or other damage. Refer to division 22 Section "Hangers and Supports for Plumbing Piping" for insulation shields.
  - 4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
  - 5. Butt insulation to hanger or riser clamp for vertical pipe. Butt pipe insulation tightly at insulation joints.
  - 6. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints.
  - 7. For cold pipes, apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture ingress.
- G. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves (except balancing and flow control valves), strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Butt tightly against adjoining pieces and bond with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  - 8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves (except balancing and flow control valves), flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.



9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- H. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- I. Install removable insulation covers at locations indicated. Installation shall conform to the following:
  1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
- J. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.
- K. Exterior Piping and Piping Exposed to Weather:
  1. General: Provide piping jacket around insulation as scheduled in the Piping Jacket Schedule. Jacket material shall be approved by the jacket manufacturer for use with the specific insulation material that it covers. Locate longitudinal seams of outer shell (aluminum, flexible elastomeric, or cladding as applicable) at bottom of pipe. Provide insulation shields so that the piping supports cannot puncture, cut or break the jacket.
  2. Paintable Coating: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
  3. Rigid aluminum shell: Space attachment bands 12 inches on center and directly centered over end joints.
  4. Multilayer Laminate Vapor Barrier Cladding: Install cladding only when ambient temperature is above 50 degrees F. Provide low-temp products for installation in low ambient temperatures down to 10 degrees F.
- L. Heat Traced Piping
  1. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide insulation shields so that the piping supports cannot puncture, cut or break the jacket.

### 3.7 INSTALLATION OF EQUIPMENT INSULATION

- A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
- B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

- C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.
- D. Do not apply insulation to equipment, breechings, or stacks while hot.
- E. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.
- F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.
- H. Do not insulate boiler manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames, and accessories.

### 3.8 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

### 3.9 PIPING SYSTEM INSULATION SCHEDULE

- A. Reference Pipe Insulation Thickness Schedule at the end of this specification for thickness requirements based on insulation conductivity.
- B. Do not apply insulation to piping that operates outside of the minimum and maximum service temperature range.
- C. Omit insulation on the following:
  - 1. Flexible connections and expansion joints in pipes with fluids above ambient temperatures.
  - 2. Chrome-plated exposed piping
  - 3. Water Hammer Arrestors
  - 4. Balancing and flow valves
  - 5. Drain lines from water coolers
  - 6. Drainage piping located in crawl spaces or tunnels
  - 7. Exterior condensate drain piping
  - 8. Buried piping
  - 9. Pre-insulated equipment.
- D. Exterior Piping Exposed to Weather: Insulate all exterior plumbing piping exposed to weather with:
  - 1. Flexible elastomeric
- E. Cold Piping (minimum operating temperature less than 60 degrees F.)
  - 1. Service
    - a. Potable cold water piping.
    - b. Non-potable cold water piping
    - c. Potable chilled water piping.
    - d. Plumbing vents within 6 lineal feet of roof outlet.

- e. Horizontal interior above-ground storm drainage piping and vertical run from roof drain to horizontal run.
  - f. Horizontal and vertical interior above-ground storm drainage piping and vertical run from roof drain to horizontal run.
  - g. Horizontal and vertical interior above-ground overflow storm drainage piping and vertical run from roof drain to horizontal run.
  - h. Lawn irrigation piping.
  - i. Condensate piping inside the building.
  - j. Trap arms, waste branches and dedicated stacks serving chilled water waste or condensate drains.
2. Insulate each piping system specified above with one of the following types of insulation.
- a. Mineral fiber.
- F. Hot Temperature Piping (105 degrees to 180 degrees F (40 to 82 degrees C)):
- 1. Service:
    - a. Hot water supply and return piping.
  - 2. Insulate each piping system specified above with one of the following types of insulation.
    - a. Mineral fiber.
    - b.

### 3.10 PIPE INSULATION THICKNESS SCHEDULE

- A. P-traps:
- 1. Insulate P-traps receiving chilled water waste and P-traps of water coolers as described below:
    - a. Flexible Elastomeric: 1" thick for pipe sizes up to and including 2", 1-1/2" thick for pipe sizes 2" to 6" (largest size permitted).
  - 2. Insulate P-traps receiving hot water waste above 140F as described below:
    - a. Fiberglass: 1" thickness.
    - b. Calcium Silicate: 1-1/2" thickness.
    - c. Flexible Elastomeric (high temp formula up to 300F): 1" thickness.
- B. Piping Inside Masonry Wall Units:
- 1. Insulate cold, hot, and hot water recirculation piping installed inside of masonry walls where the piping needs to be insulated as the wall is constructed as described below:
    - a. Flexible Elastomeric: 1/2" thick for pipe sizes up to and including 2", 1" thick for pipe sizes 2-1/2" to 6" (largest size permitted).
- C. Exterior Heat Traced Piping Systems
- 1. Refer to Division 22 Section "Heat Tracing for Plumbing Piping" for heat trace system material and installation requirements.
  - 2. Freeze Protection: Insulate P-traps in waste systems with mineral fiber insulation 2" thick insulation where indicated on the drawings. Insulate waste piping systems with mineral fiber insulation 2" thick insulation where indicated on the drawings.]
  - 3. Grease Waste Flow Maintenance: Insulate grease waste P-traps and piping with mineral fiber insulation 2" thick insulation where indicated on the drawings.
- D. Exterior Exposed to Weather Heat Traced Piping Systems
- 1. Refer to Division 22 Section "Heat Tracing for Plumbing Piping" for heat trace system material and installation requirements.
  - 2. Freeze Protection: Insulate P-traps in waste systems with flexible elastomeric 1" thick insulation where indicated on the drawings. Insulate waste piping systems with flexible elastomeric 1" thick insulation where indicated on the drawings.]
  - 3. Grease Waste Flow Maintenance: Insulate grease waste P-traps and piping with flexible elastomeric 1" thick insulation where indicated on the drawings.
- E. IECC – 2015 Requirements, Pipe Insulation

Fluid Operating Temp. Range (°F) And Usage	Minimum Pipe Insulation Thickness						
	Insulation Conductivity		Nominal Pipe or Tube Size (in.)				
	Conductivity, Btu·in./(hr·ft <sup>2</sup> ·°F)	Mean Rating Temp., °F.	1	1 to 1-1/2	1-1/2 to 4	4 to 8	≥8
			Insulation Thickness, in.				
141°F–200°F	0.25–0.29	125	1.5	1.5	2.0	2.0	2.0
105°F–140°F	0.21–0.28	100	1.0	1.0	1.5	1.5	1.5
40°F–60°F	0.21–0.27	75	0.5	0.5	1.0	1.0	1.0

**Notes:**

- a. For piping smaller than 1-1/2 inch and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted (before thickness adjustment required in footnote b) but not to a thickness less than 1 inch.
- b. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:  $T = r(1 + t/r)(K/k) - 1$  where
  - 1) T minimum insulation thickness (in.),
  - 2) r actual outside radius of pipe (in.),
  - 3) t insulation thickness listed in this table for applicable fluid temperature and pipe size,
  - 4) K conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu·in./hr·ft<sup>2</sup>·°F); and
  - 5) k the upper value of the conductivity range listed in this table for the applicable fluid temperature.
- c. Insulation thicknesses are based on energy efficiency considerations only. Add insulation where noted on the drawings.
- d. The table is based on steel pipe. Non-metallic pipes schedule 80 thickness or less shall use the table values. For other non-metallic pipes having thermal resistance greater than that of steel pipe, reduced thicknesses are permitted if documentation is provided showing that the pipe with the proposed insulation has no more heat transfer per foot than a steel pipe of the same size with the insulation thickness shown on the table.

**3.11 PIPING JACKET SCHEDULE**

- A. Exposed piping within mechanical rooms (below 10 feet):
  1. Semi-rigid PVC.
  2. Rigid aluminum shell.
- B. Exposed piping within mechanical rooms (above 10 feet):
  1. Semi-rigid PVC.
  2. Rigid aluminum shell.
  3. All-service jacket.
- C. Exposed piping:
  1. All-service jacket.
  2. Semi-rigid PVC.
- D. Piping within return air plenums:
  1. All-service jacket.
- E. Exterior Piping Exposed to Weather
  1. Aluminum with stucco finish.

END OF SECTION

**SECTION 22 11 00 - WATER DISTRIBUTION PIPING AND SPECIALTIES****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes domestic cold water, hot water, and hot water recirculation piping, fittings, and specialties within the building to a point 5 feet outside the building.
- B. Contractors Option:
1. The Division 22 contractor may provide mechanically joined plumbing piping systems to connect mechanical joints, couplings, fittings, valves, and related components as an option in lieu of, in whole or in part, copper sweat, brazing, threaded or flanged piping methods. Mechanically joined water distribution piping systems where used shall be provided in compliance with specification Section 221111 "Mechanically Joined Plumbing Piping Systems".
  2. The Division 22 contractor may provide stainless steel water distribution piping systems in lieu of, in whole or in part, for copper tube water distribution systems 3" and larger. Stainless steel water distribution piping systems are specified in Division 22 Section 221114 "Stainless steel Water Distribution Piping and Specialties".
- C. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
  2. Division 2 Section "Water Service Systems," for water service piping beginning from 5'-0" outside the building.
  3. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
  4. Division 11 Section "Kitchen and Food Service Equipment," for faucets and valves furnished with the food service and kitchen equipment.
  5. Division 22 Section "Identification, for Plumbing Piping and Equipment" for labeling and identification of water distribution piping.
  6. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall penetrations and equipment pads.
  7. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, flexible connectors, unions, dielectric unions, dielectric flanges, and mechanical sleeve seals.
  8. Division 22 Section "General Duty Valves for Plumbing Piping," for materials and methods for installing water distribution piping valves.
  9. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields, materials, and methods for hanging and supporting water distribution piping.
  10. Division 22 Section "Plumbing Insulation," for materials and methods for insulating water distribution piping.
  11. Division 22 Section "Sanitary Drainage and Vent Piping and Specialties," for material and methods for trap primer outlet piping.
  12. Division 23 Section "Direct-Digital Control for HVAC" for interlock of pilot operated flood control valve water shutoff alarm with building management system.
- D. Products installed but not furnished under this Section include water meters that will be provided by the utility company to the site and ready for installation. Following is the name and address of the utility company:

Mobile Area Water and Sewer System (MAWSS)

4725 Moffett Rd,  
Mobile, AL 36618

## 1.2 DEFINITIONS

- A. Water Distribution Pipe: A pipe within the building or on the premises that conveys water from the water service pipe or meter to the points of usage.
- B. Water Service Pipe: The pipe from the water main or other source of potable water supply to the water distribution pipe of the building served.
- C. Pipe sizes used in this Specification are nominal pipe size (NPS).
- D. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content  $\leq 0.25\%$  per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

## 1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
  - 1. Product data for each piping specialty and valve specified.
  - 2. Welder Certificates signed by Contractor certifying that welders comply with requirements specified in Article "Quality Assurance" below.
  - 3. Certification of Compliance with ASME and UL fabrication requirements specified in Article "Quality Assurance" below.
  - 4. Maintenance data for each piping specialty and valve specified for inclusion in Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."
  - 5. Test reports specified in Part 3 of this Section.
  - 6. Submit certification that specialties and fittings for domestic water distribution for drinking or cooking comply with NSF 61 Annex G and / or NSF 372. The following specialties need not comply:
    - a. Hose bibbs
    - b. Wall, yard, and roof hydrants
    - c. Backflow preventers isolating irrigation or mechanical make-up systems
    - d. Emergency mixing valves
    - e. Trap primers

## 1.4 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."
- B. Regulatory Requirements: Comply with the provisions of the following codes:
  - 1. ASME B31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
  - 2. ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications" for Qualifications for Welding Processes and Operators.
- C. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution for drinking or cooking.
- D. Pipe, fittings, and specialties shall be manufactured in the United States or be certified to meet ASTM and ANSI standards.

**1.5 SPARE PARTS**

- A. Maintenance Stock: Furnish one valve key for each key-operated wall hydrant, hose bibb, fixture supply, or faucet installed.

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Automatic Flow Control Valves:
    - a. Calefi
    - b. Flow Design, Inc., Autoflow Div.
    - c. Victaulic Company
  2. Hose Bibbs with Vacuum Breaker:
    - a. Chicago Faucet Co.
    - b. Eljer, A Household International Company
    - c. T & S Brass & Bronze Works, Inc.
  3. Hose Bibbs:
    - a. Lee Brass Co.
    - b. Mansfield Plumbing Products
    - c. Mifab Manufacturing, Inc.
    - d. Nibco, Inc.
    - e. Prier, Inc.
    - f. Watts Regulator Co.
    - g. Woodford Mfg. Co.
  4. Wall/Yard Hydrants:
    - a. Josam Co.
    - b. Mifab Manufacturing, Inc.
    - c. Smith (Jay R.) Mfg. Co.
    - d. Prier, Inc.
    - e. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
    - f. Watts Drainage
    - g. Woodford Mfg. Co.
    - h. Zurn Industries Inc., Hydromechanics Div.
  5. Backflow Preventers:
    - a. Cla-Val Co.
    - b. Conbraco Industries, Inc.
    - c. Febco
    - d. Hersey Products, Inc.
    - e. Mifab Manufacturing, Inc./Beeco
    - f. Watts Regulator Co.
    - g. Zurn Industries Inc. Wilkins Regulator Div.
  6. Pilot Operated Pressure-Reducing Valves:
    - a. Cla-Val Co.
    - b. Conbraco Industries, Inc.
    - c. Mifab Manufacturing, Inc./Beeco
    - d. OCV
    - e. Watts Regulator Co.
    - f. Zurn Industries Inc. Wilkins Regulator Div.
  7. Pilot Operated Flood Control Valves:
    - a. Cla-Val Co.
    - b. Conbraco Industries, Inc.
    - c. Mifab Manufacturing, Inc./Beeco

- d. OCV
- e. Watts Regulator Co.
- f. Zurn Industries Inc. Wilkins Regulator Div.
- 8. Water Meters:
  - a. Badger Meter, Inc.
  - b. Hays Div., Romac Industries
  - c. Hersey Products, Inc.
  - d. Neptune Water Meter Co.; Subs. Neptune Intl. Corp.
  - e. Rockwell Intl.; Measurement & Flow Control Div.
- 9. Relief Valves:
  - a. Cash (A. W.) Valve Mfg. Corp.
  - b. Conbraco Industries, Inc.
  - c. Watts Regulator Co.
  - d. Zurn Industries, Inc. Wilkins Regulator Div.
- 10. Piston Type Water Hammer Arresters:
  - a. Amtrol, Inc.
  - b. Josam Co.
  - c. Precision Plumbing Products, Inc.
  - d. PROFLO
  - e. Sioux Chief Manufacturing Co.
  - f. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
  - g. Watts Regulator Co.
  - h. Zurn Industries, Inc. Wilkins Regulator Div.
- 11. Point of Use Thermostatic Mixing Valves
  - a. Acorn Engineering Co.
  - b. Cash Acme
  - c. Leonard Valve Co.
  - d. Powers Process Controls
- 12. Emergency Mixing Valves
  - a. Acorn Engineering Co.
  - b. Bradley
  - c. Haws Corp.
  - d. Lawler Manufacturing Co., Inc.
  - e. Leonard Valve Co.
  - f. Stingray Systems
- 13. Trap Primers and Distribution Units
  - a. Mifab Manufacturing, Inc.
  - b. Precision Plumbing Products, Inc.
  - c. PROFLO
  - d. Sioux Chief
- 14. Plumbing Pipe Support Brackets
  - a. Holdrite
  - b. PROFLO
  - c. Sioux Chief
- 15. Tube Suspension Clamps
  - a. PROFLO
  - b. Sioux Chief or approved Equivalent
- 16. Sanitary Roof Hydrants
  - a. Hoeptner Perfected Products
  - b. Jay R. Smith Mtg Co.
  - c. Prier, Inc.
  - d. Mapa
  - e. Woodford Mfg. Co.



**2.2 PIPE AND TUBE MATERIALS GENERAL**

- A. Pipe and Tube: Refer to Part 3, Articles "Above Ground Water Distribution Pipe and Fittings" or "Below Ground Water Distribution Pipe and Fittings", for identification of systems where the materials listed below are used.
- B. Copper Tube: ASTM B88, Type L Water Tube, drawn temper.
- C. Copper Tube: ASTM B88, Type K Water Tube, annealed temper.
- D. Ductile-Iron Pipe: AWWA C151 or AWWA C115 ductile-iron pipe, with AWWA C104 cement-mortar lining.

**2.3 FITTINGS**

- A. Wrought Copper Solder-Joint Fittings: ANSI B16.22, streamlined pattern.
- B. Ductile or Gray-Iron Flanged Fittings: AWWA C110 Class 125 with AWWA C116 epoxy coating inside and outside.
- C. Ductile-Iron Gasketed Fittings: AWWA C153, 150 psi rating, with AWWA C104 cement mortar lining and AWWA C111 rubber gaskets.
- D. Brass Fittings: Chrome plated ANSI B16, Class 125 with threaded connections.
- E. PVC to Ductile Iron Adapter Flanges: EBBA Iron, Inc. Series 2000PV or approved equivalent.

**2.4 JOINING MATERIALS**

- A. Solder Filler Metal: ASTM B32 Alloy Sb-5, 95-5 Tin-Antimony.
- B. Brazing Filler Metals: AWS A5.8, Bag-7 Silver.
- C. Gasket Material: Thickness, material, and type suitable for fluid to be handled and design temperatures and pressures.

**2.5 GENERAL-DUTY VALVES**

- A. General-duty valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 22 Section "General Duty Valves for Plumbing Piping." Special duty valves are specified below by their generic name; refer to Part 3, Article "Valve Applications" for specific uses and applications for each valve specified.

**2.6 SPECIAL DUTY VALVES**

- A. Automatic Flow Control Valves: 400 PSI WOG, flow regulator, with series 300 stainless steel body, series 300 stainless steel automatic pre-set flow balancing cartridge, union connection body, and threaded-end connections.

**2.7 PIPING SPECIALTIES**

- A. Hose Connections: Hose connections shall have garden hose thread outlets conforming to ASME B1.20.7.
- B. Hose Bibbs: Bronze body, renewable composition disc, tee handle, 1/2- or 3/4-inch solder inlet, hose outlet.
- C. Hose Bibbs: Bronze body with chrome- or nickel-plated finish, with renewable composition disc, wheel handle, 1/2- or 3/4-inch solder inlet, hose outlet.

- D. Hose Bibbs: Bronze body with chrome- or nickel-plated finish, with renewable composition disc, integral vacuum breaker, wheel handle, 1/2- or 3/4-inch solder inlet, hose outlet.
- E. Recessed Nonfreeze Wall Hydrants: Cast-bronze box, with chrome-plated face, tee handle key, vacuum breaker, hinged locking cover, 3/4-inch inlet, and hose outlet. Bronze casing shall be length to suit wall thickness.
- F. Roof Hydrants: As specified on the drawings.
- G. Backflow Preventers: Comply with requirements of ASSE Standard 1013 and as specified on the drawings.
- H. Pressure Reducing Valves: Comply with requirements of ASSE Standard 1003 and as specified on the drawings.
- I. Flood Control Valves: As specified on the drawings.
- J. Water Meters: Water meters to be supplied from city.
- K. Relief Valves: Sizes for relief valves shall be in accordance with ASME Boiler and Pressure Vessel Codes for indicated capacity of the appliance for which installed.
  - 1. Combined Pressure-Temperature Relief Valves: Bronze body, test lever, thermostat, complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Temperature relief valves shall be factory set at 210 deg F, and pressure relief at 150 psi.
- L. Piston Type Water Hammer Arresters: Piston type, with casing of type "L" copper tube and spun copper ends, nylon piston with two EPDM "O"rings pressure lubricated with FDA approved silicone, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-201.
- M. Point of Use Thermostatic Mixing Valves:
  - 1. Lead free bronze or brass body meeting ASTM B584 with non-corrosive parts, tamper resistant temperature adjustment, checks, stops, other components as scheduled and meeting ASSE 1070. Valve shall be designed to fail to the cold side of the system. Maximum pressure drop shall not be exceeded for the scheduled flow rate.
- N. Emergency Mixing Valves:
  - 1. Bronze body construction meeting ASTM B584, non-corrosive parts, tamper resistant temperature adjustment, union inlets. Valve shall be designed to fail to the cold side of the system with full cold water flow. Maximum pressure drop shall not be exceeded for the scheduled flow rate.
- O. Trap Primers: Brass construction, line pressure operation, capacity to prime number of traps as indicated with distribution units complying with requirements of ASSE Standard 1018.
- P. Pipe Support Brackets:
  - 1. Sheet Stud Bracket: 20 gauge copper with nominal copper tube holes of 1/2" on 2" centers and holes of 3/4" or 1" on 4" centers.
  - 2. Pipe Mounted Bracket: 20 gauge copper or plastic bracket with clamps for securing copper water tube and stainless steel hose clamp for securing bracket to vertical waste and vent pipe in wall.
  - 3. Carrier Bracket: 20 gauge copper bracket with 1" hole for supporting rough-in for flush valve copper tube and bolt slot for attaching to chair carrier.
- Q. Tube Suspension Clamps
  - 1. Combination plastic supports and insulators for installing copper tube in stud walls with integral bracket for securing to stud with screws.

**PART 3 - EXECUTION****1.1 INSTALLATION GENERAL**

- A. Install piping, valves and specialties in accordance with manufacturer's installation instructions.

**3.2 PREPARATION FOUNDATION FOR BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS**

- A. Copper Tube: Provide 6" thick sand pipe bed underneath and around sides of pipe, up to middle half of the pipe. Support pipe in trench with sand bags level and true at fittings to prevent sand, gravel or debris from interfering with the brazing process. After pressure testing is complete, install bedding at fittings and install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.
- B. Ductile Iron Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand bedding. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation. For piping with rock trench bottoms, provide sand pipe bed 6" underneath and around sides of pipe up to middle half of the pipe, including fittings. After pressure testing is complete, provide first layer of pea gravel backfill 6" above pipe, tamp backfill with mechanical tamper and install bedding at fittings and install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

**3.3 ABOVE GROUND WATER DISTRIBUTION PIPE AND FITTINGS**

- A. Install Type L, drawn copper tube with wrought copper fittings and solder joints for pipe sizes 8 inches and smaller, within the building.
- B. Install ductile or gray-iron epoxy coated fittings for 3" and larger at water service entrance riser and only upstream of the backflow preventer.

**3.4 BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS**

- A. Install Type K, soft annealed copper tube and brazed joints for pipe sizes 2 inches and smaller, with minimum number of joints, inside and outside building.
- B. Install cement-lined ductile-iron pipe with rubber gasketed joints, inside and outside under the building, for pipe 3 inches and larger.

**3.5 PIPING INSTALLATION**

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and branch connections.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

- F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.
- I. Fire Barrier Penetrations: Where pipes pass through fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.
- J. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves packing, and sealant. Refer to Division 22 Section "Basic Piping Materials and Methods" for additional information.
- K. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section "Basic Piping Materials and Methods" for additional information.
- L. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Basic Piping Materials and Methods" for special sealers and materials.
- M. Install piping level with no pitch.

### 3.6 HANGERS AND SUPPORTS

- A. General: Hanger, support, insulation protection shield and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.
- B. Pipe Attachments: Install the following:
  - 1. Adjustable steel clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
  - 2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs. Provide copper coated riser clamps when in contact with copper tube.
  - 3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Supports and Anchors" and "Plumbing Insulation".
  - 4. Copper coated extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of copper tube 2" and smaller on walls and for securing 1-1/4" to 2" copper tube inside walls and chases for battery fixtures. Secure clamp to the copper tube.
    - a. Seal each joint with insulation and split ring pipe to maintain the insulation barrier. Refer to Section "Plumbing Insulation" for requirement for maintenance of the vapor barrier and vapor barrier seal method.
  - 5. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of stainless steel tube 2" and smaller on walls or for securing tube inside walls for connection to faucets.
  - 6. Support copper tube in chases and walls at plumbing fixtures with plastic or copper brackets secured to structure and U-bolts sized to bare on the pipe.
  - 7. Engineered strut support system may be provided, at the contractor's option, in lieu of individual hangers for horizontal pipes as specified in Division 22 "Hangers and Supports for Plumbing Piping". Provide two piece straps for uninsulated pipe secured to the bare pipe and provide plastic galvanic isolators for bare copper tube. Provide two piece straps

- and 360° insulation protection shields sized for the insulation thickness used for the pipe for all insulated pipes.
8. Provide 316 stainless steel rods, nuts, washers, beam clamps, channels, insulation protection shields, adjustable band hangers, MSS SP-69 Type 7, or clevis hangers, MSS SP-69 Type 1, for piping located in Hydrotherapy and Pool Equipment Rooms.
  9. Pipe clamps for sway bracing: B-Line Fig 4B or approved equal.
  10. Secure copper tube rough-in for individual fixtures with sheet stud brackets attached to the wall studs or pipe mounting brackets attached to the fixture waste & vent pipe at each plumbing fixture.
  11. Secure 1" and smaller copper water tubing in stud walls at stud penetrations with tube suspension clamps.
    - a. Cut hole through non-supporting studs with a minimum 1/8" clearance around each uninsulated copper tube or insulated copper tube.
    - b. Seal each joint of insulation and tube suspension clamp to maintain the insulation barrier. Refer to Division 22 "Plumbing Insulation" for requirement for maintenance of the vapor barrier similar to insulation butted against insulation inserts and vapor barrier seal method.
  12. Secure copper tubes for flush valve wall mounted water closets to the chair carrier with carrier brackets.
  13. Provide roll hangers for individual horizontal runs 100 feet or longer.
- C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

<u>Nom. Pipe Size - In.</u>	<u>Steel Pipe Max. Span - Ft.</u>	<u>Copper Tube Max. Span - Ft.</u>	<u>Min. Rod Dia. - In.</u>
Up to 1-1/4	12	6	3/8
1-1/2 to 2	12	10	3/8
2-1/2 to 4	12	10	3/8
5	12	10	1/2
6	12	10	1/2
8	12	10	1/2
10 to 12	12	10	5/8
14	12	N/A	3/4
16	12	N/A	7/8

1. Support vertical steel pipe at each floor and in intervals not to exceed 15 feet.
  2. Support vertical copper tube at each floor and in intervals not to exceed 10 feet.
- D. Support water piping within 12" of each elbow or tee and for water piping 2-1/2" and larger at each valve or strainer.
- E. Support water piping above the floor with pipe supports attached to the floor with anchor bolts where indicated on the drawings. Conform to the table above for maximum spacing of supports.
- F. Provide vibration isolation for piping connected to rotating equipment. Vibration isolators are specified in Division 22 specification Section "Vibration Isolation for Plumbing Piping and Equipment".
- G. PIPE AND TUBE JOINT CONSTRUCTION
- H. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."
- I. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts of piping specialties before soldering and brazing.

2. Fill the tubing and fittings during brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
  3. Heat joints to proper and uniform temperature.
- J. Threaded Joints: Conform to ASME B1.20.1, tapered pipe threads for field-cut threads. Join pipe fittings and valves as follows:
1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
  2. Align threads at point of assembly.
  3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
  4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.
    - a. Damaged Threads: Do not use pipe with corroded or damaged threads. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- K. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- L. Joints Containing Dissimilar Metals: Provide dielectric unions for 2" and smaller and dielectric flanges for piping 2-1/2" and larger. Provide dielectric waterway fittings for 2" and smaller in concealed locations. Dielectric unions, waterway fittings and flanges are specified in Section "Basic Piping Materials and Methods".
- M. Joints at Valve Assemblies or Connections to Equipment: Provide unions downstream of shutoff valves at valve assemblies or equipment connections. Unions are not required at flanged connections. Unions are specified in Division 22 section "Basic Piping Materials and Methods".

### 3.7 SERVICE ENTRANCE

- A. Extend water distribution piping to connect to water service piping, of size and in location indicated for service entrance to building. Water service piping is specified in a separate section of Division 2.
- B. Underground exterior water distribution piping to be a depth as required by local conditions, in accordance with authority having jurisdiction's requirements and at depth no less than 18" below grade.
- C. Install sleeve and mechanical sleeve seal at penetrations through foundation wall for watertight installation.
- D. Install sleeve and caulk at penetrations through building floor for watertight installation.
- E. Install shutoff valve at service entrance inside building; complete with strainer, pressure gauge, and test tee with valve.
- F. Ductile-Iron Pipe: Install in accordance with AWWA C-600. Pipe below ground inside building and to a point 5 feet outside of building shall have restrained joints.
- G. Copper Pipe: Install Type K, soft annealed copper tube and brazed joints, with minimum number of joints, to a point 5 feet outside of building. Install changes of direction larger than the manufacturer recommended minimum bend radius to prevent kinks in the line.
- H. Install pilot operated flood control valve upstream of backflow preventer. Coordinate interlock of flood control valve water shutoff alarm with building management system. Alarm wiring and alarm interlock with the building management system are specified in Division 23 Section "Direct-Digital Control for HVAC".

**3.8 INSTALLATION OF WATER METER**

- A. Install water meter in accordance with utility company's installation instructions and requirements.
  - 1. Provide three valve water meter by pass, sized per the authority having jurisdiction's requirements.
- B. Size meter and arrange piping and specialties to comply with utility company's requirements.
- C. Set meter on concrete pad as indicated. Refer to Division 3 for concrete, formwork, and reinforcing requirements.

**3.9 ROUGH-IN FOR WATER METER**

- A. Install rough-in piping and specialties for water meter installation in accordance with utility company's instructions and requirements.

**3.10 VALVE APPLICATIONS**

- A. General-Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shut-off duty: Use gate, ball, and butterfly valves.

**3.11 INSTALLATION OF VALVES**

- A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2 inches and smaller, use gate or ball valves; for sectional valves 2-1/2 inches and larger, use ball, gate or butterfly valves.
- B. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, on each supply to each plumbing fixture, and elsewhere as indicated. For shutoff valves 2 inches and smaller, use gate or ball valves; for shutoff valves 2-1/2 inches and larger, use ball, gate or butterfly valves.
- C. Drain Valves: Install drain valves on each plumbing equipment item, located to drain equipment completely for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to drain distribution piping system completely. For drain valves 2 inches and smaller, use gate or ball valves; for drain valves 2-1/2 inches and larger, use ball, gate or butterfly valves.
- D. Check Valves: Install swing check valves on discharge side of each pump and elsewhere as indicated.
- E. Hose Bibbs: Install on exposed piping where indicated with vacuum breaker.
- F. Wall Hydrants: Install where indicated with vacuum breaker.
- G. Emergency Mixing Valves: Install where indicated on the plans with hot and cold water branch lines connecting to the mains without any shutoff valves. No other fixtures shall connect to the branch lines feeding the emergency mixing valve. Install ball valves with locking handles at the emergency mixing valve as indicated on the plans.
- H. Point-of-Use Thermostatic Mixing Valve: Install valve complying with ASSE 1070 on all public lavatories and handwashing sink locations. Install valve to be accessible by maintenance staff. Set temperature limit to 110F for dual temperature faucet or 100F for single temperature faucet."

**3.12 INSTALLATION OF FLOW CONTROL VALVES**

- A. Install flow control valves or automatic flow control valves in each hot water recirculating loop, and elsewhere as indicated. Install a shutoff valve and strainer upstream and a union, check valve and shutoff valve downstream of each flow control or automatic flow control valve.
- B. Set flow control valve flow rate as follows:
  - 1. Preliminary Procedures For Hot Water Return System Balancing:
    - a. Before operating the system perform these steps:
      - 1) Open valves at recirculation pump and flow control valves to full open position.
      - 2) Remove and clean all strainers.
      - 3) Check recirculation pump rotation.
      - 4) Set water heater temperature as indicated on the drawings.
  - 2. Procedures For Hot Water Return System Balancing
    - a. Refer to the drawings for required flow rate for each flow control valve.
    - b. Provide required instrumentation to obtain proper measurements. Instruments shall be properly maintained and protected against damage.
    - c. Apply instrument as recommended by the manufacturer.
    - d. Take readings with the eye at the level of the indicated value to prevent parallax.
    - e. Mark flow control valve setting with memory stop. Mark with paint or other suitable, permanent identification materials.
    - f. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.
- C. Reports: Prepare hot water return system balancing reports signed and submit to the Architect upon completion of the project. Include the following information:
  - a. Valve tag number and description of location
  - b. Valve body size
  - c. Differential pressure reading from instrument in psi
  - d. Actual flow rate derived from the manufacturer's charts and tables for the valve size and measured differential pressure.

**3.13 TRAP PRIMERS**

- A. Install trap primers where indicated and where required by local authorities having jurisdiction.
- B. Connect trap primer supply line to the top of domestic cold water line no larger than 1-1/2" in diameter.
- C. Provide trap primer distribution units for trap primers serving more than one trap.
- D. Install trap primer distribution level to insure even water distribution unit to each circuit.
- E. Where applicable, adjust the trap primer for proper flow.
- F. Install trap primers a minimum of 12 inches above finished floor for every 20 feet of horizontal outlet piping to floor drains served.
- G. Install trap primers in an accessible location.
- H. Refer to Division 22 Section "Sanitary Drainage and Vent Piping and Specialties" for trap primer outlet pipe requirements.

**3.14 INSTALLATION OF PIPING SPECIALTIES**

- A. Install backflow preventers at each connection to mechanical equipment and systems and in compliance with the plumbing code and authority having jurisdiction. Locate in same room as



equipment being connected. Install air gap fitting and pipe relief outlet drain without valves to nearest floor drain.

- B. Install pressure reducing valves with inlet and outlet shutoff valves and balance cock bypass. Install pressure gauge on valve outlet.

### 3.15 EQUIPMENT CONNECTIONS

- A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by plumbing code.
- B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection; provide drain valve on drain connection. For connections 2-1/2 inches and larger, use flanges instead of unions.
- C. Coordinate interlock of flood control valve "shutdown" alarm with the building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".
- D. Coordinate interlock of deduct meter transducer with water purveyor per their standards. Set up a deduct account for each deduct meter with water purveyor.

### 3.16 FIELD QUALITY CONTROL

- A. Inspections: Inspect water distribution piping as follows:
  - 1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
  - 2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
    - a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed in after system is roughed in and prior to setting fixtures.
    - b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
    - c. Reinspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.
    - d. Reports: Prepare inspection reports signed by the plumbing official and turn over to the Architect upon completion of the project.
- B. Factory Start-up for Master Thermostatic Mixing Valves: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide start-up service, and demonstrate operation of equipment to the Owner's maintenance personnel for a minimum time of 1 hour.
  - 1. Reports: Prepare inspection reports and required corrective action signed by the factory-authorized service representative and turn over to the Architect upon completion of the project.
- C. Piping System Test: Test water distribution systems in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
  - 1. Test for leaks and defects all new water distribution piping systems and parts of existing systems that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.

2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
  3. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
  4. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
  5. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.
- D. Super Flush Test:
1. Purpose:
    - a. This test is designed to closely simulate the usage of the domestic water system at a high usage event such as halftime. The test shall verify adequate residual water pressure is present and is sized for such an event. Great care shall be taken not to "over simulate" the halftime event by flushing fixtures at a more rapid rate than what can realistically occur.
  2. Procedure:
    - a. Fixtures to be tested: Water closets and urinals in the public restrooms on the Event, Main Concourse, Suite levels.
    - b. Duration: 10 minutes.
    - c. Flushing frequency:
      - 1) Water Closets: Flush every water closet in a restroom every 90 seconds.
      - 2) Urinals: Flush every urinal in a restroom every 30 seconds.
      - 3) At a minimum, provide (1) person per each (3) water closets or urinals to perform the test.
      - 4) At the start of the test, flush no more than two water closets and two urinals simultaneously.
  3. Timing: Notify Architect a minimum of one week in advance of the test.
  4. Report: Provide pressure gauge at most remote/highest elevation toilet room hose bibbs at each water pressure zone (boosted and non-boosted). Provide video of hose bibb pressure gauges and booster pump control panel to indicate peak flow rate, booster pump discharge and suction pressures and number of pumps running. Contractors option, record booster pump suction pressure, flow rate and discharge header pressure digitally thru booster pump computer interface.

### 3.17 AD USTING AND CLEANING

- A. Clean and disinfect water distribution piping as follows:
1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.
  2. Use the purging and disinfecting procedure proscribed by the authority having jurisdiction or, in case a method is not proscribed by that authority, the procedure described in either AWWA C651, or AWWA C652, or as described below:
    - a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
    - b. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.
    - c. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.

- d. Following the allowed standing time, flush the system with clean, potable water until chlorine residual is lowered to incoming city water level.
  - e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.
3. Reports: Prepare disinfection reports signed by the authority having jurisdiction and turn over to the Architect upon completion of the project.

### **3.18 COMMISSIONING**

- A. Fill the system. Check compression tanks to determine that they are not air bound and that the system is completely full of water.
- B. Before operating the system, perform these steps:
  1. Close drain valve, hydrants, and hose bibbs.
  2. Open valves to full open position.
  3. Remove and clean strainers.
  4. Check pumps for proper direction of rotation. Correct improper wiring.
  5. Lubricate pump motors and bearings.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 11 11 - MECHANICALLY JOINED PLUMBING PIPING SYSTEMS****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section only applies to Mechanically Joined Plumbing Piping Systems for joining piping for Plumbing applications as defined in Division Section 22 "Water Distribution Piping and Specialties". Section includes:
  - 1. Copper grooved piping system
  - 2. Copper press piping systems
- B. The Division 22 contractor may provide mechanically joined, couplings, fittings, valves and related components as an option in lieu of, in whole or in part, copper sweat, brazing, threaded or flanged piping methods.
- C. Mechanically joined couplings, fittings, valves and related components specified in this section shall not be provided for natural gas piping in lieu of welded, threaded or flanged piping methods.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

**1.3 DEFINITIONS**

- A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content  $\leq 0.25\%$  per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

**1.4 SUBMITTALS**

- A. Submit in accordance with conditions of Contract and Division 01 submittal procedures.
- B. Product Data: Submit data for each type of coupling, fitting and special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing.
- C. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure.
  - 1. Indicate grooved-joint couplings and fittings on drawings and product submittals, and specifically identify with the applicable style or series designation.
  - 2. If an assembly of flexible couplings are used for seismic vibration, thermal expansion, or noise and vibration reduction, submit shop drawings indicating location of assembly, including anchors and guides. Include movement analysis of the assembly, and performance data of the assembly.
- D. Maintenance Data: Include for each piping specialty and valve in Maintenance Manual specified in Division 01 and Division 22 Section "General Plumbing Requirements."
- E. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Failed test results and corrective action taken to achieve requirements.

- F. Submit a schedule of dissimilar metal joints and adaptor flanges and flange kits. Include joint type material, connection method and proposed flange kits to isolate dissimilar metals. Include minimum and maximum torque requirements for flange connections to valves. Dielectric flange kits are specified in Division 22 section “Basic Plumbing Piping Materials and Methods”.
- G. Submit certification that valves and fittings for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.
- H. Submit certification that pipe, pipe fittings, pipe specialties, and valves and fittings are manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.
- I. Submit training certificate of completion for each worker to engineer of record within 30-days of mobilization. Include copy of each worker’s training certificate of completion with closeout documents.
- J. Piping Analysis:
  - 1. As a contractor’s option, Victaulic can provide piping system design services to accommodate movement at building expansion joints. The service includes required grooved piping components detailed in CAD on an overlay of the plumbing contract drawing(s), including anchor load calculations and placement of anchors. A calculation report showing thermal movement and seismic accommodation shall be provided.
    - a. A design stamped by a qualified professional engineer of the manufacturer licensed in the jurisdiction where the project is being constructed is required.

**1.5 QUALITY ASSURANCE**

- A. All mechanically joined piping components shall be of one manufacturer, be date and origin stamped for quality assurance and traceability.
- B. Mechanically joined piping component end product manufacturer shall be ISO certified.
- C. Grooving tools shall be of an approved manufacturer by the grooved fittings manufacturer. Verify tolerances of and maintain grooving tool components for duration of grooving processes. Replace grooving tool components that are found out of tolerance with new as required.
- D. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of valves and fittings containing no more than 0.25% lead by weight for domestic water distribution.
- E. Pipe, fittings, specialties, and valves shall be manufactured in plants located in the United States or certified to meet the specified ASTM, ANSI, and MSS standards.
- F. Installer Qualifications:
  - 1. Company specializing in performing work of the type specified in this Section, with minimum three years of documented experience.

**1.6** **OPERATING PROCEDURES** **per part iii “Training Procedures” below. Maintain a copy of each worker’s training**

**1.7 COORDINATION**

- A. Reference Division 22 Section “Water Distribution Piping and Specialties” for coordination.

**1.8 DELIVERY STORAGE AND HANDLING**

- A. Comply with Division 22 Section “Basic Plumbing Piping Materials and Methods.”

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Refer to manufacturer's current literature for comparable products and pressure ratings of couplings and standard fittings for various pipe sizes and pipe schedules. Products identified by model number are based on available size ranges from that manufacturer. Products offered by manufacturers with extended ranges are acceptable provided they meet the specified requirements.
- B. Copper Grooved Copper Tubing System
  - 1. ASC Engineered Solutions "Gruvlok".
  - 2. Shurjoint Piping Products.
  - 3. Victaulic Company of America.
- C. Press to Connect Copper Tubing System
  - 1. Apollo "Press"
  - 2. GRINNELL Mechanical Products "G-Press"
  - 3. Mueller Streamline PRS
  - 4. NIBCO Inc., Press System.
  - 5. Viega ProPress

**2.2 COPPER GROOVED TUBING SYSTEM**

- A. Pipe:
  - 1. 2 inch through 8 inch: CTS, ASTM B88 Type L, hard drawn.
  - 2. Ends: Roll grooved only in accordance to manufacturer's current listed standards. Flaring of tube ends to IPS dimensions or to accommodate alternate sized couplings is not allowed.
  - 3. Grooved mechanical piping shall conform to local code approval and/or as listed by ANSI-B31.9, ASME, UL/ULC, FM, IAPMO or ICC.
    - a. Components shall be capable of providing system rigidity to accommodate hanging and support in accordance with ANSI B31.9.
- B. General requirements for couplings, adapters, and standard fittings:
  - 1. Full-flow type, compatible with ASTM B75 or B88 CTS grooved joints.
  - 2. Flaring of tube ends to IPS dimensions or to accommodate alternate sized couplings is not allowed.
- C. Couplings:
  - 1. Meeting ASTM F1476 and constructed of two-piece housing attached with bolts and nuts with pressure responsive elastomeric gasket, with pressure rating of 300 PSI at 180F. Provide washers where required by the manufacturer.
  - 2. Material: Cast of ductile iron conforming to ASTM A536, Grade 65-45-12 or ASTM A395 Grade 65-45-15, coated with suitable enamel or epoxy.
  - 3. Rigid Type:
    - a. ASC Engineered Solutions Gruvlok Series # 6402.
    - b. Shurjoint Piping Products Styles #305, #306, and #307.
    - c. Victaulic Style # 607.
  - 4. Bolts, nuts, and washers:
    - a. Track-head bolts of heat treated carbon or manganese steel conforming to ASTM A183 or A449 with a minimum tensile strength of 110,000 psi.
    - b. Heavy-duty hexagonal nuts conforming to ASTM A563, Grade B.
    - c. Plated carbon steel flat washers conforming to ASTM F436.
    - d. Zinc-electroplated conforming to ASTM B633.
    - e. Type 304 or 316 stainless steel bolts and nuts conforming to ASTM A193, Grade B8/B8M, Class 2 or ASTM F593 and F594, Group 2, Condition CW.

- f. Type 304 or 316 stainless steel washers.
- D. Flange Adapters:
  - 1. For connection to ANSI class components according to ANSI B16.1 (steel) or ANSI B16.24 (copper).
  - 2. Material: Cast of ductile iron conforming to ASTM A536, Grade 65-45-12 or ASTM A395 Grade 65-45-15, coated with suitable enamel or epoxy.
  - 3. 2 inch-6 inch (ANSI class 125/150):
    - a. ASC Engineered Solutions Gruvlok Series # 6084.
    - b. Shurjoint Piping Products Styles # C341.
    - c. Victaulic Style # 641.
- E. Fittings:
  - 1. Materials:
    - a. Wrought copper conforming to ASTM B75 alloy C12200 or ASTM B152 alloy C1100.
    - b. Lead free bronze sand cast conforming to ASTM B584 alloy UNS C89836.
- F. Gaskets:
  - 1. EPDM Gaskets:
    - a. Grade "E", "EHP" or "EHT" EPDM compound (green or red/green color coded, respectively) conforming to ASTM D2000 designation 2CA615A25B24F17Z.
    - b. Temperature operating range: -30 degrees F to 230 degrees F.
    - c. Style suitable for the application.
  - 2. Fluoroelastomer Gaskets
    - a. Fluoroelastomer compound specifically formulated for compatibility with potable water systems resistant to chlorine and chloramine disinfectants (red and blue stripe color code).
    - b. Temperature operating range: 0 degrees F to 180 degrees F.
    - c. Style suitable for the application.
- G. Valves:
  - 1. Provide valves as specified in Division 22 section "General Duty Valves for Plumbing Piping."
- H. Adapters – Grooved X Plain Copper
  - 1. Wrought copper conforming to ASTM B75 alloy C12200 or ASTM B152 alloy C1100. CTS grooved end x plain end for press or sweat connection.
    - a. ASC Engineered Solutions Gruvlok Series #652
    - b. Shurjoint #C52

### 2.3 PRESS TO CONNECT COPPER TUBING SYSTEM

- A. Copper Tube:
  - 1. CTS □ inch through 2inch: ASTM B-88 Type L.
- B. General requirements for couplings, adapters, and standard fittings:
  - 1. Fittings shall meet ASTM F3226, ASME B16.51, ASME B31.9 and IAPMO PS-117 or ICC-ES IC 1002.
  - 2. Acceptable body materials:
    - a. Wrought copper conforming to ASTM B75 alloy C12200 or ASTM B152 alloy C11000.
    - b. Lead free cast brass conforming to ASTM B584 alloy C87600..
  - 3. Coupling and fitting housings with soldered ends shall conform to ASME B16.18 and B16.22.
  - 4. Coupling and fitting housings with flared ends shall conform to ASME B16.26.
  - 5. Coupling and fitting housings with threaded ends shall conform to ASME B1.20.1.
  - 6. Coupling and fitting housings for press ends shall have self-contained O-ring seals in the coupling/fitting ends.
  - 7. Rated for 200 psi CWP up to 250 degrees F maximum.



8. Press to connect fittings shall have leak feature integral to the fitting body to detect unpressed fittings during pressure testing.
- C. O-Ring Seals: EPDM compound conforming to ASME B16.51, style suitable for the application.
- D. Flange Adapters:
1. For connection to ANSI class components according to ANSI B16.1 (steel) or ANSI B16.24 (copper).
  2. 2-1/2 inch through 4 inch (ANSI class 125/150):
    - a. Steel flange with NSF 14 compliant fused epoxy coating, copper or brass press to connect joint with copper face ring and plastic or rubber dielectric isolating ring separating the flange from the press to connect joint.
  3. Rated for 200 psi CWP up to 250 degrees F maximum.
- E. Valves:
1. Provide 2 inch and smaller press to connect valves listed in this section or lead free cast bronze valves 2 inch and smaller listed in Division 22 section "Water Distribution Piping and Specialties" may be used with sweat connections or sweat X press adapters.
  2. Ball Valve:
    - a. Rated for 200 psi CWP up to 250 degrees F maximum, conforming to MSS SP-110.
    - b. Body and trim: Lead free cast bronze conforming to ASTM B584.
    - c. Ends: Female press to connect ends of copper material.
    - d. Ball: Full port, chrome-plated brass ball.
    - e. Stem: Blow-out proof, of material silicon bronze conforming to ASTM B371 or ASTM B99, or stainless steel.
    - f. Seat: PTFE or TFE, suitable for intended service.
    - g. Operator: Lever handle with non-thermal conductive material for insulated piping. Provide with 2 inch extended sleeve to allow valve operation without disturbing the insulation and with memory stop for throttling, metering or balancing service.
      - 1) Apollo # 77WLF
      - 2) NIBCO # PC-585-LF
      - 3) Milwaukee # UPBA-450-12
  3. Ball Valve:
    - a. Rated for 200 psi CWP up to 250 degrees F maximum, conforming to MSS SP-110.
    - b. Body and trim: Lead free cast bronze conforming to ASTM B62 or B584.
    - c. Ends: Female press to connect ends of copper material.
    - d. Ball: Full port, stainless steel ball.
    - e. Stem: Blow-out proof, of material silicon bronze conforming to ASTM B371 or ASTM B99, or stainless steel.
    - f. Seat: PTFE or TFE, suitable for intended service.
    - g. Operator: Lever handle with non-thermal conductive material for insulated piping. Provide with 2 inch extended sleeve to allow valve operation without disturbing the insulation and with memory stop for throttling, metering or balancing service.
    - h. 2 inch and smaller:
      - 1) Apollo # 77WLF-140
      - 2) NIBCO # PC-585-66-LF
      - 3) Milwaukee # UPBA-450S-12
      - 4) Viega # 2971.1 ZL
  4. Gate Valves
    - a. Rated for 200 psig CWP up to 250 degrees F maximum, conforming to MSS SP-80.
    - b. Body and trim: Lead free cast bronze body conforming to B584 with threaded bonnet and solid wedge.
    - c. Ends: Female press to connect ends of copper or brass material.
    - d. Stem: Silicon bronze conforming to ASTM B371 or ASTM B99, or stainless steel, rising type with brass packing gland and non-asbestos packing.
    - e. Operator: Malleable or ductile iron hand-wheel.
    - f. 2 inch and smaller:

- 1) Apollo # 101T-PRLF
  - 2) Hammond # UP645 P2
  - 3) Milwaukee UP105 P2
  - 4) NIBCO # PC-113-LF
5. Globe Valves
    - a. Rated for 200 psig CWP up to 250 degrees F maximum, conforming to MSS SP-80.
    - b. Body and trim: Lead free cast bronze conforming to B584 with threaded bonnet.
    - c. Disc: PTFE renewable seat and disc.
    - d. Ends: Female press to connect ends of copper or brass material.
    - e. Stem: Silicon bronze conforming to ASTM B 99, or stainless steel, rising type with brass packing gland and non-asbestos composition packing.
    - f. Operator: Malleable or ductile iron hand-wheel.
    - g. 2 inch and smaller:
      - 1) Apollo # 120T-PRLF
      - 2) Hammond # UP440 P2
      - 3) Milwaukee # UP502 P2
  6. Check Valves (Y pattern, swing type or in-line)
    - a. Rated for 200 psig CWP up to 250 degrees F maximum, conforming to MSS SP-80.
    - b. Body and trim: Cast bronze conforming to ASTM B62.
    - c. Disc: PTFE renewable seat and disc.
    - d. Ends: Female press to connect ends of copper or brass material.
    - e. 2 inch and smaller:
      - 1) Apollo # 163T-PRLF
      - 2) Hammond # UP904 P2
      - 3) NIBCO # PF-413-Y-LF
      - 4) Milwaukee # UP509 P2
  7. Check Valves (lift type, in-line)
    - a. Rated for 250 psig CWP up to 250 degrees F maximum, conforming to MSS SP-80.
    - b. Body: Cast bronze conforming to ASTM B584.
    - c. Spring: 316 stainless steel.
    - d. Ends: Female press to connect ends of copper or brass material.
    - e. 2 inch and smaller:
      - 1) Apollo # 61LF
      - 2) Milwaukee # UP548T P2
  8. Gate Valves -2-1/2 inch and Larger
    - a. MSS SP-70; Class 125, 200-psi CWP, iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B; with flanged ends, non-asbestos composition packing, and two-piece packing gland assembly. Provide with factory installed press to connect flange adapters, as described herein, with bolts, nuts and washers.
      - 1) NIBCO
- F. Strainers:
1. Provide 2 inch and smaller press to connect strainers listed in this section or lead free cast bronze strainers 2 inch and smaller listed in Division 22 section "Basic Piping Materials and Methods" may be used with sweat connections or sweat X press adapters.
  2. Strainers (Y pattern)
    - a. Rated for 250 psig CWP up to 250 degrees F maximum.
    - b. Body: Cast bronze conforming to ASTM B584.
    - c. Screen: Stainless steel mesh with 0.062" perforations.
    - d. Ends: Female press to connect ends of copper or brass material.
    - e. 2 inch and smaller:
      - 1) Apollo # 59LF

**PART 3 - EXECUTION****3.1 PIPING INSTALLATIONS**

- A. Install pipe, fittings, valves and specialties in accordance with manufacturer's installation instructions.
- B. Water distribution piping installations shall be installed subject to Division 22 Section "Water Distribution Systems and Specialties" in addition to those requirements specified in this Section.
- C. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

**3.2 PIPE APPLICATIONS ABOVE GRADE**

- A. Water piping in sizes 2-1/2 to 8 inches shall be Type "L" drawn copper tube with roll-grooved ends and copper tube dimensioned mechanical couplings and fittings or water piping sizes 2-1/2 inch to 4 inch shall be Type L drawn copper tube with plain ends and copper tube dimensioned press to connect fittings.
- B. Water piping in sizes 2 inches and smaller shall be Type "L" drawn copper tube with plain ends and copper tube dimensioned press to connect copper couplings and fittings.

**3.3 HANGERS AND SUPPORTS**

- A. Support of piping must account for expansion and contraction, vibration, and the dead load of the piping and its contents.
- B. General: Hanger supports, and anchors devices are specified in Division 22 Section "Hangers and Supports for Plumbing Piping." Reference Division 22 Section "Water Distribution Systems and Specialties" for pipe spacing limitations.

**3.4 PIPE JOINT CONSTRUCTION**

- A. Copper Grooved tubing System
  1. Pipe ends shall be clean and free from oils, indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing.
  2. Roll and cut groove ends in accordance to manufacturer's current listed standards. Use rolls sets designed and intended for use on the appropriate pipe material when grooving pipe.
  3. Flaring of CTS tube ends to IPS dimensions or to accommodate alternate sized couplings is not allowed.
  4. Verify the gasket style and elastomeric material (grade) is suitable for the intended service as specified and in combination with any system chemical additive.
  5. Reference latest published manufacturer's product data for additional pressure ratings and application information.
  6. Reference latest published manufacturer's field installation instructions or other included installation instruction prior to attempting assembly.
  7. Ream, deburr and clean tube ends and verify they are free from indentations, projections and roll marks in the area from tube end to groove for proper gasket sealing.
  8. All grooved components (couplings, fittings, valves, gaskets, bolts and nuts) shall be of one manufacturer. All grooving tools shall be of one manufacturer, though not necessarily the same as the grooved component manufacturer.
  9. Install gaskets with lubricant suitable for all piping services. Lubricant shall be by one manufacturer.

- B. Press to connect Copper Tubing System
1. Ream, deburr and clean tube ends and verify they are free from indentations, projections, burrs and foreign matter.
  2. Install permanent inspection mark on tube.
  3. Clean tube and fittings of all dirt and oil. Verify O-ring is in place, press connection components in place and free of oil, grease or dirt.
  4. Push copper tube into fittings with twisting action to all the way to the fitting stop or shoulder.
  5. Mark tube with permanent marker to indicate proper tube insertion depth.
  6. Verify press tool has correct size jaw set for tube size used.
  7. Complete one tool cycle with empty jaw to calibrate tool for each time new jaw is inserted into tool.
  8. Squeeze jaw arms to open tool jaws and place jaws around the contour of the fitting. Verify tool is perpendicular to the fitting and depress tool switch.
  9. Squeeze jaw open to remove the tool and observe witness mark.
  10. Verify crimped fitting connection for misalignment of the copper tube, misalignment of the tool or improper insertion of the tube. If any of these conditions are found cut out the joint and provide a new joint.
  11. Maintain minimum distance between joints per the manufacturer's published installation instructions.
  12. Perform pressure test for unpressed fitting detection per manufacturer's installation instruction prior to final pressure test.
- C. Dielectric Isolation Requirements for Copper Grooved Connections: Provide dielectric grooved waterway fittings or couplings at grooved galvanized steel, stainless steel or ductile iron to grooved copper joints. Dielectric waterway fittings are specified in Section "Basic Piping Materials and Methods".
- D. Dielectric Isolation Requirements for Press to Connect Adapter Flange Connections: Provide dielectric flanges or flange kits for the following joint types:
1. Adapter Flanges to Iron, Ductile Iron or Steel Body Valves and Fittings (Except Butterfly Valves with EPDM Sleeve/Seats): Provide full face gaskets between flanges and adapter flanges. At each bolt provide, steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves on valve and adapter flanges.
  2. Full face gaskets, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves are specified in Section "Basic Piping Materials and Methods".
- E. Flange Adapters:
1. Install flange adapter washers when flange adapters are used against the following surfaces:
    - a. Rubber.
    - b. Adapting to ANSI/AWWA cast flanges.
    - c. Rubber faced lug valves.
    - d. Serrated flanged surfaces.
  2. Do not install flange adapters for applications that incorporate tie rods for anchoring or on standard grooved-end fittings within 90 degrees of each other.

### 3.5 VALVE APPLICATIONS

- A. Reference Division 22 Section "Water Distribution Piping and Specialties" for valve applications.

### 3.6 EQUIPMENT CONNECTIONS

- A. Grooved flexible style couplings may be used at equipment connections where specified for vibration isolation control only.

- B. Press to connect joints shall not be provided for equipment connections. Provide flanges, unions, di-electric unions or waterway fittings. Flanges, unions, di-electric unions and waterway fittings are specified in Division 22 specification section "Basic Piping Materials and Methods"

### **3.7 STRAINERS**

- A. Provide strainers as specified in part 2 of this specification section or Division 22 specification section "Basic Piping Materials and Methods".
  1. Provide manufacturer strainer with press to connect ends for 2 inches and smaller.
  2. Provide copper press to connect X screwed NPT adapters for 2 inches and smaller.
  3. Provide press to connect adapter flanges for 2-1/2 inches to 4 inches.
  4. Provide copper grooved adapter flanges for 2-1/2 inches to 8 inches.

### **3.8 WATER DISTRIBUTION SPECIALTIES INSTALLATION**

- A. Reference Division 22 Section "Water Distribution Systems and Specialties" for water distribution specialties and installation requirements.

### **3.9 FIELD QUALITY CONTROL**

- A. The following procedures are paraphrased from the ASME B-31.9, code for pressure piping, building services piping.
- B. Installing contractor shall schedule certification training session with the mechanically joined piping component manufacturer, or manufacturer's representative, for all workers that will be installing or handling the mechanically joined piping systems. Training shall cover the proper use of mechanically joining tools and installation of mechanically joined piping products. Mechanically joined piping component manufacturer, or manufacturer's representative shall provide a certificate of completion for each attending worker.
- C. Provide testing procedures as defined in Division 22 Section "Water Distribution Systems and Specialties" and as specified in mechanically joined piping component manufacturer's installation instructions.
- D. Installing contractor shall visually inspect couplings and repair or replace any misaligned couplings and couplings with gaps prior to calling for inspection as defined in Division 22 Section "General Plumbing Requirements."
- E. Mechanically joined piping component manufacturer's representative shall make periodic visits to the jobsite during construction to ensure the installing contractor is following the latest published manufacturer's field installation instructions and best practice procedures provided during the training session.
- F. Workers performing mechanically joined joints shall initial each joint with a permanent ink marker, such as a "Sharpie". Initials shall be block letters with a minimum height of 1/4".

### **3.10 STARTUP**

- A. Refer to Division 22 Section "Water Distribution Piping and Specialties" for startup procedures.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 11 14 - STAINLESS STEEL WATER DISTRIBUTION PIPING AND SPECIALTIES****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes the piping material, components, documentation, examination, installation, and testing for piping system fluid services of domestic cold water, hot water, and hot water recirculation piping, fittings, and specialties within the building.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

**1.3 SUBMITTALS**

- A. Submit in accordance with conditions of Contract and Division 01 submittal procedures.
- B. Product Data: Submit data for each type of coupling, fitting and special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing.
- C. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure.
  - 1. Indicate grooved-joint couplings and fittings on drawings and product submittals, and specifically identify with the applicable style or series designation.
  - 2. If an assembly of flexible couplings are used for seismic vibration, thermal expansion, or noise and vibration reduction, submit shop drawings indicating location of assembly, including anchors and guides. Include movement analysis of the assembly, and performance data of the assembly.
- D. Maintenance Data: Include for each piping specialty and valve in Maintenance Manual specified in Division 01 and Division 22 Section "General Plumbing Requirements."
- E. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Failed test results and corrective action taken to achieve requirements.
- F. Submit a schedule of dissimilar metal joints and adaptor flanges and flange kits. Include joint type material, connection method and proposed flange kits to isolate dissimilar metals. Include minimum and maximum torque requirements for flange connections to valves. Dielectric flange kits are specified in Division 22 section "Basic Plumbing Piping Materials and Methods".
- G. Submit certification that pipe, pipe fittings, pipe specialties, and valves and fittings are manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.
- H. Submit training certificate of completion for each worker to engineer of record within 30-days of mobilization. Include copy of each worker's training certificate of completion with closeout documents.
- I. Piping Analysis:
  - 1. As a contractor's option, Victaulic can provide piping system design services to accommodate movement at building expansion joints. The service includes required

grooved piping components detailed in CAD on an overlay of the plumbing contract drawing(s), including anchor load calculations and placement of anchors. A calculation report showing thermal movement and seismic accommodation shall be provided.

- a. A design stamped by a qualified professional engineer of the manufacturer licensed in the jurisdiction where the project is being constructed is required.

J. Welding Procedure Specifications

1. Provide Welding Procedure Specifications (WPS) for welded pipe fabrication. A Welding Procedure Specification is a document that provides, in detail, required welding conditions for a specific application. The standard to which the product is being manufactured will normally identify which of the WPS variables are qualification variables. Qualification variables are items in the WPS that, if changed beyond specified limits, require requalification of the welding procedure. Common variables include, but are not limited to: Scope, Base Metal, Welding Process, Filler Metal, Type of Current and Range, Arc Voltage and Travel Speed, Joint Design, Tack Welding, Welding detail, Position of Welding, Preheat and Interpass Temperature, Peening, Heat Input, Second Side Preparation, and Postheat treatment.
  - a. Reference ASME BPVC QW-200.1, Section IX.
  - b. Reference ASME form QW-482 - Welding Procedure Specifications.
2. Submit Welding Procedure Specifications (WPS) to the Owner for approval at least one week prior to the start of fabrication.
3. Contractor shall prepare and qualify welding procedures in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code. The Contractor shall submit an index of all weld procedure specifications required for the job accompanied by four copies of each procedure, including the Procedure Qualification Record (PQR).
4. Procedures shall contain the specific information required by Section IX of the ASME Code QW—200.1. It is suggested that the WPS form QW—482, as recommended by Section IX, be utilized.

K. Welder/Welding Operator Performance Qualification

1. Provide Welder/Welding Operator Performance Qualifications (W/WOPQ). Welder, Welding Operator and Tack welder qualification tests determine the ability of the persons tested to produce acceptable sound welds with the process, materials and procedure called for in the test. Qualification tests are not intended to be used as a guide for welding during actual construction, but rather to assess whether an individual has a required minimum level of skill to produce sound welds. When the individual has passed the performance test, paperwork will be issued deeming that they are certified to produce a sound weld using that procedure.
  - a. Reference ASME BPVC QW-301, Section IX.
  - b. Reference ASME forms QW-484, QW-484A, and QW-484B - Welder/Welding Operator Performance Qualifications.
  - c. Reference ASME B31.9 paragraph 927.
2. Procedures shall contain the specific information required by Section IX of the ASME Code QW—301. It is suggested that the W/WOPQ forms QW—484, 484A and 484b, as recommended by Section IX, be utilized.

L. Procedure Qualification Record for Welding

1. Provide Procedure Qualification Records (PQR) for welded pipe fabrication. The (PQR) is a record of the welding data used to weld a test coupon. It records the actual welding condition used to produce an acceptable test joint. The results of the qualification test are recorded. This is the phase where the WPS is used like a recipe to produce the test specimen. The Qualification tests commonly used are Visual Inspection (VT), Dye Penetrant (PT), Magnetic Particle (MT), Ultrasonic (UT), Radiographic (RT), tensile and Bend testing. The referencing code will determine the test needed to be performed.
  - a. Reference ASME BPVC QW-201.2, Section IX.
  - b. Reference ASME forms QW-483 – Procedure Qualification Records (for welding).



2. Procedures shall contain the specific information required by Section IX of the ASME Code QW—201.2. It is suggested that the PQR form QW—483, as recommended by Section IX, be utilized.

#### 1.4 QUALITY ASSURANCE

- A. All grooved components shall be of one manufacturer, be date and origin stamped for quality assurance and traceability and conform to local code approval.
- B. Grooved mechanical piping shall conform to local code approval and/or as listed by ANSI/ASME-B-31.9, ASME, UL/ULC, FM, IAPMO or ICC.
- C. Grooved product manufacturer shall be ISO certified.
- D. Grooved couplings shall meet the requirements of ASTM F-1476.
- E. All wetted surface copper alloy couplings, fittings and valves shall meet ANSI/NSF-61, section 8.
- F. Contractor shall submit a copy of their (Contractor's) Quality Control Procedure to the Architect for review.
- G. At a minimum the procedure shall cover the following topics:
  1. Construction documents shall be reviewed by Contractor's Quality Control for Code compliance and constructability. The Architect shall be notified of any discrepancies before any action is taken.
  2. Contractor fabrication drawings shall be reviewed by Contractor's Quality Control for Code compliance and accuracy.
  3. Contractor's Quality Control shall review Purchase Orders for proper material and components.
  4. Receipt of material shall be examined by Contractor's Quality Control.
  5. Pipe fabrication shall be examined by Contractor's Quality Control.
  6. Contractor's Quality Control shall examine spool shipments for proper loading technique.
  7. Contractor's Quality Control shall verify that installation complies with design.
  8. Contractor's Quality Control shall verify spot passivation of welds.
  9. Contractor's Quality Control shall verify cleaning and testing of installed pipe.
- H. Examinations shall be in accordance with ASME B31.9.
- I. Couplings, fittings and valves shall meet ANSI/NSF-61.
- J. Stainless steel couplings, fittings and valves shall meet ANSI/NSF-61 Annex G.
- K. Qualify welding processes, welders, and welding operators in accordance with ASME Boiler and Pressure Vessel Code (BPVC), Section IX, "Welding and Brazing Qualifications."
- L. Regulatory Requirements: Comply with the provisions of the following codes:
  1. ASME B31.9 "Building Services Piping" for fabrication, installation, and testing.
  2. ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications" for Qualifications for Welding Processes, welders, and welding Operators.
- M. Pipe and fittings shall be manufactured in the United States or be certified to meet ANSI and ASTM standards.
- N. Workers performing spot passivation of welds shall have a minimum of one year experience or be under the direct supervision of experienced passivation workers.
- O. Installer Qualifications:
  1. Company specializing in performing work of the type specified in this Section, with minimum three years of documented experience.
  2. Obtain installation training from the mechanically joined piping manufacturer for all workers that will be installing or handling the mechanically joined piping components per Part III

“FIELD QUALITY CONTROL” below. Maintain a copy of each worker’s training certificate of completion on site for the duration of the project.

### 1.5 COORDINATION

- A. Reference Division 22 Section “Water Distribution Piping and Specialties” for coordination.

### 1.6 DELIVERY STORAGE AND HANDLING

- A. Comply with Division 22 Section “Basic Plumbing Piping Materials and Methods.”

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance, with requirements, provide products by one of the following:
  - 1. Stainless Steel Grooved Mechanical-Joint Fittings and Couplings:
    - a. ASC Engineered Solutions “Gruvlok”.
    - b. Shurjoint Piping Products.
    - c. Victaulic Company of America.

### 2.2 PIPE AND TUBE MATERIALS GENERAL

- A. Pipe and Tube: Refer to Part 3, Article "Pipe Applications", for identification of systems where the materials listed below are used.
- B. Stainless Steel Pipe: ASTM A312.
  - 1. Schedule 10S Type 304L where noted on the drawings for use with grooved mechanical couplings with rolled grooved ends and Type 304L components as appropriate to pipe material, wall thickness, pressures, size and method of joining. Pipe ends shall be grooved in accordance with standards conforming to ANSI/AWWA C-606.
  - 2. Pipe shall be factory passivated.

### 2.3 FITTINGS

- A. Stainless steel fittings shall be the same of the same alloy as the pipe described above.
- B. Refer to current manufacturer’s literature for pressure ratings of couplings and standard fittings for various pipe sizes and pipe schedules.
- C. Stainless Steel Fittings: Fittings shall be smooth turn full flow stainless steel fittings with grooves designed to accept grooved end couplings. Provide Schedule 10S fittings where noted on the drawings. Specific style numbers are listed in manufacturer’s current literature. Mitered fittings are not allowed, except for angles 7-1/2 degrees or less. Otherwise, when a directional change requires a non-standard, single-plane angle the required angle shall be achieved by trimming a standard 45° or 90° elbow. Fittings shall be factory passivated.
- D. Ductile Iron Couplings:
  - 1. Material: Cast of ductile iron conforming to ASTM A536, Grade 65-45-12 or ASTM A395 Grade 65-45-15, coated with suitable enamel or epoxy.
  - 2. Constructed of two-piece housing attached with bolts and nuts with pressure responsive elastomeric gasket. Provide washers where required by the manufacturer.
  - 3. Rigid Type:
    - a. ASC Engineered Solutions Gruvlok Series #7401.
    - b. Shurjoint Piping Products Style #Z07.
    - c. Victaulic Style # 107N.

4. Flexible Type:
    - a. ASC Engineered Solutions Gruvlok Series #7001
    - b. Shurjoint Piping Products Style #7707.
    - c. Victaulic Style # 475.
      - 1) 8-inch and smaller: Style 177N
      - 2) 10-inch and larger: Style 77
  5. Rigid CTS Adapter Type: IPS X CTS.
    - a. Shurjoint Piping Products Styles#C307
    - b. ASC Engineered Solutions Gruvlok Fig 617.
  6. Bolts, nuts, and washers:
    - a. Heavy-duty hexagonal nuts conforming to ASTM A563, Grade B.
    - b. Plated carbon steel flat washers conforming to ASTM F436.
    - c. Zinc-electroplated conforming to ASTM B633.
- A. Stainless Steel Couplings:
7. Material: Cast of 316L stainless steel conforming to ASTM A74, Grade CR-8M or ASTM A395 Grade 65-45-15, coated with suitable enamel or epoxy.
  8. Constructed of two-piece housing attached with bolts and nuts with pressure responsive elastomeric gasket. Provide washers where required by the manufacturer. Rigid Type:
    - a. ASC Engineered Solutions Gruvlok Series #472
    - b. Shurjoint Piping Products Style #SS-7
    - c. Victaulic Style # 89
  9. Flexible Type
    - a. ASC Engineered Solutions Gruvlok Series #405
    - b. Shurjoint Piping Products Style #SS-8X
    - c. Victaulic (1/2" to 6") Style # 77DX
    - d. Victaulic (8" to 18") Style # 77DX
  10. Bolts and nuts
    - a. Stainless steel neck bolts meeting ASTM F93 Group 2 (316 SS)
    - b. Stainless steel nuts meeting ASTM F594 Group 2 (316 SS)
- E. Stainless Steel Flanges: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connection and facing:
1. Material Group: 2.3.
  2. End Connections Type Flange: Butt Welding.
  3. Facings: Raised face.
- F. Stainless Steel Flange Adapter Nipples:
1. ANSI 150 flange with welded grooved nipple or grooved nipple and flange of one piece. Two piece "clamshell" flanges with O-ring is not acceptable.
    - a. ASC Engineered Solutions Fig 7084SS
    - b. Shurjoint Model SS-80
    - c. GRINNELL Mechanical Products Style Fig 441.
    - d. Victaulic Style 445R
- G. Stainless Steel Strainers:
1. Shurjoint Model SS-726.
- H. Dielectric Waterway Adapters: Bronze or nylon encapsulated ductile iron body with IPS grooved X CTS grooved ends.
1. ASC Engineered Solutions Gruvlok #7091
  2. Victaulic Style # 647GG.

## 2.4 JOINING MATERIALS

- A. Welding Materials: Comply, with Section II, Part C. ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

- B. Gasket Material: Thickness, material, and type suitable for fluid to be handled and design temperatures and pressures.
  - 1. Manufacturer's Flange: EPDM.
  - 2. ASME Flange: 1/8" Thick EPDM.

## 2.5 GENERAL-DUTY VALVES

- A. General-duty valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 22 Section "General Duty Valves for Plumbing Piping."

## PART 3 - EXECUTION

### 3.1 INSTALLATION GENERAL

- A. Install pipe, fittings, valves and specialties in accordance with manufacturer's installation instructions.

### 3.2 ABOVE GROUND WATER DISTRIBUTION PIPE AND FITTINGS

- A. Install for domestic hot, cold and soft cold water Schedule 10S Type 304L stainless steel pipe with roll grooved fittings and joints for pipe sizes 4 inches and larger.

### 3.3 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
- B. Use standard fittings for all changes in direction and branch connections. Trim fittings only where required. Segmentally welded fittings are not permitted.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.
- I. Fire Barrier Penetrations: Where pipes pass through fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials
- J. Contact manufacturer's product representative during the bidding phase to facilitate constructability, training, and to track progress to ensure stock-on-hand at the time of purchase. The factory representative shall also serve as a technical resource during construction.

- K. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Basic Piping Materials and Methods" for special sealers and materials. Stainless Branch Connections: Provide fittings as scheduled below for main and branch connections:

Pipe Size	Branch Size								
	½" to 2"	2-1/2"	3"	4"	6"	8"	10"	12"	
2-1/2"	RR	RT	T						
3"	RR		RT	T					
4"	RR		RT	RT	T				
6"	W		W	RT	RT	T			
8"	W		W	W	RT	RT	T		
10"	W		W	W	W	RT	RT	T	
12"	W		W	W	W	RT	RT	RT	T

Legend: T Tee, RT Reducing Tee, RR Reducing Tee & Reducer, W Butt Weld Pipet, TP Threaded Pipet

- L. Stainless steel piping shall not come in contact with ferrous material during its handling, storage, staging, transporting, or fabrication.
- M. The fabrication of stainless steel shall be segregated from that of ferrous materials.
- N. Fabricating tools that come in contact with stainless steel shall be dedicated to stainless steel.

### 3.4 HANGERS AND SUPPORTS

- A. General: Hanger, support, insulation protection shield and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.
- B. Pipe Attachments: Install the following:
- Adjustable stainless steel clevis hangers, MSS SP-69 Type 1, for stainless steel pipe 2" and larger for individual horizontal runs where hanger is in direct contact with the stainless steel pipe.
  - Adjustable steel clevis hangers, MSS SP-69 Type 1, for stainless steel pipe 2" and larger for individual horizontal runs where hanger is not in direct contact with the stainless steel pipe.
  - Riser clamps, MSS SP-69 Type 8, for individual vertical runs. Provide stainless steel riser clamps when in contact with stainless steel pipe.
  - Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Hangers and Supports for Plumbing Piping" and "Plumbing Insulation".
  - Extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of stainless steel pipe 2" on walls or for securing tube inside walls for connection to faucets.
  - Engineered strut support system may be provided, at the contractor's option, in lieu of individual hangers for horizontal pipes as specified in Division 22 "Hangers and Supports for Plumbing Piping". Provide stainless steel two piece straps for uninsulated pipe secured to the bare stainless steel pipe. Provide two piece straps and 360° insulation protection shields sized for the insulation thickness used for the pipe for all insulated pipes.
  - Provide roll hangers for individual horizontal runs 100 feet or longer.
  - Provide vibration isolation on piping as specified in Division 22 Section "Vibration Isolation for Plumbing Piping and Equipment."
- C. Install hangers for horizontal piping with the following maximum spacing and minimum rod sizes:

Nom. Pipe Size - In.	Steel Pipe Max. Span - Ft.	Min. Rod Dia. - In.
Up to 3/4	7	3/8
2-1/2	10	3/8
3	10	3/8
3-1/2	10	3/8
4	10	3/8
5	10	1/2
6	10	1/2
8	10	1/2

1. Support vertical steel pipe at each floor.

- D. Support water piping above the floor with pipe supports attached to the floor with anchor bolts where indicated on the drawings. Conform to the table above for maximum spacing of supports.

### 3.5 PIPE AND TUBE JOINT CONSTRUCTION

- A. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

B. Stainless Steel Grooved Tubing System

1. Verify gasket style and elastomeric material (grade) is suitable for the intended service as specified and in combination with any system chemical additives.
2. Reference latest published manufacturer's product data for additional pressure ratings and application information.
3. Reference latest published manufacturer's field installation instructions or other included installation instruction prior to attempting assembly.
4. Ream, debur and clean tube ends and verify they are free from indentations, projections and roll marks in the area from tube end to groove for proper gasket sealing.
5. All grooved components (couplings, fittings, valves, gaskets, bolts and nuts) and all grooving tools shall be of one manufacturer.
6. Install gaskets with lubricant suitable for system piping services. Lubricant shall be by one manufacturer.
7. Provide ductile iron couplings on schedule [10][40] pipe sizes [X"] and smaller
8. Provide stainless steel couplings on schedule [10][40] pipe sizes [X"] and larger

C. Stainless Steel to Copper Systems:

1. Stainless steel 4 inch and smaller to copper 2 inches and smaller:
  - a. Stainless steel reducing tee with 2 inch grooved side outlet.
  - b. Stainless steel rigid coupling, dielectric waterway adapter and CTS rigid coupling. CTS rigid couplings and their installation requirements are specified in Division 22 Section "Mechanically Joined Plumbing Piping Systems".
  - c. Contractors Option (in lieu of above) - 2 inch rigid CTS adapter coupling, 2 inch grooved X copper plain adapter (size as required). 2 inch grooved X copper plain adapters and their installation requirements are specified in Division 22 Section "Mechanically Joined Plumbing Piping Systems".
2. Stainless steel 6 inch and larger to copper 2 inches and smaller:
  - a. Stainless steel tee and welded pipet with 2 inch welded outlet.
  - b. Stainless steel rigid coupling, dielectric waterway adapter and CTS rigid coupling. CTS rigid couplings and their installation requirements are specified in Division 22 Section "Mechanically Joined Plumbing Piping Systems".
  - c. Contractors Option (in lieu of above) - Stainless steel reducing tee with 2 inch grooved side outlet, 2 inch rigid CTS adapter coupling, 2 inch grooved X copper plain adapter (size as required). 2 inch grooved X copper plain adapters and their

installation requirements are specified in Division 22 Section "Mechanically Joined Plumbing Piping Systems".

3. Stainless steel 6 inch and larger to copper 2-1/2 inches to 4 inches:
    - a. Stainless steel tee or reducing tee with grooved side outlet:
    - b. Stainless steel rigid coupling, dielectric waterway adapter and CTS rigid coupling. CTS rigid couplings and their installation requirements are specified in Division 22 Section "Mechanically Joined Plumbing Piping Systems".
    - c. Contractors Option (in lieu of above):
      - 1) Rigid CTS adapter coupling, grooved X copper plain adapter (size as required). Grooved X copper plain adapters and their installation requirements are specified in Division 22 Section "Mechanically Joined Plumbing Piping Systems".
      - 2) Grooved X stainless steel flange adapter nipple (X size as required), bronze flange and dielectric flange kit. Bronze flanges and dielectric flange kits and their installation requirements are specified in Division 22 Section "Basic Piping Materials and Methods Requirements".
  4. Stainless steel to copper 6 inches to 8 inches:
    - a. Stainless steel tee or reducing tee with grooved side outlet.
    - b. Stainless steel rigid coupling.
    - c. Grooved X stainless steel flange adapter nipple (X size as required).
    - d. Bronze flange and dielectric flange kit. Bronze flanges and dielectric flange kits and their installation requirements are specified in Division 22 Section "Basic Piping Materials and Methods Requirements".
- D. Welded Joints:
1. Comply with the requirement in ASME Code B31.9-"Building Services Piping" Para. 927.
  2. Use 316L, or 317L consumable electrode material when welding 316L pipe.
  3. Other consumable electrode materials may be used if the materials and the process qualification methods used are specifically approved by owner.
  4. Joint preparation for welding may be performed by machining, grinding, thermal cutting or combinations thereof. Excessively deep or sharp irregularities in joint edges shall be removed by machining or by grinding. Joint edges shall be free of cracks and laminations prior to welding.
  5. Prior to welding all oil, grease, dirt, rust or loose scale shall be removed from the surfaces of the joint and the adjacent base metal within one inch from the edge of the joint.
  6. Root gap in excess of 3/16" is not permitted.
  7. Acceptable welding processes are GTAW and GMAW. Requests to use any other welding processes shall be submitted to the owner for review.
  8. End prep for buttwelds shall comply with ASME B16.25 – Buttweld Ends.
  9. During welding provide internal purge with Argon or other suitable purge gas.
  10. Discoloration of the internal surface of the pipe wall within the Heat Affected Zone (HAZ) of a weld shall not exceed example weld No. 3 as represented in Fig. 1 – Weld Color Chart from AWS D18.2.

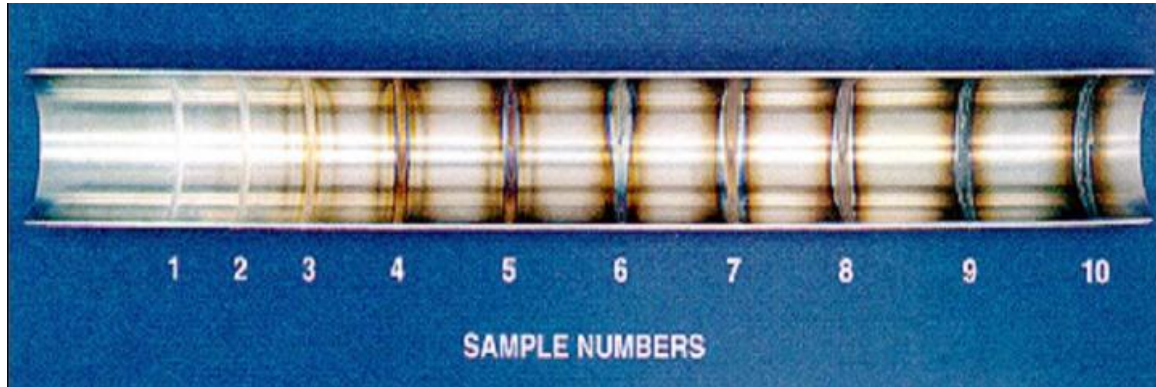


Figure 1 – Weld Color Chart from AWS D18.2

Note: For Quality Assurance purposes contractor is to obtain an original color chart from AWS for examination comparison. Fig. 1 is an example and is not to be used as a QC comparison tool.

- E. Passivation of Welded Joints
1. Situate all cleaning equipment in a central location that is free of performance hindering congestion and unauthorized traffic.
  2. Provide protective covering for floors, pipe fittings and equipment.
  3. Rinse area to be cleaned with appropriate volume of deionized water sending all waste water to drain.
  4. Pour small amount of ore-mixed Ultradent Citric Acid 10% solution into small plastic container. Using the plastic container pour just the amount to cover the welds.
  5. Using a non-metallic brush apply a uniform layer of passivation gel to the spot to be cleaned. Continue to wash the affected area every 20 to 30 minutes until a minimum of 2 hours contact time is achieved.
  6. In between applications, scrub the affected area with soft bristle, non-metallic (including stainless steel) brush for up to five minutes.
  7. Mix a solution of deionized water with 15 to 20% food grade sodium bicarbonate. Ensure sodium bicarbonate is completely dissolved.
  8. Using a non-metallic brush, apply sodium bicarbonate solution to the area to be cleaned. Continue to wet the affected area until all noticeable foaming reaction ceases.
  9. Test pH of the surface. Continue to wash affected area until pH value between 6 to 8 is achieved.
  10. Rinse affected area with de-ionized water for a minimum duration of ten minutes sending all waste water to drain.
  11. Contractor's quality control shall review each weld passivation and prepare report with list of completed passivation for each weld. Include date, location and size of weld passivated.

### 3.6 VALVE APPLICATIONS

- A. General-Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shut-off duty: Use ball and butterfly valves.
  2. Throttling duty: Use ball and butterfly valves.

### 3.7 INSTALLATION OF VALVES

- A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2 inches and smaller, use gate or ball valves; for sectional valves 2-1/2 inches and larger, use butterfly valves.



- B. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, on each supply to each plumbing fixture, and elsewhere as indicated. For shutoff valves 2 inches and smaller, use ball valves; for shutoff valves 2-1/2 inches and larger, use butterfly valves.
- C. Drain Valves: Install drain valves on each plumbing equipment item, located to drain equipment completely for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to drain distribution piping system completely. For drain valves 2 inches and smaller, use ball valves; for drain valves 2-1/2 inches and larger, use butterfly valves.
- D. Check Valves: Install swing check valves on discharge side of each pump and elsewhere as indicated.

### 3.8 STRAINERS

- A. Provide stainless steel strainers in stainless steel piping systems for 3 inch to 8 inch.
- B. Provide strainers as specified in Division 22 specification section "Basic Piping M and M Requirements".
  - 1. Provide stainless steel adapter flanges for 2-1/2 inches and larger.

### 3.9 WATER DISTRIBUTION SPECIALTIES INSTALLATION

- A. Reference Division 22 Section "Water Distribution Systems and Specialties" for water distribution specialties and installation requirements.

### 3.10 FIELD QUALITY CONTROL

- A. The following procedures are paraphrased from the ASME B-31.9, code for pressure piping, building services piping.
- B. Installing contractor shall schedule certification training session with the mechanically joined piping component manufacturer, or manufacturer's representative, for all workers that will be installing or handling the mechanically joined piping systems. Training shall cover the proper use of mechanically joining tools and installation of mechanically joined piping products.. Mechanically joined piping component manufacturer, or manufacturer's representative shall provide a certificate of completion for each attending worker.
- C. Mechanically joined piping component manufacturer's representative shall make periodic visits to the jobsite during construction to ensure the installing contractor is following the latest published manufacturer's field installation instructions and best practice procedures provided during the training session.
- D. Workers performing mechanically joined joints shall initial each joint with a permanent ink marker, such as a "Sharpie". Initials shall be block letters with a minimum height of 1/4".
- E. Inspections: Inspect water distribution piping as follows:
  - 1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected, leak tested, and approved by the authority having jurisdiction.
  - 2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
    - a. Rough-in Inspection: Arrange for inspection of the piping system before piping is concealed or closed in after system is roughed in and prior to setting fixtures.
    - b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.

- c. Reinspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.
  - d. Reports: Prepare inspection reports signed by the plumbing official and turn over to the Architect upon completion of the project.
- F. Piping System Leak Test: After installation and prior to the disinfecting treatment of the domestic water piping system, perform an "initial service" leak test in accordance with ASME B31.9.
- 1. Test for leaks and defects in all new water distribution piping systems and parts of existing systems that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
  - 2. If leak testing is done in segments highlight and mark the boundaries of each piping test circuit on a P&ID, system isometric, or other suitable type drawing. Each test circuit shall have its own identifier. This identifier shall be used to identify the piping involved in each test.
  - 3. Each test shall be documented on a test form indicating, at the minimum, the date, type of test, start time, finish time, test pressure, test temperature, contractor representative and owner witness signatures.
  - 4. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
  - 5. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for 0.5 hours. Leaks and loss in test pressure constitute defects that must be repaired and retested.
  - 6. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
  - 7. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

### **3.11 CLEANING AND DISINFECTING**

- A. Clean and disinfect water distribution piping system as follows:
- 1. Prior to flushing or purging the system with domestic water remove all strainer elements.
  - 2. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.
  - 3. Flush the system with clean, potable water until chlorine residual is equal to incoming city water level.
    - a. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.
  - 4. Reports: Prepare disinfection reports signed by the authority having jurisdiction and turn over to the Architect upon completion of the project.

### **3.12 FLUSHING**

- A. The piping systems shall not be let to stand without use for no more than three days. Flush the system with twice the volume of the system to prevent stagnation.

### **3.13 COMMISSIONING**

- A. If the system remains in operation after flushing, leak test, and disinfecting process ensure that:
- 1. All air has been purged from the system.
  - 2. All gages and instruments are working properly.
  - 3. All pumps and equipment are working properly.

- B. If the piping system has been drained after the “initial service” leak test and disinfecting process, perform these steps prior to start-up of the system:
  - 1. Close drain valves, hydrants, and hose bibbs.
  - 2. Open in-line valves to full open position.
  - 3. Remove and clean strainers.
- C. Gradually fill the system again. Check compression tanks to determine that they are not air bound and that the system is completely full of water.
- D. Before operating the system, perform these steps:
  - 1. Close drain valve, hydrants, and hose bibbs.
  - 2. Open valves to full open position.
  - 3. Remove and clean strainers.

### **3.14 STARTUP**

- A. Refer to Division 22 Section “Water Distribution Piping and Specialties” for startup procedures.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 11 23 - DOMESTIC WATER PUMPS****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes the following types of plumbing pumps:
  - 1. Inline circulator pumps
  - 2. Packaged domestic booster pumps
- B. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 3 Section "Concrete Work" for specifications on concrete and reinforcing materials and concrete placing requirements for equipment pads.
  - 2. Division 22 Section "Coordination" for basic requirements for electrical components that are an integral part of packaged system components.
  - 3. Division 22 Section, "Basic Piping Materials and Methods" for rubber flexible connectors.
  - 4. Division 22 Section "Vibration Isolation for Plumbing Piping and Equipment" for inertia pads, isolation pads, spring supports, and spring hangers.
  - 1. Division 23 Section "Direct-Digital Control for HVAC" for interlock of alarms with building automation system and alarm wiring.
  - 5. Division 26 Section "Common Work Results for Electrical" required electrical devices.
  - 6. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

**1.2 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
  - 1. Product data including standard performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories, plus installation and start-up instructions.
  - 2. Shop drawings showing layout and connections for plumbing pumps. Include setting drawings with templates, and directions for installation of foundation bolts, anchor bolts, and other anchorages.
  - 3. Wiring diagrams detailing wiring for power, signal, and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.
  - 4. Maintenance data for plumbing pumps, for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."
  - 5. Submit certification that pumps, valves, fittings and specialties comply with NSF 61 Annex G.
- B. Submit certificate to the Architect stating completion of factory start up and of proper booster pump installation per "startup" in Part III below:

**1.3 QUALITY ASSURANCE**

- A. Hydraulic Institute Compliance: Design, manufacture, and install plumbing pumps in accordance with "Hydraulic Institute Standards."
- B. National Electrical Code Compliance: Components shall comply with NFPA 70 "National Electrical Code."
- C. UL Compliance: Plumbing pumps shall be listed and labeled by UL and comply UL Standard 778 "Motor Operated Water Pumps."

- D. UL Compliance: Control panels shall be listed and labeled by UL and comply with Standard 508A "Control Panels".
- E. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.
- F. Single-Source Responsibility: Obtain plumbing pumps of the same type from a single manufacturer.
- G. Design Criteria: The Drawings indicate sizes, profiles, connections, and dimensional requirements of plumbing pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of plumbing pumps is on the proposer.
- H. Comply with NSF 61 Annex G (pending) for wetted surfaces of valves, fittings and specialties containing no more than 0.25% lead by weight compliance for valves for domestic water service.
- I. Valves, pumps and fittings shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

#### 1.4 SPARE PARTS

- A. Furnish spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Mechanical Seals: One mechanical seal for each pump.

#### 1.5 WARRANTY

- A. Warranty on Pumps: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, pumps with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement includes both parts and labor for removal and reinstallation.
  - 1. Warranty Period: One year from date of substantial completion.

### PART 2 - PRODUCTS AND MATERIALS

#### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Inline Circulator Pumps:
    - a. Armstrong Pumps, Inc.
    - b. Bell & Gossett, ITT.
    - c. Grundfos Pumps, Corp.
    - d. Taco, Inc.
  - 2. Packaged Domestic Booster Pumps – Variable Speed Multistage
    - a. Armstrong
    - b. Bell & Gossett, ITT
    - c. Grundfos Pumps, Corp.
    - d. QuantumFlo, Inc.
  - 3. Aquastats:
    - a. Dayton
    - b. Honeywell
    - c. Penn
    - d. White-Rodgers

4. Time Switches
  - a. Intermatic.com
  - b. NSI Industries "TORK Series"

## 2.2 PUMPS GENERAL

- A. Pumps and circulators: factory assembled and factory tested.
- B. Preparation for shipping: After assembly and testing, clean flanges and exposed machined metal surfaces and treat with an anticorrosion compound. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- C. Motors: Conform to NEMA standards; single, multiple, or variable speed with type of enclosure and electrical characteristics as indicated; have built-in thermal-overload protection and grease-lubricated ball bearings. Select motors that are nonoverloading within the full range of the pump performance curve.
- D. Apply factory finish paint to assembled, tested units prior to shipping.

## 2.3 INLINE CIRCULATOR PUMPS

- A. General Description: Circulators shall be horizontal inline, centrifugal, separately coupled, single-stage, all-bronze, radially split case design, with mechanical seals, permanently lubricated ball bearings and rated for 125 psig working pressure and 225 deg F continuous water temperature.
- B. Casings: Cast lead free bronze, with threaded companion flanges for piping connections smaller than 2-1/2 inches, and threaded gauge tappings at inlet and outlet connections.
- C. Impeller: Statically and dynamically balanced, closed, overhung, single suction, fabricated from cast lead free bronze conforming to ASTM B 584, and keyed to shaft.
- D. Pump Shaft and Sleeve: Steel shaft with oil-lubricated copper sleeve.
- E. Mechanical Seals: Carbon steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
- F. Pump Bearings: Oil-lubricated, bronze journal and thrust bearings.
- G. Motor Bearings: Oil-lubricated sleeve bearings.
- H. Shaft Couplings: Flexible; capable of absorbing torsional vibration and shaft misalignment.
- I. Motors: Resiliently mounted to the pump casing.

## 2.4 PACKAGED DOMESTIC BOOSTER PUMPS – VARIABLE SPEED MULTISTAGE

- A. Packaged, constant pressure type with triplex vertical multiple stage centrifugal pumps, control panel, motors, variable frequency drives, gauges, ball type isolation valves, dielectric isolators, accumulator tank, thermal bleed aquastat and solenoid valve and accessories. The packaged system, including all items listed below, shall be factory assembled on a fabricated steel base plate with structural steel framework. The completed package shall be factory tested, adjusted and certified for the specified flow conditions, and shipped as an integral unit ready for plumbing and electrical connections.
- B. Pumps: Provide multiple stage vertical multiple stage centrifugal type with close-coupled motors, cast iron suction / discharge chamber, motor stool and pump shaft couplings, mechanical seals, 304 stainless steel and impellers, chambers, straps, suction interconnector and neck rings, 431 stainless steel pump shaft and 316 stainless steel bearings, neck rings retainers, split cones, split cone nuts, wear and lock rings.
- C. Motors: Provide variable speed, totally enclosed fan cooled type, operate at 3500 rpm and shall not overload at any point of the pump curve.

- D. Piping: Suction and discharge headers shall be 316 stainless steel with ANSI class 150 pressure rating and flanges welded to the headers. Peak velocity in headers shall not exceed 8 feet per second. Furnish with the following valves:
- a. Butterfly Valves, 2-1/2-Inch and Larger: MSS SP-67; 200-psi CWP; lug-type body constructed of cast-iron conforming to ASTM A 126, Class B or ductile iron conforming to ASTM A 536. Provide valves with field replaceable EPDM sleeve/seat, aluminum-bronze CF8M (316) stainless steel disc, 416 stainless steel stem, and EPDM O-ring stem seals. Provide lever operators, (10 position minimum), with lock and stops with locks for sizes 2-1/2 through 6 inches and gear operators with position indicator for sizes 8 inch and larger. Drill and tap valves on dead-end service or requiring additional body strength. Valves must be rated for dead end service at 150 psi with no downstream flange required.
  - b. Cast Iron Body Ball Valves, 2-1/2" and larger: 200 CWP, maximum operating temperature of 140F; two piece cast iron body meeting ASTM A126 Class B with flanged ends, 304 stainless steel full port ball and shaft, ductile iron handle, PTFE gasket, stem seal and seat.
  - c. Wafer Check Valves: Class 150, stainless steel body; with replaceable stainless steel seat, and non-slam design lapped and balanced twin stainless steel flappers and stainless steel trim and torsion spring. Provide valves designed to open and close at approximately one foot differential pressure.
- E. Accumulator Tank: Provide tank size as scheduled on the drawings with a minimum pressure rating of 125psig; FDA approved elastomer bladder, tank bottom connection and air charge valve. Tank shall be complete with check valves, isolation valves and pressure reducing valve for remote installation.
- F. Controls and Instruments: Control panel shall be mounted on the pump package and shall include a NEMA 12 enclosure, through door disconnect, disconnect for each pump, overload relays and indicator lights, 120V control circuit transformer with primary and secondary fuse protection, low suction pressure limit switch, suction and discharge header pressure sensors, programmable logic controller and variable speed drives. Touchscreen operator interface for monitoring and adjustment of the programmable controller variables with virtual on-off-automatic selector switch for each pump, low suction pressure shutdown alarm, high system pressure shutdown alarm, high flow rate shutdown alarm, VFD failure alarm contact, pump running indicators and hour meter for each pump. Control panel shall be configured for termination of 1 incoming power feeder. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings.
1. Programmable Logic Controller (PLC): Designed specifically for the control of pumps with variable speed drives capable of receiving two analog pressure inputs, analog flow input, automatic pump alternating and On-line field modified data entries for staging pumps, with software memory stored in non-volatile EPROM memory, furnish with user interface keypad with LED display.
  2. Alarm Interface: Provide dry contact internal to the control panel for the following alarm conditions:
    - a. Low suction pressure shutdown alarm
    - b. High system pressure shutdown alarm
    - c. High flow rate shutdown alarm
    - d. VFD failure alarm
  3. Data Interface: Provide BACnet card following alarm and data conditions:
    - a. Low suction pressure shutdown alarm
    - b. High system pressure shutdown alarm
    - c. High flow rate shutdown alarm
    - d. VFD failure alarm
    - e. Instantaneous system flow rate
    - f. Suction header pressure
    - g. Discharge header pressure



4. Variable Frequency Drive: The variable speed drives (VFD) shall be adjustable frequency type which employs a pulse width modulated inverter. The drive shall include built in diagnostics. Diagnostics shall be annunciated through the alpha numeric keypad. The drive shall be listed UL, ETL and/or CSA. To insure safety of the equipment, the VFD shall include these protective features and options:
  - a. NEMA 1 enclosure.
  - b. Static instantaneous over-current and over-voltage trip.
  - c. Static over-speed (over-frequency) protection.
  - d. Line or fuse loss and under-voltage protection.
  - e. Power unit over-temperature protection.
  - f. Motor inverse time overload protection.
  - g. Input fused disconnect or circuit breaker.
  - h. Total voltage harmonic distortion from the VFD shall be less than 5% to meet IEEE requirements.
  - i. Speed meter.
  - j. Automatic restart after power failure or minor drive fault. The drive shall attempt a minimum of two restarts before a complete drive shut-down.
  - k. Power on light.
  - l. Manual speed potentiometer or control capability through the keypad.
  - m. Hand/Off/Automatic Switch or Manual/Automatic Switch with start/stop pushbutton.
  - n. Test switch
  - o. VFD fault light and reset with alarm relay.
  - p. Output to the PLC and integral LED display
  - q. The VFD shall be microprocessor based and utilize digital input for all parameter adjustments. The VFD shall include a digital display for monitoring system parameters and for first fault indication, and digital input programming capability on the main logic board.
  - r. The VFD shall operate on a frequency range of 1 to 66 Hz with resolution of 0.1% of base speed with analog input or 0.025% with digital input and have accuracy within 0.05% of set point. VFD shall operate in environment of 0 to 40 degrees C, 3,300 feet altitude and 95% non-condensing humidity without derating.
  - s. All control circuit voltages shall be physically and electrically isolated from power circuit voltages.
  - t. All VFD's shall be tested/run in the equivalent of NEMA 1 enclosure and burned in at rated ambient (40° C) with a fully loaded motor.
  - u. Configured for mounting on top of motor or outside of control panel.
5. Pressure Sensors: NEMA 4 water tight enclosure with pressure rating of 2,000psi, stainless steel wetted parts, 0.25" male NPT connection, calibration from 0 to 150 psi with 4-20mA DC signal at 24 VDC. Refer to the floor plans for location of remote pressure sensor.
6. Sequence of Operation: The domestic water booster pump shall be in automatic mode per the design conditions shown on the booster pump schedule. The pump shall modulate its speed to maintain the discharge head pressure setpoint, as determined by the internal control algorithm, simulating the performance of a system utilizing a remote differential pressure sensor. The pumps shall run in a lead/lag operation based on user defined run-time setpoint. When the flow capacity of the lead pump is exceeded, the lag pump shall start after an adjustable time delay. If the capacity of the lead pump and lag pump is exceeded, the second lag pump (and the N 1 sequencing shall continue based on the number of pumps in the system) shall start.
  - a. When a single pump operates at minimum flow rate, the pump speed shall be reduced to the minimum discharge header pressure as scheduled. When required flow increases, the pump speed shall increase linearly to the discharge pressure as scheduled at full flow, simulating the performance of a system utilizing a remote differential pressure sensor.

- b. When the lead pump is stopped because of required zero flow, the pump speed shall increase linearly to the discharge pressure as scheduled to charge the tank, then stop.
- 7. Safeties:
  - a. Low Suction Pressure
    - 1) When the suction pressure drops below the low suction pressure alarm point as determined by the integral suction pressure sensor, the pumps shall be disabled and an audible alarm shall be sent to the BMS or local building alarm system.
  - b. High Discharge Pressure
    - 1) When the discharge pressure rises above the high discharge pressure alarm point as determined by the integral discharge pressure sensor, the pumps shall be disabled and an audible alarm shall be sent to the BMS or local building alarm system
  - c. High Flow Shutdown
    - 1) When the discharge flow, as calculated by the control system, rises above the high flow alarm point, the pumps shall be disabled and an audible alarm shall be sent to the BMS or local building alarm system.
  - d. VFD Alarm
    - 1) When a VFD goes into alarm condition, as calculated by the internal VFD control system, an audible alarm shall be sent to the BMS or local building alarm system.
- 8. Control Wire: Domestic booster pump manufacturer shall furnish the appropriate type and amount of wire for interlock of the remote sensors with the domestic booster pump control panel.

## 2.5 AQUASTATS

- A. Remote sensing bulb type, non-modulating, single pole double pole throw with surface mount sensing bulb and mounting bracket, adjustable direct reading scale for set point with adjustable differential.

## 2.6 TIME SWITCHES

- A. As described on the drawings

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install pumps in accordance with manufacturer's installation instructions.
- B. General: Comply with the manufacturer's written installation and alignment instructions.
- C. Install pumps in locations and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.
- D. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.
- E. Suspend inline pumps with all thread hanger rod and vibration isolation hangers of sufficient size to support the weight of the pump independent from the piping system.

**3.2 EXAMINATION**

- A. Examine areas, equipment foundations, and conditions with Installer present, for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine rough-in for plumbing piping systems to verify actual locations of piping connections prior to installation.

**3.3 CONCRETE EQUIPMENT BASES**

- A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for concrete equipment bases.
  - 1. Form concrete equipment bases by using framing lumber with form release compounds. Chamfer top edge and corners of pad.
  - 2. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves using manufacturer's installation template.
  - 3. Place concrete and allow to cure before installation of pumps.

**3.4 ALIGNMENT**

- A. Align pump and motor shafts and piping connections after setting on foundations, after grout has been set and foundations bolts have been tightened, and after piping connections have been made.
  - 1. Adjust alignment of pump and motor shafts for angular and parallel alignment by one of the two methods specified in the Hydraulic Institute "Centrifugal Pumps - Instructions for Installation, Operation and Maintenance."
- B. After alignment is correct, tighten the foundation bolts evenly but not too firmly. Fill the base plate completely with nonshrink, nonmetallic grout, with metal blocks and shims or wedges in place. After grout has cured, fully tighten foundation bolts.
  - 1. Alignment tolerances shall meet manufacturers recommendations.

**3.5 CONNECTIONS**

- A. General: Install valves that are same size as the piping connecting the pump.
- B. Install suction and discharge pipe sizes equal to or greater than the diameter of the pump nozzles.
- C. Install a nonslam check valve and shutoff valve on the discharge side of pumps.
- D. Install a gate valve and strainer on the suction side of inline pumps.
- E. Install pressure gauges on the suction and discharge of each pump at the integral pressure gauge tapings provided.
- F. Install pressure gauge connector plugs in suction and discharge piping around pump. Pressure gauge connector plugs are specified in Division 22 Section "Meters and Gauges for Plumbing Piping."
- G. Install surface mounted aquastat on bare metal pipe, fastened securely to pipe upstream of circulator pump when indicated on the drawings.
- H. Interlock aquastat and or timer in series with hot water recirculation pump motor. Electrical wiring and connections are specified in Division 26 section "Common Work Results for Electrical".
- I. Electrical wiring and connections are specified in Division 26 section "Common Work Results for Electrical".

- J. Install domestic booster pump remote sensors as recommended by the manufacturer. Coordinate interlock of the sensors and domestic booster pump. Install control wire furnished with the domestic booster pump for interlock with the sensors. Electrical wiring and connections are specified in Division 26 section "Common Work Results for Electrical".
- K. Install flexible connectors at the header inlet and outlet of domestic booster pump, refer to Division 22 Section "Basic piping Materials and Methods".
- L. Provide equipment pad and vibration isolators, refer to Division 22 Section "Vibration Isolation for Plumbing Piping and Equipment".
  - 1. Extend equipment pads to 2" beyond elbows, shutoff valves and flexible connectors. Anchor elbows and shutoff valves to equipment pad.
  - 2. Extend equipment pad to 2" beyond base elbows. Anchor elbows to equipment pad. Install flexible connectors and shutoff valves in the vertical. Anchor shutoff valves to the structure.
- M. Provide concrete inertia base and vibration isolators, refer to Division 22 Section "Vibration Isolation for Plumbing Piping and Equipment".
  - 1. Provide an equipment pad, separate from the inertia pad, to 2" beyond elbows. Anchor elbows to equipment pad. Install flexible connectors and shutoff valves in the vertical. Anchor shutoff valve to the structure.
- N. Coordinate interlock of high flow rate, low suction pressure, high discharge pressure level and VFD failure alarms with the building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".
- O. Coordinate interlock of booster pump with building automation system via BACnet protocol for high flow rate, low suction pressure, high discharge pressure level and VFD failure alarms, Instantaneous system flow rate, Suction header pressure, and Discharge header pressure data. Wiring and interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".

### 3.6 FIELD QUALITY CONTROL

- A. Check suction lines connections for tightness to avoid drawing air into the pump.

### 3.7 STARTUP

- A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:
  - 1. Lubricate oil-lubricated bearings.
  - 2. Remove grease-lubricated bearing covers and flush the bearings with kerosene and thoroughly clean. Fill with new lubricant in accordance with the manufacturer's recommendations.
  - 3. Disconnect coupling and check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
  - 4. Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.
- B. Starting procedure for pumps with shutoff power not exceeding the safe motor power:
  - 1. Prime the pump, opening the suction valve, closing the drains, and prepare the pump for operation.
  - 2. Open the valve in the cooling water supply to the bearings where applicable.
  - 3. Open the sealing liquid supply valve if the pump is so fitted.
  - 4. Open the warm-up valve of a pump handling hot liquids if the pump is not normally kept at operating temperature.
  - 5. Open the recirculating line valve if the pump should not be operated against dead shutoff.

6. Start motor.
  7. Open the discharge valve slowly.
  8. Observe the leakage from the stuffing boxes and adjust the sealing liquid valve for proper flow to ensure the lubrication of the packing. Do not tighten the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.
  9. Check the general mechanical operation of the pump and motor.
  10. Close the recirculating line valve once there is sufficient flow through the pump to prevent overheating.
- C. If the pump is to be started against a closed check valve with the discharge gate valve open, the steps are the same except that the discharge gate valve is opened some time before the motor is started.
- D. Start Up Services for Booster Pump:
1. Startup Services: Domestic booster pump manufacturer representative shall provide factory start-up and check out of the booster pump. Domestic booster pump manufacturer shall provide the Owner a minimum of 1 hour of training in the operation of the booster pump.
  2. Certification: Domestic booster pump manufacturer representative shall prepare a certificate stating completion of factory start up and of proper booster pump installation signed by the manufacturer representative.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 13 00 - SANITARY DRAINAGE AND VENT PIPING AND SPECIALTIES****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes building sanitary drainage and vent piping systems, including drains and drainage specialties.
- B. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
  - 2. Division 33 Section "Sanitary Sewage Systems," for sanitary drainage piping beginning from 5'-0" outside the building.
  - 3. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
  - 4. Division 11 Section "Kitchen and Food Service Equipment," for drains and trim furnished with the food service and kitchen equipment.
  - 5. Division 12 Section "Laboratory Casework and Fixtures," for laboratory drains and trim furnished with the casework.
  - 6. Division 22 Section "Plumbing Identification," for labeling and identification of drainage and vent piping.
  - 7. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall and floor penetrations and equipment pads
  - 8. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
  - 9. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting drainage and vent piping.
  - 10. Division 22 Section "Plumbing Insulation," for materials and methods for insulating drainage piping.
  - 11. Division 22 Section "Water Distribution Piping and Specialties," for material and methods for trap primers and trap primer inlet piping.
  - 12. Division 22 Section "Condensate Pumps for HVAC Equipment," for material and methods for condensate pumps.

**1.2 DEFINITIONS**

- A. Sanitary Building Drain: That part of the lowest piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer.
- B. Sanitary Building Sewer: That part of the drainage system which extends from the end of the building drain and conveys its discharge to a public sewer, private sewer, individual sewage disposal system, or other point of disposal.
- C. Drainage System: Includes all the piping within a public or private premises which conveys sewage or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.
- D. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

**1.3 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
- B. Product data for the following products:
  - 1. Drainage piping
  - 2. Drainage piping specialties
  - 3. Floor drains
  - 4. Trench drains
  - 5. Interceptors
  - 6. No-hub fitting restraints
- C. Test reports specified in Part 3 of this Section.

**1.4 QUALITY ASSURANCE**

- A. Comply with the installation requirements for CPVC pipe and CPVC CTS tube per the Lubrizol "FlowGuard Gold and CORZAN Design and Installation Manual" and the installed manufacturer's installation manual.
- B. Regulatory Requirements: Comply with the provisions of the following codes:
  - 1. 2015 International Plumbing Code

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Drainage Piping Specialties, including backwater valves, expansion joints, cleanouts, floor drains, cast-iron trench drains and vandal-proof vent caps:
    - a. Jay R. Smith Mfg. Co.
    - b. Josam Mfg. Co.
    - c. Mifab Manufacturing Co.
    - d. Sioux Chief Manufacturing Co. Inc.
    - e. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
    - f. Watts Industries, Inc.
    - g. Zurn Industries, Inc.; Hydromechanics Div.
  - 2. Non-Metallic Trench Drains:
    - a. ABT, Inc., Polydrain
    - b. Dura Trench
    - c. Jay R. Smith Mfg. Co.
    - d. MEA-JOSAM
    - e. Mifab Manufacturing Co.
    - f. NDS
    - g. Sioux Chief Manufacturing Co. Inc.
    - h. Watts Industries, Inc.
    - i. Zurn Industries, Inc.
  - 3. Plastic Hydromechanical Grease Interceptors:
    - a. CANPLAS
    - b. Green Turtle, Inc.
    - c. Mifab Manufacturing, Inc.
    - d. Schier Products
  - 4. Heavy Duty Hubless Couplings
    - a. Anaco Husky HD-2000
    - b. Clamp-All 80in. lb.



- c. Ideal Tridon "HD"
- d. Mifab Manufacturing, Inc. #MI-XHUB-series
- e. Mission Rubber Company, "Heavy Weight"
- f. ProFlo "HD"
5. Cast Iron Soil Pipe and Fittings
  - a. AB & I Foundry
  - b. Charlotte Pipe and Foundry Company
  - c. Tyler Pipe / Soil Pipe Division
6. Shielded Transition Couplings
  - a. FERNCO, "Proflex 3000 Series"
  - b. Mifab Manufacturing, Inc. #MI-HUB-ARC-series
  - c. Mission Rubber Company, "Band Seal Specialty Couplings"
7. Underground Shielded Adapter Couplings
  - a. FERNCO, "1056 Series with SR73 Shear Ring"
  - b. Mifab Manufacturing, Inc. #MI-HUB-ARC-CL-series
  - c. Mission Rubber Company, "MR56 Series"
8. Trap Seals
  - a. Green Drain, Inc.
  - b. Jay R. Smith Mfg. Co.
  - c. Mifab Manufacturing, Inc.
  - d. Proset Systems "Trap Guard"
  - e. Rector Seal, Inc.
  - f. Zurn Industries, Inc.; Hydromechanics Div.
9. Hubless Couplings:
  - a. Anaco
  - b. Ideal Tridon
  - c. Mifab Manufacturing, Inc. #MI-HUB- series
  - d. Mission Rubber Company
  - e. ProFlo "PFNH"
  - f. Tyler Pipe / Soil Pipe Division
10. Plastic Gravity Interceptors
  - a. Green Turtle, Inc.
  - b. Mifab Manufacturing, Inc.
  - c. Schier Products
  - d. Thermaco, Inc.
  - e. Xerxes Corp.
11. No-Hub Fitting Restraints
  - a. Holdrite
12. Backwater Valves
  - a. Cleancheck
  - b. Mainline Backflow Products
  - c. Mifab Manufacturing Co.
  - d. Sioux Chief
  - e. Spears
13. Shower Linear Trench Drains
  - a. Infinity Drain
  - b. Jay R. Smith Mfg. Co.
  - c. Schluter systems
  - d. Zurn industries

## 2.2 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS

- A. Refer to Part 3, Article "Pipe Applications - Above Ground, Within Building" for identification of systems where the materials listed below are used.

- B. Cast-Iron Soil Pipe: CISPI 301 and ASTM A888, no-hub pipe and fittings and bearing the trademark of CISPI and NSF.
  - 1. Couplings and compression gaskets, NSF certified: ASTM C564 and CISPI 310.
  - 2. Heavy duty couplings and compression gaskets: ASTM C1540 and meeting FM 1680.
- C. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with "solid wall" PVC meeting ASTM D1784 with cell class 12454-B.
  - 1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
  - 2. Solvent: ASTM D2564.
- D. Steel Pipe: ASTM A53, Type E or S, schedule 40, Grade B, galvanized, threaded ends.
  - 1. Galvanized Malleable Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ASME B1.20.1.
- E. Shielded Transition Couplings: ASTM C1460 with neoprene adapter gasket with stainless steel Shield and hose clamps.

### **2.3 UNDERGROUND BUILDING DRAIN AND VENT PIPE AND FITTINGS**

- A. Refer to Part 3, Article "Pipe Applications - Below Ground, Within Building" for identification of systems where the materials listed below are used.
- B. Cast-Iron Soil Pipe: ASTM A74, Service weight, hub-and-spigot soil pipe and fittings. Pipe and fittings shall have a heavy coating of coal tar varnish or asphaltum on both inside and outside surfaces and bearing the trademark of CISPI and NSF.
  - 1. Neoprene Compression Gaskets: ASTM C564.
- C. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with "solid wall" PVC meeting ASTM D1784 with cell class 12454-B.
  - 1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
  - 2. Solvent: ASTM D2564.
- D. PVC Pressure Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 with "solid wall" PVC meeting ASTM D1784 with cell class 12454.
  - 1. Solvent: ASTM D2564.
  - 2. Fittings: Schedule 40 meeting ASTM D2466 with solvent cement socket joints.
- E. Underground Shielded Adapter Couplings: ASTM C1173 with neoprene adapter gasket with stainless steel shield and stainless steel hose clamps.

### **2.4 DRAINAGE PIPING SPECIALTIES**

- A. Backwater Valves: Valve assembly shall be bronze fitted cast-iron, with bolted cover. Flapper shall provide a maximum 1/4 inch clearance between flapper and seat for air circulation. Valve ends shall suit piping material.
- B. Cleanout Plugs: As specified on the drawings.
- C. Floor Cleanouts: As specified on the drawings.
- D. Wall Cleanouts: As specified on the drawings.
- E. Floor Drains: As specified on the drawings.
- F. Cast-iron Trench Drains: As specified on the drawings.
- G. Trap seals: Provide trap seals meeting either description below:
  - 1. Smooth, soft, flexible, elastomeric PVC material with a flapper closure. The flow of wastewater allows flapper to open and adequately discharge to floor drain through its opening. The flapper closes and returns to original position after wastewater discharge is complete.

**2.5 NO-HUB FITTING RESTRAINTS**

- A. Pre-engineered kits of galvanized steel pipe straps with stainless steel band clamps and tee bolts, meeting requirements of the CISPI Installation Handbook.

**2.6 TRENCH DRAINS**

- A. Trench drain type designations and sizes are indicated on the Drawings.
- B. Non-Metallic Trench Drains: Polyester resin and quartz aggregate, precast, interlocking design, with bottom radius and 0.6 percent slope.
  - 1. Precast Material: Load pressure of 14,500 psi, bending pressure of 2,900 psi, frost-proof, salt-proof, inert under dilute acid and alkali conditions, and less than 1.0 percent water absorption rate.
  - 2. Grates: Cast iron or steel as indicated, for heavy-duty truck traffic, with openings designed to prevent entry of bicycle or wheelchair tires.

**2.7 SHOWER LINEAR TRENCH DRAINS**

- A. Shower linear trench drain type designations and sizes are indicated on the drawings.

**2.8 INTERCEPTORS**

- A. Interceptor type designations, flow rates, and capacities are indicated on the drawings.
- B. Hydromechanical Grease Interceptor: As scheduled on the drawings.
- C. Lint Interceptor: As scheduled on the drawings.

**PART 3 - EXECUTION****3.1 INSTALLATION GENERAL**

- A. Install pipe and specialties in accordance with manufacturer's installation instructions.

**3.2 PREPARATION FOUNDATION FOR UNDERGROUND SANITARY BUILDING DRAINS**

- A. Pipe Beds:
  - 1. PVC Pipe: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement process. After pressure testing is complete, gradually install bedding to maintain continuous pipe slope and prevent pipe deflection and then install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.
  - 2. Cast Iron Soil Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand bedding. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation and maintain continuous pipe slope. For piping with rock trench bottoms, provide sand pipe bed 6" underneath and around sides of pipe, including fittings. After pressure testing is complete, install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

**3.3 PIPE APPLICATIONS - ABOVE GROUND WITHIN BUILDING**

- A. Install hubless, cast-iron soil pipe and fittings for 15" and smaller soil, waste, and vent pipe.
- B. Install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings, copper sweat X screwed with solder joints, for waste connections from urinals, lavatories, sinks, water coolers, and kitchen equipment to cast iron drainage piping.
- C. Install Type M copper tube with wrought copper fittings with solder joints, 1" and smaller, with 3/4" minimum size and install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings for 1-1/4" and larger for waste connections from kitchen equipment and terminate over floor receptors with air gap.
- D. Condensate drain piping and pumped condensate drain piping inside the building: Provide 3/4" minimum size or as indicated on the drawings. Slope gravity drainage condensate piping from mechanical equipment at 1/8" per foot minimum slope. Discharge to floor receptor with air gap.
  - 1. Install Type M copper tube with wrought copper fittings with solder joints, 1" and smaller and install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings for 1-1/4" and larger. Provide galvanic isolators as specified in Division 22 "Basic Piping Materials and Methods".
- E. Condensate drain piping outside the building: Provide 3/4" minimum size or as indicated on the drawings. Slope condensate piping at 1/8" per foot minimum slope to discharge point. Discharge to roof receptors or roof drains with air gap.
  - 1. Install Type M copper tube with wrought copper fittings with solder joints, 1" and smaller, and install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings for 1-1/4" and larger. Provide galvanic isolators as specified in Division 22 "Basic Piping Material and Methods".
  - 2. Install PVC pressure pipe and fittings for 1" and smaller and install "solid wall" PVC Type DWV pipe and fittings for 1-1/4" and larger.
- F. Install galvanized schedule 40 steel pipe and malleable iron fittings for sump pump discharge pipe.
- G. Install type "L" copper tube with wrought copper fittings with solder joints for sump pump discharge pipe.
- H. Install 1/2" type L copper tube for trap primer outlet piping.

**3.4 PIPE APPLICATIONS - BELOW GROUND WITHIN BUILDING**

- A. Install hub-and-spigot, service weight, cast-iron, soil pipe and fittings with gasketed joints for 15 inch and smaller for soil, waste, and vent pipe.
- B. As a contractor's option with Owner approval, Install PVC Type DWV Plastic pipe and fittings for drainage and vent pipe for 24" and smaller. Install fabricated fittings for 16 inch and larger.
- C. Install PVC pressure pipe and fittings for sump pump discharge.
- D. Install type "K" soft copper tube with wrought copper fittings with solder joints for sump pump discharge pipe, 2" and smaller.
- E. Install 1/2" type K soft copper tube for trap primer outlet piping.

**3.5 PIPE AND TUBE JOINT CONSTRUCTION**

- A. Copper Tubing: Solder joints in accordance with the procedures specified in AWS "Soldering Manual."
- B. Cast-Iron Soil Pipe: Make hubless joints in accordance with the Cast-Iron Soil Pipe & Fittings Handbook, Chapter IV. Install Couplings as followings:

1. Install hubless couplings complying with CISPI 310 on soil and waste piping 3" and smaller and all vent piping.
  2. Install heavy duty hubless couplings on soil or waste stacks, soil and waste piping connections to soil or waste stacks and all soil and waste piping 4" and larger.
  3. Install No-Hub fitting restraints on joints 5" and larger at:
    - a. Changes of direction from vertical to horizontal
    - b. 4" branch connections, including tees, wyes and wye combination fittings to soil and waste piping 5" and larger
    - c. Horizontal changes of direction 22-1/2 degrees and greater
    - d. Changes in diameter of two pipe sizes or greater.
- C. PVC DWV Pipe: Joining and installation of PVC drainage pipe and fittings shall conform to ASTM D2665.
- D. ABS to PVC Transition Joints: When joining ABS to PVC components (such as an ABS building drain to PVC sewer pipe) make joints using solvent cements conforming to ASTM D3138.
- E. Cast Iron to PVC Above Grade: Join cast iron to PVC with shielded transition couplings.
- F. Cast Iron to PVC Below Grade: Join cast iron to PVC with underground shielded adapter couplings.

### 3.6 INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing, slope, expansion, and other design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and all branch connections.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Paint exposed copper drain lines serving kitchen equipment with a minimum of two coats of chromium-based paint.
- H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and sealer. Refer to Division 22 Section " Basic Piping Material and Methods" for special sealers and materials.
- I. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls using sleeves and mechanical sleeve sealers. Refer to Division 22 Section "Basic Piping Material and Methods" for additional information.
- J. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings and floors, maintain the fire rated integrity. Refer to Division 22 Section " Basic Piping Material and Methods" for special sealers and materials.

- K. Foundation Penetrations: Where pipes pass through foundation walls above strip footings or under strip footings, protect pipes from building load with cast iron soil pipe sleeves two pipe sizes larger than the pipe. Sleeves installed under the strip footing shall be encased in concrete.
- L. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.
- M. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, combination wye and eighth bend, or long sweep, quarter, sixth, eighth, or sixteenth bends. Sanitary tees or quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn pattern combination wye and eighth bends where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. Double wyes or double wye combinations shall not be used in the horizontal. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper sized standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.
- N. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- O. Install drainage piping pitched down at a minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger. Install vent piping pitched to drain back by gravity to the sanitary drainage piping system.
- P. Install condensate drains pitched down at a minimum slope of 1 to 10 for piping 3 inches and smaller.
- Q. Extend building drain to connect to service piping, of size and in location indicated for service entrance to building. Sewer service piping is specified in a separate section of Division 2.
- R. Install 1 inch thick extruded polystyrene over underground building drain piping not under building. Width of insulation shall extend minimum of 12" beyond each side of pipe. Install directly over, and center on pipe center line.

### 3.7 HANGERS AND SUPPORTS

- A. General: Hanger, support, insulation protection shields, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.
- B. Install the following pipe attachments:
  - 1. Adjustable clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
  - 2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.
  - 3. Provide 316 stainless steel rods, nuts, washers, beam clamps, channels, insulation protection shields, adjustable band hangers, MSS SP-69 Type 7, or clevis hangers, MSS SP-69 Type 1, for piping located in Hydrotherapy and Pool Equipment Rooms.
  - 4. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Hangers and Supports for Plumbing Piping" and "Plumbing Insulation".
    - a. Install high density insulation on insulated pipe.
  - 5. Provide vinyl coated hangers and riser clamps for use with PVC pipe and CPVC CTS tube.

1. Provide roll hangers for individual horizontal runs 100 feet or longer.
2. Provide ceiling flanges attached to the floor, all thread rod and split ring pipe clamps for indirect drains and condensate drains supported from the floor 2" and smaller.

C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

Nom. Pipe	Steel Pipe		Copper Tube	Min. Rod	Dia. - In.
	Size - In.	Max. Span - Ft.	Max. Span - Ft.	Max. Span - Ft.	
Up to 1-1/4	12	6		3/8	
	1-1/2 to 2	12		10	3/8
	2-1/2 to 4	12		10	3/8
	5	12		10	1/2
	6	12		10	1/2
	8	12		10	1/2
	10 to 12	12		10	5/8
	14 to 15	12		N/A	3/4

1. Support all sizes of horizontal cast iron piping every five feet, except up to ten feet where ten foot sections are installed. Support all sizes of hubless horizontal cast iron piping every other joint, unless over four feet, then support each joint. Provide support adjacent to joint, not to exceed 18". Provide support at each horizontal branch.
2. Support all sizes of vertical cast iron piping every ten feet.
3. Support all sizes of horizontal of PVC piping every four feet.
4. Support all sizes of vertical of PVC piping every floor, but not to exceed ten feet. For sizes 2 inches and smaller, provide guide midway between required vertical supports.
5. Support piping within 12" of each elbow or tee.
6. Support each P-trap.

D. Support condensate piping located on roof with pre-engineered roof supports, pre-engineered roof supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table above for maximum spacing of supports. Adjust pipe support to maintain minimum pipe slope.

E. Sway bracing:

1. Provide rigid sway bracing for pipe 4" and larger at changes of direction greater than 45 degrees.

F. Bracing for above floor base of stacks 4" and larger and higher than three stories:

1. Secure horizontal base of stack to structure with riser clamp within at the fitting changing direction of flow from vertical to horizontal. Provide rods of size equal to cast iron pipe size scheduled above in pipe hanger schedule.

### 3.8 INSTALLATION OF PIPING SPECIALTIES

- A. Install backwater valves in sanitary building drain piping as indicated, and as required by the plumbing code. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover and of adequate size to remove valve cover for service.
- B. Provide PVC DWV expansion joints every 30' on straight vertical PVC waste or sanitary stacks receiving hot water waste. Install expansion joint at middle travel for equal expansion and contraction travel. Provide riser clamps within 18" of each end of expansion joint. Install expansion joint per manufacturer's installation instructions.

- C. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:
1. as required by plumbing code;
  2. at each change in direction of piping greater than 45 degrees;
  3. at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping;
  4. at base of each vertical soil and waste stack.
- D. Cleanout Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.
- E. Floor Cleanouts: Install in below floor building drain piping as indicated, and:
1. as required by plumbing code;
  2. at each change in direction of piping greater than 45 degrees;
  3. Install in below floor building drain piping at minimum intervals of 50' for piping 4" and smaller and 75' for larger piping;
  4. Install floor cleanouts in waterproof floors with waterproof membrane securely flashed with cleanout body flashing clamp so that no leakage occurs between cleanout body and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
- F. Exterior Cleanouts: Install exterior cleanouts embedded in a 18" x 18" x 8" block of concrete, flush with finished grade.

### 3.9 INSTALLATION OF FLOOR DRAINS FLOOR SINKS

- A. Install floor drains, floor sinks, and shower linear trench drains in locations indicated.
- B. Install floor drains, trench drains and shower linear trench drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor. Set floor sinks and floor troughs flush with the level finish floor.
- C. Refer to architectural documents for floor slope requirements and set floor drain elevation to match. Where architectural documents do not indicate the requirements, set the floor drain elevation depressed below the finished slab elevation as listed below to provide proper slope to drain:

<u>DEPRESSION IN INCHES</u>	<u>RADIUS OF AREA DRAINED - FEET</u>
1/2	5
3/4	10
1	15
1-1/4	20
1-1/2	25

- D. Provide P-traps for drains connected to the sanitary sewer.
- E. Install floor drains, floor sinks, and shower linear trench drains, in waterproof floors with waterproof membrane securely flashed with drain flashing clamp so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
- F. Position drains so that they are level, accessible and easy to maintain.

### 3.10 INSTALLATION OF TRAP PRIMERS

- A. Install trap primer outlet piping with 1/32" per foot slope towards drain trap where possible.
- B. Connect trap primer outlet piping only to factory installed taps on the drain body or P-trap assembly or provide an auxiliary inlet fitting with factory installed trap primer tap.
- C. Install trap primer outlet piping in elevated slabs or slabs on grade below concrete reinforcing bars. Wrap with 1/2" thick flexible unicellular insulation, attach to the reinforcing bars with plastic



ties and spacers every five feet to eliminate galvanic corrosion. Refer to Division 22 Section "Plumbing Insulation" for flexible unicellular insulation.

- D. Where proper trap primer outlet piping slope can be maintained and the trap primer outlet line would not be subject to freezing, trap primer outlet lines may be installed as follows:
  - 1. Install below elevated floor slabs.
  - 2. Install in the sub grade of slab on grade.
- E. Install sleeves and caulk at penetrations through building floor for watertight installation. In an elevated floor slab installation, bracket the piping to bottom of floor once the slab is poured.
- F. Refer to Division 22 Section "Water Distribution Piping and Specialties" for trap primer and trap primer inlet pipe requirements.

### **3.11 INSTALLATION TRAP SEALS**

- A. Install trap seals in accordance with manufacturer's written instructions and in locations indicated.
- B. Make watertight seal using an adhesive type caulk along bottom of trap seal, if required by the manufacturer.
- C. Employ a test plug for testing and remove before normal floor drain use. Clean inside of drain tailpiece and install trap seal after testing.
- D. Do not touch elastomeric plug or allow contact with primer or solvent cement.

### **3.12 CONNECTIONS**

- A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.
- B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

### **3.13 FIELD QUALITY CONTROL**

- A. Inspections
  - 1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
  - 2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
    - a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
    - b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to insure compliance with the requirements of the plumbing code.
    - c. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspection by the plumbing official.
    - d. Reports: Prepare inspection reports, signed by the plumbing official.
- B. Piping System Test: Test drainage and vent system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
  - 1. Test for leaks and defects all new drainage and vent piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.

2. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
  3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
  4. Final Plumbing Test Procedure: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Tightly close all openings, initially except vents thru the roof, in the system and fill the system with smoke from one or more smoke machines designed for smoke testing of plumbing systems. When smoke appears at a vent thru the roof, seal the vent thru roof with a test plug. Pressurize the system with 1" water column of smoke for 15 minutes. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Visually verify all joints for leaks.
  5. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
  6. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.
- C. Super Flush Test:
1. Purpose: This test is designed to closely simulate the usage of the sanitary drainage system at a high usage event such as halftime. The test shall verify that the sanitary system is sized for such an event. Great care shall be taken not to "over simulate" the halftime event by flushing fixtures at a more rapid rate than what can realistically occur.
  2. Procedure:
    - a. Station personnel at each sanitary building drain exit at nearest floor drain, hub drain, floor sink or mop sink. Observe that no overflow occurs during the Super Flush Test of the Water Distribution System. Refer to Division 22 Section "Water Distribution Piping and Specialties" for additional Super Flush Test requirements.
  3. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained. If overflow occurs, verify obstructions are not present downstream of overflow location with a sewer camera. Remove obstructions with power snake. Notify Architect if overflow observed with no obstructions found.
  4. Reports: Prepare observation report of a successful super flush test and turn over to the Architect upon completion of the project.

### **3.14 AD USTING AND CLEANING**

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Clean drain strainers, domes, and traps. Remove dirt and debris.

### **3.15 PROTECTION**

- A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.
- C. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of a water based latex paint.

END OF SECTION

**SECTION 22 13 28 - CONDENSATE PUMPS FOR HVAC EQUIPMENT****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes the following types of plumbing pumps:
  - 1. Condensate pumps for HVAC equipment
- B. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 22 Section "Coordination" for basic requirements for electrical components that are an integral part of packaged system components.
  - 2. Division 22 Section "Sanitary Drainage and Vent Piping and Specialties" for condensate pipe material and installation requirements.
  - 3. Division 23 Section "Direct-Digital Control for HVAC" for interlock with HVAC equipment and interlock of alarms with building automation system and alarm wiring.
  - 4. Division 26 Section "Common Work Results for Electrical" for required electrical devices.
  - 5. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

**1.2 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
  - 1. Product data including standard performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories, plus installation and start-up instructions.
  - 2. Wiring diagrams detailing wiring for power, signal, and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.
  - 3. Maintenance data for condensate pumps, for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."

**1.3 QUALITY ASSURANCE**

- A. Hydraulic Institute Compliance: Design, manufacture, and install condensate pumps in accordance with "Hydraulic Institute Standards."
- B. National Electrical Code Compliance: Components shall comply with NFPA 70 "National Electrical Code."
- C. UL Compliance: Plenum rated condensate pumps shall be listed and labeled by UL and comply with Standard 2043 "Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air Handling Spaces".
- D. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.
- E. Single-Source Responsibility: Obtain plumbing pumps of the same type from a single manufacturer.
- F. Design Criteria: The Drawings indicate capacity, connections, and power requirements of condensate pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of plumbing pumps is on the proposer.

**1.4 WARRANTY**

- A. Warranty on Pumps: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, pumps with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement includes both parts and labor for removal and reinstallation.
  - 1. Warranty Period: One year from date of substantial completion.

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Plenum Rated HVAC Condensate Pump:
    - a. Little Giant with no substitutions

**2.2 PUMPS GENERAL**

- A. Condensate Pumps: Factory assembled and factory tested.
- B. Preparation for shipping: Provide suitable packaging to protect pump from damage during shipping.

**2.3 CONDENSATE PUMPS FOR HVAC EQUIPMENT**

- A. General Description: Pumps shall be direct connected, single stage type with body and reservoir of a material suitable for plenum or non-plenum installation as scheduled on plans, normally open safety overflow switch with two dry contacts, integral check valve and power cord with ground.
- B. Non-plenum rated: Reservoir and body shall be either ABS or PE plastic.
- C. Plenum rated: Reservoir and body shall be all polypropylene and meet UL 2043.

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Install in accordance with manufacturer's installation instructions.
- B. Install pumps in locations and arrange to provide access for periodic maintenance.
- C. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.

**3.2 EXAMINATION**

- A. Examine areas, equipment foundations, and conditions with Installer present, for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine rough-in for plumbing piping systems to verify actual locations of piping connections prior to installation.

**3.3 CONNECTIONS**

- A. Piping between the HVAC unit and the pump shall be the greater of the discharge port size on the HVAC equipment or 3/4" pipe size or as shown on plans, whichever is larger. Discharge piping from the condensate pump shall be equal to or greater than the diameter of the pump nozzle, minimum 3/4", or as shown plans, whichever is larger. Condensate pump discharge pipe material is specified in Division 22 Section "Sanitary Drainage and Vent Piping and Specialties".
- B. Electrical wiring and connections are specified in Division 26 section "Common Work Results for Electrical".
- C. Coordinate interlock of condensate pump safety overflow switch with unit served to disable unit if safety overflow switch closes as noted on plans and schedules. HVAC interlock wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".
- D. Coordinate interlock of condensate pump failure alarm with Building Automation System. HVAC interlock wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".

**3.4 STARTUP**

- A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:
  - 1. Ensure pump is connected to the condensate discharge system.
  - 2. Verify all power wiring is in place and power is provided to pump.
- B. Testing procedure for condensate pumps:
  - 1. Pour water into the pump reservoir until the water sensing switch is activated.
  - 2. Verify water is pumped out of the reservoir and that there are no leaks in the condensate piping or at the connection point to the pump.
  - 3. Verify integral check valve is operating properly, replace with new if found to be defective.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 14 00 - STORM DRAINAGE PIPING AND SPECIALTIES****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes building storm drainage piping systems, including drains and drainage specialties.
- B. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
  - 2. Division 33 Section "Storm Systems," for storm drainage piping beginning from 5'-0" outside the building.
  - 3. Division 33 Section "Foundation Drainage," for foundation drainage piping.
  - 4. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
  - 5. Division 22 Section "Identification for Plumbing Piping and Equipment," for labeling and identification of drainage piping.
  - 6. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall and floor penetrations and equipment pads
  - 7. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
  - 8. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting drainage piping.
  - 9. Division 22 Section "Plumbing Insulation," for materials and methods for insulating drainage piping.

**1.2 DEFINITIONS**

- A. Storm Building Drain: That part of the lowest piping of a drainage system which receives the discharge from storm drainage pipes inside the walls of the building and conveys it to the building sewer.
- B. Storm Building Sewer: That part of the drainage system which extends from the end of the building drain and conveys its discharge to a public sewer or private sewer or other point of disposal.
- C. Drainage System: Includes all the piping within a public or private premises which conveys storm water or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.

**1.3 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
- B. Product data for the following products:
  - 1. Drainage piping
  - 2. Drainage piping specialties
  - 3. Area drains
  - 4. Trench drains
  - 5. Roof drains
  - 6. Hubless fitting restraints
- C. Test reports specified in Part 3 of this Section.

**1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements: Comply with the provisions of the following codes:
  - 1. 2015 International Plumbing Code
- B. Comply with the installation requirements for PVC gasketed sewer pipe per the Uni-Bell PVC Pipe Association "Installation Guide for Solid Wall PVC Sewer Pipe". Comply with the installation requirements for gasketed fittings per the Uni-Bell PVC Pipe Association "Installation Guide for PVC Fittings and Laterals for Solid Wall PVC Sewer Pipe".
- C. Obtain installation training from the PVC gasketed sewer pipe manufacturer for all workers that will be installing or handling the PVC gasketed sewer pipe piping systems. Submit certification letter along with each workers certificate of completion to engineer of record within 30-days of mobilization. Include copy of certification letter with closeout documents.

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Drainage Piping Specialties, including backwater valves, expansion joints, cleanouts, area/roof drains, cast-iron trench drains and downspout nozzles:
    - a. Josam Mfg. Co.
    - b. Sioux Chief Manufacturing Co. Inc.
    - c. Smith (Jay R) Mfg. Co.
    - d. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
    - e. Watts Industries, Inc.
    - f. Zurn Industries, Inc.; Hydromechanics Div.
    - g. Mifab Manufacturing, Inc.
  - 2. Heavy Duty Hubless Couplings
    - a. Anaco Husky HD-2000
    - b. Clamp-All 80in. lb.
    - c. Ideal Tridon "HD"
    - d. Mifab Manufacturing, Inc. #MI-XHUB-series
    - e. Mission Rubber Company "Heavyweight"
    - f. ProFlo "HD"
  - 3. Downspout Boots 4" and smaller
    - a. Josam Mfg. Co.
    - b. Smith (Jay R) Mfg. Co.
    - c. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
    - d. Watts Industries, Inc.
    - e. Zurn Industries, Inc.; Hydromechanics Div.
    - f. Mifab Manufacturing, Inc. Neenah Foundry Company
  - 4. Downspout Boots 5" and larger
    - a. Barrycraft
    - b. R. J. Hoe
    - c. Piedmont Pipe Manufacturing
  - 5. Cast Iron Soil Pipe and Fittings
    - a. AB & I Foundry
    - b. Charlotte Pipe and Foundry Company
    - c. Tyler Pipe / Soil Pipe Division
  - 6. Shielded Transition Couplings
    - a. FERNCO, "Proflex 3000 Series"
    - b. Mifab Manufacturing, Inc. #MI-HUB-ARC-series
    - c. Mission Rubber Company, "Band Seal Specialty Couplings"
  - 7. Underground Shielded Adapter Couplings



- a. FERNCO, "1056 Series with SR73 Shear Ring"
- b. Mifab Manufacturing, Inc. #MI-HUB-ARC-CL-series
- c. Mission Rubber Company, "MR56 Series"
- 8. PVC DWV Fittings 16" and Larger
  - a. Plastic Trends, Inc.
- 9. Hubless Fitting Restraints
  - a. Holdrite
- 10. PVC DWV Expansion Joints
  - a. Charlotte Pipe and Foundry Company #133
  - b. Spears Manufacturing Company #S119
- 11. Backwater Valves
  - a. Cleancheck
  - b. Mainline Backflow Products
  - c. Sioux Chief
  - d. Spears
  - e. Mifab Manufacturing, Inc.

## 2.2 ABOVE GROUND DRAINAGE PIPE AND FITTINGS

- A. Refer to Part 3, Article "Pipe Applications - Above Ground, Within Building" for identification of systems where the materials listed below are used.
- B. Cast-Iron Soil Pipe: CISPI 301 and ASTM A888, hubless pipe and fittings, and bearing the trademark of CISPI and NSF.
  - 1. Heavy duty couplings and compression gaskets: ASTM C564, ASTM C1540 and meeting FM 1680.
- C. Shielded Transition Couplings: ASTM C1460 with neoprene adapter gasket with stainless steel Shield and hose clamps.

## 2.3 UNDERGROUND BUILDING DRAIN PIPE AND FITTINGS

- A. Refer to Part 3, Article "Pipe Applications - Below Ground, Within Building" for identification of systems where the materials listed below are used.
- B. Cast-Iron Soil Pipe: ASTM A74, Service weight, hub-and-spigot soil pipe and fittings, and bearing the trademark of CISPI and NSF. Pipe and fittings shall have a heavy coating of coal tar varnish or asphaltum on both inside and outside surfaces.
  - 1. Neoprene Compression Gaskets: ASTM C564.
- C. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with "solid wall" PVC meeting ASTM D1784 with cell class 12454-B.
  - 1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
  - 2. Solvent: ASTM D2564.
- D. PVC Pressure Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 with "solid wall" PVC meeting ASTM D1784 with cell class 12454.
  - 1. Fittings: Schedule 40 meeting ASTM D2466 with solvent cement socket joints.
  - 2. Solvent: ASTM D2564.
- E. Underground Shielded Adapter Couplings: ASTM C1173 with neoprene adapter gasket with stainless steel shield and stainless steel hose clamps.

## 2.4 DRAINAGE PIPING SPECIALTIES

- A. Backwater Valves: Valve assembly shall be bronze fitted cast-iron, with bolted cover. Flapper shall provide a maximum 1/4 inch clearance between flapper and seat for air circulation. Valve ends shall suit piping material.

- B. Cleanout Plugs: As specified on the drawings.
- C. Floor Cleanouts: As specified on the drawings.
- D. Wall Cleanouts: As specified on the drawings.
- E. Area drains: As specified on the drawings.
- F. Roof Drains: As specified on the drawings.
- G. PVC DWV Expansion Joints: Schedule 40 PVC DWV meeting ASTM D2665 with socket connections and telescoping expansion joint with EPDM O-ring seal.

## **2.5 TRENCH DRAINS**

- A. Trench drain type designations and sizes are indicated on the Drawings.

## **2.6 HUBLESS FITTING RESTRAINTS**

- A. Pre-engineered kits of galvanized steel pipe straps with stainless steel band clamps and tee bolts, meeting requirements of the CISPI Installation Handbook.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION GENERAL**

- A. Install pipe and specialties in accordance with manufacturer's installation instructions.

### **3.2 PREPARATION FOUNDATION FOR UNDERGROUND BUILDING DRAINS**

- A. Pipe Beds:
  - 1. PVC Pipe: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement process. After pressure testing is complete, gradually install bedding to maintain continuous pipe slope and prevent pipe deflection and then install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.
  - 2. Cast Iron Soil Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand bedding. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation and maintain continuous pipe slope. For piping with rock trench bottoms, provide sand pipe bed 6" underneath and around sides of pipe, including fittings. After pressure testing is complete, install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

### **3.3 PIPE APPLICATIONS - ABOVE GROUND WITHIN BUILDING**

- A. Install hubless, cast-iron soil pipe and fittings 15" and smaller for storm pipe.
- B. Install Type DWV copper tube with cast bronze Type DWV fittings 15" and smaller for storm pipe where indicated on the drawings.
- C. Install PVC pressure pipe and fittings for sump pump discharge, except no plastic pipe shall be installed in return air plenums.

- D. As a contractor's option with Owner approval, Install PVC Type DWV Plastic pipe and fittings for 24 inch and smaller storm pipe. Install fabricated fittings for 16 inch and larger.
- E. Install galvanized schedule 40 steel pipe and malleable iron fittings for sump pump discharge pipe.

### 3.4 PIPE APPLICATIONS - BELOW GROUND WITHIN BUILDING

- A. Install hub-and-spigot, service weight, cast-iron, soil pipe and fittings with gasketed joints for 15 inch and smaller storm pipe.
- B. [As a contractor's option with Owner approval, i] Install PVC Type DWV Plastic pipe and fittings for 24 inch and smaller storm pipe. Install fabricated fittings for 16 inch and larger.
- C. Install PVC gasketed sewer pipe and gasketed fittings for 27" and larger storm pipe.
- D. Install PVC pressure pipe and fittings for sump pump discharge.

### 3.5 PIPE AND TUBE JOINT CONSTRUCTION

- A. Copper Tubing: Solder joints in accordance with the procedures specified in AWS "Soldering Manual."
- B. Cast-Iron Soil Pipe: Make hubless joints in accordance with the Cast-Iron Soil Pipe & Fittings Handbook, Chapter IV. Install Couplings as followings:
  - 1. Install heavy duty hubless couplings on storm drainage piping, including connections to roof drains.
  - 2. Install Hubless fitting restraints on joints 5" and larger at:
    - a. Changes of direction from vertical to horizontal
    - b. 4" branch connections, including tees, wyes and wye combination fittings to storm drainage piping 5" and larger
    - c. Horizontal changes of direction 22-1/2 degrees and greater
- C. PVC DWV Pipe: Joining and installation of PVC drainage pipe and fittings shall conform to ASTM D2665.
- D. ABS to PVC Transition Joints: When joining ABS to PVC components (such as an ABS building drain to PVC sewer pipe) make joints using solvent cements conforming to ASTM D3138.
- E. Cast Iron to PVC Above Grade: Join cast iron to PVC with shielded transition couplings.
- F. Cast Iron to PVC Below Grade: Join cast iron to PVC with underground shielded adapter couplings.
- G. Gasketed Fittings: Install fittings per the Uni-Bell PVC Pipe Association "Installation Guide for PVC Fittings and Laterals for Solid Wall PVC Sewer Pipe".

### 3.6 INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing, slope, expansion, and other design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and all branch connections.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and sealer. Refer to Division 22 Section "Basic Piping Materials and Methods" for special sealers and materials.
- H. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls using sleeves and mechanical sleeve sealers. Refer to Division 22 Section "Basic Piping Material and Methods" for additional information.
- I. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings and floors, maintain the fire rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.
- J. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.
- K. Foundation Penetrations: Where pipes pass through foundation walls above strip footings or under strip footings, protect pipes from building load with cast iron soil pipe sleeves two pipe sizes larger than the pipe. Sleeves installed under the strip footing shall be encased in concrete.
- L. Make changes in direction for drainage piping using appropriate 45 degree wyes, combination wye and eighth bend, or long sweep, quarter, sixth, eighth, or sixteenth bends. Sanitary tees or quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn pattern combination wye and eighth bends where two fixtures are installed back to back and have a common drain. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper sized standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.
- M. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- N. Install drainage piping pitched down at a minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger.
- O. Extend building drain to connect to service piping, of size and in location indicated for service entrance to building. Storm service piping is specified in a separate section of Division 2.

### 3.7 HANGERS AND SUPPORTS

- A. General: Hanger, support, insulation protection shields, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.
- B. Install the following pipe attachments:
  - 1. Adjustable clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
  - 2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.

3. Provide 316 stainless steel rods, nuts, washers, beam clamps, channels, insulation protection shields, adjustable band hangers, MSS SP-69 Type 7, or clevis hangers, MSS SP-69 Type 1, for piping located in Hydrotherapy and Pool Equipment Rooms.
  4. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Hangers and Supports for Plumbing Piping" and "Plumbing Insulation".
    - a. Install high density insulation on insulated pipe.
  5. Provide vinyl coated hangers and riser clamps for use with PVC pipe.
  6. Provide roll hangers for individual horizontal runs 100 feet or longer.
- C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

Nom. Pipe Size	Steel Pipe Max. Span	Copper Tube Max. Span.	Min. Rod Dia. - Inches
<u>In Inches</u>	<u>In Feet</u>	<u>In Feet</u>	
Up to 1-1/4	12	6	3/8
1-1/2 to 2	12	10	3/8
2-1/2 to 3	12	10	3/8
4	12	10	3/8
5	12	10	1/2
6	12	10	1/2
8	12	10	1/2
10 to 12	12	10	5/8
14	12	N/A	3/4
16	12	N/A	7/8

1. Support all sizes of hubless horizontal cast iron piping every five feet, except up to ten feet where ten foot sections are installed. Support all sizes of hubless horizontal cast iron piping every other joint, unless over four feet, then support each joint. Provide support adjacent to joint, not to exceed 18". Provide sway brace on horizontal piping at not more than 40' intervals to prevent horizontal movement. Provide support at each horizontal branch.
  2. Support all sizes of vertical cast iron piping every ten feet.
  3. Support all sizes of horizontal of PVC piping every four feet.
  4. Support all sizes of vertical of PVC piping every floor, but not to exceed ten feet. For sizes 2 inches and smaller, provide guide midway between required vertical supports.
  5. Support piping within 12" of each elbow or tee.
- D. Sway bracing:
1. Provide rigid sway bracing for pipe 4" and larger at changes of direction greater than 45 degrees.

### 3.8 INSTALLATION OF PIPING SPECIALTIES

- A. Install backwater valves in storm building drain piping as indicated, and as required by the plumbing code. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover and of adequate size to remove valve cover for service.
- B. Provide PVC DWV expansion joints every 30' on straight vertical PVC waste or sanitary stacks receiving hot water waste. Install expansion joint at middle travel for equal expansion and contraction travel. Provide riser clamps within 18" of each end of expansion joint. Install expansion joint per manufacturer's installation instructions.
- C. Install expansion joints on stacks or horizontal piping as indicated, and as required by the plumbing code.

- D. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:
1. as required by plumbing code;
  2. at each change in direction of piping greater than 45 degrees;
  3. at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping;
  4. at base of each vertical soil, waste, or storm water stack.
- E. Cleanout Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.
- F. Floor Cleanouts: Install in below floor building drain piping as indicated and:
1. as required by plumbing code;
  2. at each change in direction of piping greater than 45 degrees;
  3. Install in below floor building drain piping at minimum intervals of 50' for piping 4" and smaller and 75' for larger piping;
  4. Install floor cleanouts in waterproof floors with waterproof membrane securely flashed with cleanout body flashing clamp so that no leakage occurs between cleanout body and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
- G. Exterior Cleanouts: Install exterior cleanouts embedded in a 18" x 18" x 8" block of concrete, flush with finished grade.

### 3.9 INSTALLATION OF AREA DRAINS

- A. Install area drains in locations indicated.
- B. Install area drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.
- C. Refer to architectural documents for floor slope requirements and set area drain elevation to match. Where architectural documents do not indicate the requirements, set the area drain elevation depressed below the finished slab elevation as listed below to provide proper slope to drain:

<u>DEPRESSION IN INCHES</u>	<u>RADIUS OF AREA DRAINED - FEET</u>
1/2	5
3/4	10
1	15
1-1/4	20
1-1/2	25

- D. Provide P-traps for drains connected to combined sanitary and storm sewer.
- E. Install area drains in waterproof floors with waterproof membrane securely flashed with drain flashing clamp so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
- F. Position drains so that they are level, accessible and easy to maintain.

### 3.10 INSTALLATION OF ROOF DRAINS

- A. Install roof drains at low points of roof areas with the roof membrane securely flashed with drain flashing clamp so that no leakage occurs between drain and roof membrane.
- B. Install drain flashing collar or flange so that no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.
- C. Position roof drains so that they are accessible and easy to maintain.

**3.11 FIELD QUALITY CONTROL**

- A. Inspections
  - 1. Do not enclose, cover, or put into operation the storm drainage piping system until it has been inspected and approved by the authority having jurisdiction.
  - 2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
    - a. Rough-in Inspection: Arrange for inspection of the storm drainage piping system before concealed or closed-in after system is roughed-in.
    - b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
    - c. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspection by the plumbing official.
    - d. Reports: Prepare inspection reports, signed by the plumbing official.
- B. Piping System Test: Test storm drainage system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
  - 1. Test for leaks and defects all new storm drainage piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
  - 2. Leave uncovered and unconcealed all new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
  - 3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of storm drainage piping systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
  - 4. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
  - 5. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

**3.12 ADJUSTING AND CLEANING**

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Clean drain strainers and domes. Remove dirt and debris.

**3.13 PROTECTION**

- A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.
- C. Exposed PVC Piping: Protect storm drainage piping exposed to sunlight with 2 coats of a water based latex paint.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 22 14 89 - SUMP PUMPS****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes the following types of plumbing pumps:
  - 1. Sump pumps
- B. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 3 Section "Concrete Work" for specifications on concrete and reinforcing materials and concrete placing requirements for sump basins and covers.
  - 2. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
  - 3. Division 22 Section "Coordination" for basic requirements for electrical components that are an integral part of packaged system components.
  - 4. Division 22 Section "Storm Drainage Piping and Specialties" for sump pump discharge pipe material and installation requirements.
  - 5. Division 23 Section "Direct-Digital Control for HVAC" for interlock of alarms with building automation system and alarm wiring.
  - 6. Division 26 Section "Common Work Results for Electrical" required electrical devices.
  - 7. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

**1.2 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
  - 1. Product data including standard performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories, plus installation and start-up instructions.
  - 2. Shop drawings showing layout and connections for plumbing pumps. Include setting drawings with templates, and directions for installation of foundation bolts, anchor bolts, and other anchorages.
  - 3. Wiring diagrams detailing wiring for power, signal, and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.
  - 4. Maintenance data for plumbing pumps, for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."
  - 5. Shop drawings showing basins with depth, inlet, outlet and vent locations, pit covers, float switches, non-clog check valves and shutoff valves.

**1.3 QUALITY ASSURANCE**

- A. Hydraulic Institute Compliance: Design, manufacture, and install plumbing pumps in accordance with "Hydraulic Institute Standards."
- B. National Electrical Code Compliance: Components shall comply with NFPA 70 "National Electrical Code."
- C. UL Compliance: Control panels shall be listed and labeled by UL and comply with Standard 508A "Control Panels".
- D. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.

- E. SSPMA Compliance: Test and rate sump pumps in accordance with the Sump and Sewage Pump Manufacturers Association (SSPMA) Standards.
- F. Single-Source Responsibility: Obtain plumbing pumps of the same type from a single manufacturer.
- G. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the MSS Standard Practices below:
  - 1. MSS SP 72 "Ball Valves with Flanged or Butt Welding Ends"
  - 2. MSS SP 110 "Ball Valves, Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends"
- H. Valves shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.
- I. Design Criteria: The Drawings indicate sizes, profiles, connections, and dimensional requirements of plumbing pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of plumbing pumps is on the proposer.

#### 1.4 WARRANTY

- A. Warranty on Pumps: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, pumps with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement includes both parts and labor for removal and reinstallation.
  - 1. Warranty Period: One year from date of substantial completion.

### PART 2 - PRODUCTS AND MATERIALS

#### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Elevator Pit Sump Pumps:
    - a. ABS Pump, Inc.,
    - b. FLYGT
    - c. Weil Pump Company
  - 2. Submersible Sump Pump High Level Alarms:
    - a. Weil Pump Company
    - b. Zoeller Pump Company
    - c. SJE Rhombus
  - 3. Full Port Bronze Ball Valves – 2" and smaller:
 

<u>MANUFACTURER</u>	<u>THREADED ENDS</u>	<u>SOLDER ENDS</u>
Apollo	77C-100	77C-200
Hammond	8301A	8311A
Milwaukee	BA-400	BA-450
Nibco	T-585-70	S-585-70
  - 4. Full Port Cast Iron Ball Valves – 2-1/2" and larger:
    - a. Apollo (Conbraco) "6P"
    - b. Watts "G4000M1"
  - 5. Non-Clog "Flapper Type" Check Valves:

- a. Liberty Pumps "Series CVXXXC"
- b. Little Giant Pump Company "Series CV-SE"
- c. Zoeller Pump Company "Series 30"
- 6. Cast Iron "Sinking Ball Type" Non-Clog Check Valves - 2" and smaller:
  - a. Flomatic "208"
  - b. FLYGT "2002"
  - c. GW Industries, Inc. "240T"
- 7. Cast Iron "Sinking Ball Type" Non-Clog Check Valves – 2-1/2" and larger:
  - a. Flomatic "508"
  - b. FLYGT "5087"
  - c. GW Industries, Inc. "240D"
- 8. Sump Basins
  - a. AK Industries
  - b. Fiberbasin, Inc.
  - c. Topp
- 9. Basin Covers:
  - a. Bilco
  - b. U.S.F. Fabrication
- 10. Control Panels
  - a. Cougar Sales
  - b. Sulzer
  - c. FLYGT
  - c. Weil Pump Company

## 2.2 PUMPS GENERAL

- A. Pumps: factory assembled and factory tested.
- B. Preparation for shipping: After assembly and testing, clean flanges and exposed machined metal surfaces and treat with an anticorrosion compound. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- C. Motors: Conform to NEMA standards; single, multiple, or variable speed with type of enclosure and electrical characteristics as indicated; have built-in thermal-overload protection and grease-lubricated ball bearings. Select motors that are non-overloading within the full range of the pump performance curve.
- D. Apply factory finish paint to assembled, tested units prior to shipping.

## 2.3 ELEVATOR PIT SUMP PUMPS – □ HP AND SMALLER

- A. General Description: Pumps shall be simplex centrifugal, direct connected, floor mounted, single stage type with cast iron body, stainless steel shaft, cast iron impeller, mechanical seal, permanently lubricated upper and lower ball bearings complete with integral inlet strainer, mechanical float switch, and power cord with ground.
- B. Casing: Cast iron with integral cast-iron inlet strainer and legs to elevate the pump to permit flow into the impeller. Vertical discharge with screwed female connection.
- C. Impeller: Statically and dynamically balanced, open or semiopen, overhung, single suction, fabricated from cast iron, keyed to shaft and secured by a locking capscrew.
- D. Pump and Motor Shaft: Stainless steel, with factory-sealed, upper and lower grease-lubricated ball bearings.
- E. Seals: Carbon steel rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket.

- F. Motor: NEMA 6 with class F insulation, hermetically sealed, 1750 RPM, capacitor start, air filled with built-in overload protection, with 3-conductor, waterproof cable and grounding plug.
- G. Controls: NEMA 1, tethered float switch for "on-off" control with "piggy back" power cord connection for sump pump power cord.

## 2.4 SUMP PUMPS

- A. General Description: Pumps shall be duplex centrifugal, direct connected, floor mounted, single stage type with cast iron body, stainless steel shaft, cast iron impeller, mechanical seal, permanently lubricated upper and lower ball bearings complete, control panel, mechanical float switch, and power cords with grounds.
- B. Casing: Cast iron with integral cast-iron legs to elevate the pump to permit flow into the impeller. Pump casing, volute and impeller shall pass a 2" diameter sphere. . Vertical discharge with screwed female connection.
- C. Rail Retrieval System: Provide with cast iron floor elbow, gasket, anchor bolts, yoke, pipe guides, stainless steel rope, and upper guide bracket.
- D. Impeller: Statically and dynamically balanced, open or semiopen, overhung, single suction, fabricated from cast iron, keyed to shaft and secured by a locking capscrew.
- E. Pump and Motor Shaft: Stainless steel, with factory-sealed, upper and lower grease-lubricated ball bearings.
- F. Seals: Single mechanical seal with carbon steel rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket.
- G. Seals: Tandem mechanical seals mounted in cast iron body seal chamber with upper seal of carbon rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket and lower seal of silicon carbide rotating ring, stainless-steel spring, silicon carbide seat, and Buna-N bellows and gasket.
- H. Motor: Hermetically sealed, with built-in overload protection, air filled, 1750 RPM, NEMA class B insulation capable of a maximum continuous operating temperature of 120F, 3-conductor and waterproof cable.
- I. Basin: Fiberglass reinforced plastic, PVC plastic is not acceptable, with a minimum wall thickness of 3/16", 2" wide retainer ring at the basin bottom and every four feet and factory pipe penetration connection kits. Refer to the drawings for basin dimensions.
- J. Basin: Cast in place concrete or pre-cast concrete, refer to structural drawings.
- K. Cover: Epoxy coated steel or aluminum gasketed round cover with holes for discharge piping, vent and conduits. Access cover shall be completely flush for all for discharge piping, vent and conduits entering or exiting the sump pit under the slab as indicated on the drawings.
- L. Controls: NEMA 4X fiberglass dead front door enclosure, complete with lockable combination circuit breaker magnetic motor starter and 3 leg overload protection with reset for each motor, internal test-off-automatic pump run switches, 120V control circuit transformer fused on primary and secondary, non-resettable pump run time hour meter for each pump, terminal board for connection of pumps and level sensors and automatic alternator for alternating lead-lag pump selection and to provide for both pumps to operate simultaneously under high level condition. Provide with power "on" indicator light, pump "on" light for each pump, overload relays and indicator lights, high level alarm relay, light and horn, moisture sensor alarm light for each pump, auxiliary alarm contacts for each alarm condition. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings.

Control panel shall be configured for terminating one incoming power feeder. Control panel shall be configured for terminating two incoming power feeders.

M.

N. VFD Controls: NEMA 4 enclosure with dead front door with lockable through door disconnect, programmable logic controller (PLC), lockable combination circuit breaker magnetic motor starter and 3 leg overload protection with reset for each motor, internal test-off-automatic pump run switches, 120V control circuit transformer fused on primary and secondary, terminal board for connection of pumps and level sensors and lightening arrestor. Provide with power "on" indicator light, overload relays, high level alarm relay, light and horn, second pump running alarm relay, failsafe relay, PLC Failure alarm relay, moisture sensor alarm for each pump, temperature limiter circuit alarm for each pump, auxiliary alarm contacts for each alarm condition. Provide with level transmitter with base and (3) redundant float switches. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings. Control panel shall be configured for terminating one incoming power feeder. Refer to control drawings for interlock of alarm contacts with the building automation system.

1. Touchscreen operator interface for monitoring and adjustment of the programmable controller variables with virtual on-off-automatic selector switch for each pump, high level alarm, pump running indicators, thermal overload indicator for each pump, moisture indicator for each pump and virtual hour meter for each pump. Second pump running alarm. PLC shall alternate lead-lag pump selection and to provide for two pumps to operate simultaneously under high level condition with third pump as standby. PLC shall alternate standby pump as "first "on" pump" after end of each pumping cycle.
2. Programmable Logic Controller (PLC): Designed specifically for the control of pumps with variable speed drives capable of receiving two analog pressure inputs, analog flow input, automatic pump alternating and On-line field modified data entries for staging pumps, with software memory stored in non-volatile EPROM memory, furnish with user interface keypad with LED display.
3. Variable Speed Drive: The variable speed drives (VFD) shall be adjustable frequency which employ a pulse width modulated inverter. The drive shall include built in diagnostics. Diagnostics shall be annunciated through the alpha numeric keypad. The drive shall be listed UL, ETL and/or CSA. To ensure safety of the equipment, the VFD shall include these protective features and options:
  - a. NEMA 1 enclosure.
  - b. Static instantaneous over-current and over-voltage trip.
  - c. Static over-speed (over-frequency) protection.
  - d. Line or fuse loss and under-voltage protection.
  - e. Power unit over-temperature protection.
  - f. Motor inverse time overload protection.
  - g. Input fused disconnect or circuit breaker.
  - h. Total voltage harmonic distortion from the VFD shall be less than 5% to meet IEEE requirements.
  - i. Speed meter.
  - j. Automatic restart after power failure or minor drive fault. The drive shall attempt a minimum of two restarts before a complete drive shut-down.
  - k. Power on light.
  - l. Manual speed potentiometer or control capability through the keypad.
  - m. Hand/Off/Automatic Switch or Manual/Automatic Switch with start/stop pushbutton.
  - n. Test switch
  - o. VFD fault light and reset.
  - p. Output to the PLC and integral LED display
  - q. The VFD shall be microprocessor based and utilize digital input for all parameter adjustments. The VFD shall include a digital display for monitoring system parameters

- and for first fault indication, and digital input programming capability on the main logic board.
- r. The VFD shall operate on a frequency range of 1 to 66 Hz with resolution of 0.1% of base speed with analog input or 0.025% with digital input and have accuracy within 0.05% of set point. VFD shall operate in environment of 0 to 40 degrees C, 3,300 feet altitude and 95% non-condensing humidity without derating.
  - s. All control circuit voltages shall be physically and electrically isolated from power circuit voltages.
4. All VFD's shall be tested/run in the equivalent of NEMA 1 enclosure and burned in at rated ambient (40° C) with a fully loaded motor.
  5. Sequence of operation:
    - a. Minimum run speed is 48Hz or 1400 rpm
    - b. The sewage ejector shall be in automatic mode.
    - c. When the water level rises from the level of pumps "off" to the level of first pump "on", the PLC shall start the lead pump. The PLC shall modulate the pump speed to maintain the water level in the pit at the level of first pump "on".
    - d. If water level rises to the water level of second pump "on", the PLC shall start the lag pump with a minimum run speed of 1400 rpm and the first pump will run with a minimum run speed of 1400 rpm. The PLC shall modulate the pumps speed to maintain the water at the level of second pump "on". When water level drops to the level of first pump "on", the PLC shall stop the lead pump.
    - e. When the PLC runs the pump at 48Hz or 1400 rpm and the water level drops to the level of pump "off", the PLC shall stop the pump. The lag pump shall start for the next control sequence. If a pump runs continuously for 24 hours, the PLC shall stop the lead pump and start the lag pump.
  6. Safeties:
    - a. High Level Alarm
      - 1) When the water level rises to the level of "high level alarm" an audible alarm shall sound and an alarm signal shall be sent to the BMS or local building alarm system.
    - b. Second Pump Running Alarm
      - 1) When the water level rises to the level of second pump "on", an alarm signal shall be sent to the BMS or local building alarm system.
    - c. Moisture Sensor Alarm
      - 1) When the moisture sensor in each pump senses moisture, an alarm "light" shall appear in the touch screen and an alarm signal shall be sent to the BMS or local building alarm system.
    - d. High Temperature Sensor Alarm
      - 1) When the temperature sensor in each pump senses moisture, an alarm "light" shall appear in the touch screen and an alarm signal shall be sent to the BMS or local building alarm system.
    - e. Level Transmitter Failure and Alarm
      - 1) If the level transmitter fails to send control signal to the PLC, the PLC shall shift control of the pumps via the failsafe relay to use the float switches to control the pumps at full speed. When water level rises to the water level of first pump "on", lead pump shall start. When water level drops to the level of pumps "off" the lead pump shall stop. The lag pump shall start for the next control sequence
      - 2) When the level transmitter fails to send control signal to the PLC, an alarm "light" shall appear in the touch screen and an alarm signal shall be sent to the BMS or local building alarm system.
    - f. PLC Failure and Alarm
      - 1) If the PLC has loss of power or logic failure, the failsafe relay shall use the float switches to control the pumps at full speed. When water level rises to the water level of first pump "on", lead pump shall start. When water level

drops to the level of pumps "off" the lead pump shall stop. The lag pump shall start for the next control sequence

- 2) The failsafe relay shall send a "PLC Failure Alarm" alarm signal to the BMS or local building alarm system.
- O. Level Controls: Pole mounted tethered float switches with chord grips, pole mounting plate and cover. Float switches shall be 120V 3 amp single pole normally open that closes on the rise for pump "off", first pump "on" second pump "on" and high level alarm.
  - P. Junction Box: NEMA 6P enclose of fiberglass reinforced polyester with fully gasketed cover, terminal strip and inlets and outlets for four control and two power connections.
  - Q. Disconnect: Disconnect is provided under Division 26 Section "Enclosed Switches and Circuit Breakers".

## 2.5 SUMP PUMP HIGH LEVEL ALARMS

- A. Alarm: Remote type 120V single phase with NEMA 4X enclosure, terminal block, 5 amp isolated alarm contact, alarm horn, alarm light, test-automatic-silence switch and mechanical float switch.

## 2.6 OIL SENSING SUMP PUMP ALARMS

- A. Alarm Panel: Remote type 120V NEMA 3R panel, oil and water sensor, power cord, receptacle for pump power cord, 85 bd alarm horn, oil present alarm light, water present alarm light, silence switch, test switch and alarm contacts for each alarm condition.

## 2.7 BALL VALVES

- A. Ball Valves, 2 Inch and Smaller: Meeting MSS SP 110, Class 150, 600-psi CWP; two-piece construction; with ASTM B 584 cast bronze, full port, blowout-proof stem and chrome-plated brass ball, with replaceable "Teflon" or "TFE" seats and seals, solder or threaded ends and vinyl-covered steel handle.
- B. Cast Iron Body Ball Valves, 2-1/2" and larger: Meeting MSS SP 72, 200-psi CWP, maximum operating temperature of 140F; two piece cast iron body meeting ASTM A126 Class B with flanged ends, 304 stainless steel full port ball and shaft, ductile iron handle, PTFE gasket, stem seal and seat.

## 2.8 CHECK VALVES

- A. Non Clog "Flapper Type" Check Valves, 2 Inch and Smaller: Flapper type with PVC body compression end fittings with Buna-N "O" ring and Buna-N flapper with PVC shields.
- B. Non Clog "Sinking Ball Type" Check Valves: Sinking ball type with cast iron body, steel ball with hollow core and Buna-N coating. Valve body shall be configured for unobstructed flow. Valves 2" and smaller with screwed ends and valves 2-1/2" and larger with flanged ends.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's installation instructions.
- B. General: Comply with the manufacturer's written installation and alignment instructions.
- C. Install pumps in locations and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.

- D. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.
- E. Basins: Install sump pump basins in indicated locations and connect to drainage lines. Brace interior of basin in accordance with manufacturer's instructions to prevent distortion or collapse during concrete placement. Refer to Division 3 for concrete work. Set cover over basin and fasten to top flange of basin. Install so cover is flush with finished floor.

### 3.2 EXAMINATION

- A. Examine areas, equipment foundations, and conditions with Installer present, for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine rough-in for plumbing piping systems to verify actual locations of piping connections prior to installation.

### 3.3 CONNECTIONS

- A. General: Install valves that are same size as the piping connecting the pump.
- B. Install discharge pipe sizes equal to or greater than the diameter of the pump nozzles. Sump pump discharge pipe material is specified in Division 22 Section "Storm Drainage Piping and Specialties".
- C. Install a non-clog check valve in an accessible location or where indicated on the drawings. Install a full port ball valve on the discharge side of sump pumps downstream of the check valve.
- D. Electrical wiring and connections are specified in Division 26 section "Common Work Results for Electrical".
- E. Install inlets or outlets to fiberglass sump basins in the field at the required elevation. Cut inlet or outlet per the basin manufacturer's instructions, as installation requires with factory penetration kits at each penetration. See drawings for inlet and outlet elevations.
- F. Install sump basin inlets or outlets in the field at the required elevation. Seal penetrations with mechanical link seals. Mechanical link seals are specified in Division 22 Section "Basic Piping Material and Methods." See drawings for inlet and outlet elevations.
- G. Coordinate interlock of elevator pit high level alarm with building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".
- H. Coordinate interlock of sump pump high level, two moisture sensor, two high temperature shutdown, and two overload alarms with building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".
- I. Coordinate interlock of sump pump high level, two moisture sensor, two high temperature shutdown, two overload alarms, second pump running alarm, PLC failure alarm and level transmitter failure alarm with building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".

### 3.4 FIELD QUALITY CONTROL

- A. Pressure Testing: Perform a pressure test on the discharge assembly. The test pressure shall be twice that of the shut off head of the pump.



- B. Valve Testing: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

### 3.5 STARTUP

- A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:
  - 1. Lubricate oil-lubricated bearings.
  - 2. Remove grease-lubricated bearing covers and flush the bearings with kerosene and thoroughly clean. Fill with new lubricant in accordance with the manufacturer's recommendations.
  - 3. Disconnect coupling and check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
  - 4. Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.
- B. Starting procedure for pumps with shutoff power not exceeding the safe motor power:
  - 1. Prime the pump, opening the suction valve, closing the drains, and prepare the pump for operation.
  - 2. Start motor.
  - 3. Open the discharge valve slowly.
  - 4. Observe the leakage from the stuffing boxes and adjust the sealing liquid valve for proper flow to ensure the lubrication of the packing. Do not tighten the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.
  - 5. Check the general mechanical operation of the pump and motor.
- C. If the pump is to be started against a closed check valve with the discharge shut-off valve open, the steps are the same except that the discharge shut-off valve is opened some time before the motor is started.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 34 00 - FUEL FIRED DOMESTIC WATER HEATERS****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes commercial gas fired water heaters.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 3 Section "Concrete Work" for specifications on concrete and reinforcing materials and concrete placing requirements for equipment pads.
  - 2. Division 22 Section "Common Work Results for Plumbing" for concrete equipment pads.
  - 3. Division 22 Section "Basic Piping Materials and Methods" for flexible metal braid connectors, pipe joining materials, specialties, unions, dielectric unions, dielectric flanges, dielectric flange kits and basic installation requirements.
  - 4. Division 22 Section "Meters and Gauges for Plumbing Piping." for thermometers and their installation requirements.
  - 5. Division 22 Section "Natural Gas Piping" for natural gas equipment connections.
  - 6. Division 23 Section "Breechings, Chimneys, and Stacks" for gas-fired water heater vents.
  - 7. Division 26 Section "Common Work Results for Electrical" for required electrical devices.
  - 8. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

**1.2 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
  - 1. Product data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories, and indicating dimensions, required clearances, and methods of assembly of components, and piping and wiring connections.
  - 2. Wiring diagrams from manufacturers detailing electrical requirements for electrical power supply wiring to water heaters. Include ladder-type wiring diagrams for interlock and control wiring required for final installation of water heaters and controls. Differentiate between portions of wiring that are factory installed and portions that are to be field installed.
  - 3. Certificates of shop inspection and data report as required by provisions of the ASME Boiler and Pressure Vessel Code.
  - 4. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

**1.3 QUALITY ASSURANCE**

- A. UL Standards: Provide water heaters complying with the following:
  - 1. UL 732, "Oil Fired Water Heaters."
  - 2. UL 778, "Motor Operated Water Pumps."
- B. NSF Standards: Provide water heaters complying with NSF No. 5, "Standard for Hot Water Generating Equipment for Food Service Establishments using Spray Type Dishwashing Machines," and bearing NSF label.
- C. Electrical Component Standard: Provide components complying with NFPA 70 "National Electrical Code."
- D. Listing and Labeling: Provide water heaters that are listed and labeled.
  - 1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- E. AGA Standards: Provide water heaters that bear the label of the American Gas Association.
- F. ASME Code Compliance: Provide water heaters and safety relief valves that comply with ASME Boiler and Pressure Vessel Code and that bear the appropriate code symbols.
- G. State Boiler Code Compliance: Provide rated water heaters, safety relief valve, gas train and accessories that comply with the state boiler code in effect.
- H. ASHRAE Standards: Provide water heaters with performance efficiencies not less than prescribed in ASHRAE 90.1b, "Energy Conservation in New Building Design."
- I. Design Concept: The drawings indicate types and capacities of water heaters and are based on specific descriptions and manufacturers indicated. Water heaters having equal performance characteristics by other manufacturers may be considered provided that deviations in capacities, dimensions, operation, or other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. Burden of proof for equality of water heaters is on the proposer.

#### 1.4 WARRANTY

- A. Special Project Warranty: Submit a written warranty, executed by manufacturer, agreeing to repair or replace water heater units that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, controls, tanks, coils, heat exchangers, and burners. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.
  1. Commercial, Gas Fired, Storage Water Heaters:
    - a. Storage Tank: Three years.
    - b. Controls and Other Components: One year.
  2. Commercial, Finned-Tube, Gas Fired Water Heaters:
    - a. Heat Exchanger: Five years.
    - b. Controls and Other Components: One year.
    - c. Separate Hot-Water Storage Tanks: Five years.

### PART 2 - PRODUCTS AND MATERIALS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Commercial Atmospheric Gas-Fired Water Heaters:
    - a.
    - b. A.O. Smith Water Products Co. Div.; A.O. Smith Corp.
  2. Gas-Fired High Efficiency Water Heaters With Fan Assisted Combustion And All Stainless Steel Heat Exchanger
    - a. LAARS - "Neotherm"
    - b. Lochinvar Water Heater Corp. - "Armor"
    - c. Raypak "XFyre"
    - d. RB & I - "Fusion"
  3. Thermal Expansion Tanks
    - a. Armstrong Pumps, Inc.
    - b. Amtrol, Inc.
    - c. Bell & Gosset, ITT
    - d. Elbi
    - e. TACO, Inc.

- a. Watts
- b. Wessels Tank Co.
4. Vacuum Relief Valves
  - a. Apollo #37
  - b. Cash ACME #VR-801
  - c. Watts #N36
  - d. Wilkins #VR-10

## 2.2 ATMOSPHERIC GAS-FIRED WATER HEATERS

- A. Description: Automatic, commercial, gas-fired; with vertical, ASME labeled, 150-psig-rated tank, gas burner, integral controls, draft diverter, drain valve, gas regulator, and relief valve.
  1. Fuel: Natural gas.
  2. Fuel: Liquefied petroleum (LP) gas.
- B. Insulation: Fiberglass, surrounding tank.
- C. Jacket: Steel, with baked-on enamel finish.
- D. Tank: Glass-lined steel, with anode rods and drain valve.
- E. Safety Controls: Automatic gas shutoff device to shut off entire gas supply in event of excessive temperature in tank.
- F. Controls: Adjustable surface mounted thermostat, intermittent electronic ignition and flue damper control.
- G. Temperature and Pressure Relief Valve: Lead free brass body meeting ANSI Z21.22.

## 2.3 GAS-FIRED HIGH EFFICIENCY WATER HEATERS WITH FAN ASSISTED COMBUSTION AND ALL STAINLESS STEEL HEAT EXCHANGER

- A. Description: Automatic, commercial, gas-fired, ASME labeled, 160-psig rated, finned-tube heat exchanger for condensing flue gases; with integral controls, sealed combustion chamber, modulating gas burner with fan assisted combustion and 5:1 turndown, gas train including gas regulator, ASME labeled storage tank, factory vertical, horizontal combustion air cap and exhaust flue cap and circulating pump. Low NO<sub>x</sub> burner meeting SCAQMD Rule 1146.2.
  1. Heat Exchanger: ASME Boiler Pressure Vessel Code Section 4 160-psig of all stainless steel construction
- B. Water Heater Insulation: Manufacturer's standard insulation.
- C. Storage Tank: ASME Boiler Pressure Vessel Code Section 8 150-psig rated, glass-lined steel, with anode rods and temperature and pressure relief valve.
- D. Storage Tank Insulation: Fiberglass surrounding tank.
- E. Water Heater and Storage Tank Jackets: Steel, with baked-on enamel finish.
- F. Circulating Pump: All bronze, inline, centrifugal, single-stage, radially split case design, with mechanical seals, and rated for 125 psig working pressure and 225 deg F continuous water temperature.
- G. Controls: Adjustable storage tank temperature control fitting with immersion thermostat and Intermittent electronic ignition.
- H. Safety Controls: Automatic gas shutoff device to shut off entire gas supply in event of excessive temperature, low water cutout, low gas pressure, low air pressure and flow switch to verify circulating pump operation.
- I. Safety Controls: Automatic gas shutoff device to shut off entire gas supply in event of excessive temperature, low water cutout and flow switch interlocked with circulating pump and burner.

- J. Temperature and Pressure Relief Valve: Lead free brass body meeting ANSI Z21.22.
- K. Condensate Neutralization Kits: PVC body with socket weld inlets and outlets, minimum ¾". Capacity to match heater input.

## 2.4 THERMAL EXPANSION TANKS

- A. ASME Thermal Expansion Tanks: Provide size and number as indicated; construct of welded carbon steel ASME labeled for 150 psig working pressure, 200 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity, by means of a FDA approved butyl rubber diaphragm securely sealed into tank. Provide taps for pressure gauge and air charging fitting, and drain fitting. Support vertical tanks with steel legs or base. Tank, with taps and supports, shall be constructed, tested, and labeled in accordance with ASME Pressure Vessel Code, Section VIII, Division 1.

## 2.5 VACUUM RELIEF VALVES

- A. Lead free brass body meeting ANSI Z21.22 with silicon disc. Valve shall open at 0.5 inches HG vacuum and be rated for 200 psig working pressure and 250 F operating temperature.

## PART 3 - EXECUTION

### 3.1 WATER HEATER INSTALLATION

- A. Install in accordance with manufacturer's installation instructions.
- B. General: Install water heaters on concrete equipment bases. Set and connect units in accordance with manufacturer's installation-instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances. Orient so controls and devices needing servicing are accessible.
- C. Install thermometers on water heater outlet piping. Thermometers are specified in Division 22 Section "Meters and Gauges for Plumbing Piping."
- D. NFPA Compliance: Install gas-fired water heaters in compliance with NFPA 54, "National Fuel Gas Code."
- E. NFPA Compliance: Install oil-fired water heaters in compliance with NFPA 31, "Installation of Oil Burning Equipment."
- F. Install temperature and pressure relief valve furnished with water heater. The temperature shall be normally set to relieve at 210F and the pressure relief shall be equal to the tank pressure rating. Install line size relief valve discharge line to discharge to an approved receptor with air gap.
- G. Vacuum Relief Valve: Install in cold water supply to each water heater downstream of the shutoff and check valves.
- H.
- I. Install condensate neutralization kit furnished with water heater condensate drain downstream of trap at condensate connection. Fill kit with water heater manufacturer recommended neutralization media.

### 3.2 CONCRETE EQUIPMENT BASES

- A. Construct concrete equipment bases in accordance with Section "Basic Mechanical Materials and Methods" for setting of equipment.

### 3.3 EXPANSION TANK INSTALLATION

- A. Install in-line expansion tanks in the vertical or horizontal position (where allowed by manufacturer). Where tanks are installed in horizontal position, provide supports per manufacturer requirements.
- B. Install stand mounted expansion tanks on concrete equipment bases.
- C. Charge expansion tank bladder with air to a pressure equal to the domestic water static pressure.

### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Sections of Division 22. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
  - 1. Install piping adjacent to equipment arranged to allow servicing and maintenance.
  - 2. Connect hot and cold water piping to units with shutoff valves and unions. Connect hot water circulating piping to unit with shutoff valve, check valve, and union. Extend relief valve discharge to closest floor drain.
    - a. Where water heater piping connections are dissimilar metals, install dielectric waterway fittings or dielectric unions for joints 2" and smaller and dielectric flanges for joints 2-1/2" and larger. Dielectric waterway fittings, unions and flanges are specified in Division 22 Section "Basic Piping Materials and Methods."
    - b. Install vacuum relief valve in cold water inlet piping.
  - 3. Connect gas supply piping to burner with drip leg, tee, gas cock, and union; minimum size same as inlet connection. Arrange piping to allow unit servicing. Gas piping is specified in Division 22 Section "Natural Gas Piping".
    - a. Install vent piping from gas train pressure regulators and valves to outside the building. Terminate vent piping with brass screened vent cap fitting. Do not combine vents except with approval of local authority.
    - b. Install gas pressure regulators where indicated.
  - 4. Install drain as indirect waste to spill into open drain or over floor drain.
    - a. Install drain valve at low point in water piping, for water heaters not having tank drain.
  - 5. Connect oil piping to oil burner with shutoff valve and union in supply, and check valve and union in return. Arrange piping to allow unit servicing.
  - 6. Install heat traps at inlet and outlet of each water heater storage tank. Heat trap shall be made of elbows and piping. Heat trap shall turn down to 12" below the outlet or inlet, run 12" horizontal and turn up to the cold water to the heater or hot water from the heater. Where multiple tanks are connected with a manifold, a single heat trap may be provided at the connection of the cold water supply to the cold water manifold together.
- B. Electrical Connections:
  - 1. Power wiring is specified in Division 26 Section "Common Work Results for Electrical"
  - 2. Field-installed disconnects are specified in Division 26 Sections "Enclosed Switches and Circuit Breakers".
  - 3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.
  - 4. Vents are specified in Division 23 Section "Breechings, Chimneys, and Stacks."
- C. Vent Connections for Sealed Combustion Tank Type Gas Fire Water Heaters:
  - 1. Vents are specified in Division 23 Section "Breechings, Chimneys, and Stacks."
  - 2. Furnish intake and exhaust vent terminal furnished by heater manufacturer for installation by mechanical.
  - 3. Provide 3/4" PVC indirect drain from manufacturer exhaust fitting indirect drain connection furnished with water heater. Provide 3/4" PVC P-trap with minimum 1" trap seal and route indirect drain to nearest floor drain, discharge to floor drain with air gap.
  - 4. Install condensate neutralization kit furnished with water heater on floor adjacent to water heater in an accessible location.

**3.5 FIELD QUALITY CONTROL**

- A. General: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide start-up service, and demonstrate operation of equipment as specified below.
  - 1. Test and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment.

**3.6 STARTUP**

- A. Perform the following before start-up final checks:
  - 1. Fill water heaters with water.
  - 2. Piping systems test complete.
  - 3. Check for piping connections leaks.
  - 4. Check for adequate combustion air.
  - 5. Check for clear vent.
  - 6. Test operation of safety controls and devices.
- B. Perform the following start-up procedures:
  - 1. Energize circuits.
  - 2. Adjust operating controls.
  - 3. Adjust hot water outlet temperature setting.

**3.7 TRAINING**

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
  - 1. Overview of the system and/or equipment as it relates to the facility as a whole.
  - 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
  - 3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."
- C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION



**SECTION 22 40 00 - PLUMBING FIXTURES****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes plumbing fixtures and trim, fittings, and accessories, appliances, appurtenances, equipment, and supports associated with plumbing fixtures.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 7 Section "Joint Sealers," for materials and methods for sealing between plumbing fixtures and interior walls.
  - 2. Division 10 Section "Service Wall Systems" for wall modules with built-in plumbing fixtures.
  - 3. Division 22 Section "General Duty Valves for Plumbing Piping" for valves used as supply stops.
- C. Products furnished but not installed under this Section include:
  - 1. Plumbing fittings (including faucets) and piping indicated, for fixtures, appliances, appurtenances, and equipment provided by Owner.
  - 2. Plumbing fittings (including faucets) and piping indicated, for fixtures, appliances, appurtenances, and equipment specified in other Sections.
- D. Products installed but not furnished under this Section include:
  - 1. Owner furnished fixtures, as indicated.
  - 2. Accessories, appliances, appurtenances, and equipment specified in other Sections, requiring plumbing services or fixture-related devices, as indicated.

**1.2 DEFINITIONS**

- A. Accessible: Describes a plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped people.
- B. Accessory: Device that adds effectiveness, convenience, or improved appearance to a fixture but is not essential to its operation.
- C. Appliance: Device or machine designed and intended to perform a specific function.
- D. Appurtenance: Device or assembly designed to perform some useful function when attached to or used with a fixture.
- E. Equipment: Device used with plumbing fixtures or plumbing systems to perform a certain function for plumbing fixtures but that is not part of the fixture.
- F. Fitting: Fitting installed on or attached to a fixture to control the flow of water into or out of the fixture.
- G. Fixture: Installed receptor connected to the water distribution system, that receives and makes available potable water and discharges the used liquid or liquid-borne wastes directly or indirectly into the drainage system. The term "Fixture" means the actual receptor, except when used in a general application where terms "Fixture" and "Plumbing Fixture" include associated trim, fittings, accessories, appliances, appurtenances, support, and equipment.
- H. Roughing-In: Installation of piping and support for the fixture prior to the actual installation of the fixture.
- I. Support: Device normally concealed in building construction, for supporting and securing plumbing fixtures to walls and structural members. Supports for urinals, lavatories, and sinks are made in types suitable for fixture construction and the mounting required. Categories of supports are:

1. Carrier: Floor-mounted support for wall-mounted water closet, and support fixed to wall construction for wall-hung fixture.
  2. Chair Carrier: Support for wall-hung fixture, having steel pipe uprights that transfer weight to the floor.
  3. Chair Carrier, Heavy Duty: Support for wall-hung fixture, having rectangular steel uprights that transfer weight to the floor.
  4. Reinforcement: Wood blocking or steel plate built into wall construction, for securing fixture to wall.
- J. Trim: Hardware and miscellaneous parts, specific to a fixture and normally supplied with it required to complete fixture assembly and installation.
- K. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content  $\leq 0.25\%$  per Safe Drinking Water Act as amended January 4th 2011 Section 1417.

### 1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
1. Product data for each type of plumbing fixture specified, including fixture and trim, fittings, accessories, appliances, appurtenances, equipment, supports, construction details, dimensions of components, and finishes.
  2. Wiring diagrams for field-installed wiring of electrically operated units.
  3. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."
- B. Submit third party certification that faucets and trim for domestic water distribution for drinking or cooking comply with NSF 61 Annex G and / or NSF 372. The following faucets and trim need not comply:
1. Electronic faucets
  2. Service sink faucets
  3. Flush valves
  4. Shower valves and heads

### 1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements of ICC Standard A117.1, "Accessible and Usable Buildings and Facilities," and "2010 ADA Standards for Accessible Design" with respect to plumbing fixtures for individuals with disabilities.
- B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.
  2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- C. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of faucets and trim containing no more than 0.25% lead by weight for domestic water distribution for drinking or cooking.
- D. Design Concept: The drawings indicate types of plumbing fixtures and are based on the specific descriptions, manufacturers, models, and numbers indicated. Plumbing fixtures having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions, operation, color or finish, or other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. Burden of proof for equality of plumbing fixtures is on the proposer.

**1.5 SPARE PARTS**

- A. Deliver spare parts to Owner. Furnish spare parts described below matching products installed, packaged with protective covering for storage, and identified with labels clearly describing contents.
- B. Faucet Washers and O-rings: Furnish quantity of identical units not less than 10 percent of amount of each installed.
- C. Faucet Cartridges and O-rings: Furnish quantity of identical units not less than 5 percent of amount of each installed.
- D. Flushometer Repair Kits: Furnish quantity of identical units not less than 10 percent of amount of each flushometer installed.
- E. Provide individual metal boxes or a hinged-top wood or metal box having separate compartments for each type and size of above extra materials.
- F. Toilet Seats: Furnish quantity of identical units not less than 5 percent of amount of each type toilet seat installed.

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products in each category, by one of the following listed for that category:
  - 1. Water Closets:
    - a. American Standard, Inc.
    - b. Gerber Plumbing Fixture Corp.
    - c. Kohler Co.
    - d. Sloan Valve Co.
    - e. TOTO KIKI USA, Inc.
    - f. Zurn Plumbing Products Group
  - 2. Urinals:
    - a. American Standard, Inc.
    - b. Gerber Plumbing Fixture Corp.
    - c. Kohler Co.
    - d. Sloan Valve Co.
    - e. TOTO KIKI USA, Inc.
    - f. Zurn Plumbing Products Group
  - 3. Lavatories:
    - a. American Standard, Inc.
    - b. Gerber Plumbing Fixture Corp.
    - c. Kohler Co.
    - d. Sloan Valve Co.
    - e. TOTO KIKI USA, Inc.
    - f. Zurn Plumbing Products Group
  - 4. Sinks:
    - a. Elkay Manufacturing Co.
    - b. Franke
    - c. Just Manufacturing Co.
    - d. Kohler Co.
    - e. Moen Group; Stanadyne Corp.
  - 5. Service Sinks:
    - a. American Standard, Inc.
    - b. Kohler Co.
  - 6. Mop Basins:

- a. Acorn Engineering Co.
- b. Fiat Products.
- c. Stern-Williams Co., Inc.
7. Drinking Fountains:
  - a. American Standard, Inc.
  - b. Acorn / Aqua
  - c. Elkay Manufacturing Co.
  - d. Halsey Taylor; A Household International Co.
  - e. Haws Drinking Faucet Co.
  - f. Kohler Co.
8. Water Coolers:
  - a. Acorn / Aqua
  - b. Elkay Manufacturing Co.
  - c. Filtrine Manufacturing Co.
  - d. Halsey Taylor; A Household International Co.
  - e. Haws Drinking Faucet Co.
9. Emergency Equipment:
  - a. Acorn Engineering Co.
  - b. Bradley Corp.
  - c. Chicago Faucet Co.
  - d. ENCON Safety Products
  - e. Guardian Equipment.
  - f. Haws Drinking Faucet Co.
  - g. Speakman Co.
  - h. Stingray Systems
  - i. Water Saver Faucet Co.
10. Toilet Seats:
  - a. Bemis Mfg. Co.
  - b. Beneke Div.; Sanderson Plumbing Products, Inc.
  - c. Church Seat Co.
  - d. Kohler Co.
  - e. Olsonite Corp.
  - f. Sperzel Industries, Inc.
11. Flushometers – Diaphragm Type:
  - a. Sloan Valve Co.
  - b. Zurn Industries, Inc.; Flush Valve Operations.
12. Commercial/Industrial Cast-Brass Faucets:
  - a. Chicago Faucet Co.
  - b. Delta-Commercial
  - c. Speakman Co.
  - d. T & S Brass and Bronze Works, Inc.
  - e. Zurn Industries, LTD. "Aqua Spec"
13. Commercial/Residential Cast-Brass and Cast-Brass Underbody Faucets:
  - a. American Standard, Inc.
  - b. Delta Faucet Co.; Div. of Masco Corp.
  - c. Grohe America, Inc.
  - d. Kohler Co.
  - e. Symmons Industries, Inc.
14. Commercial Pressure Balance Shower Valves:
  - a. Speakman Co.
  - b. Symmons Industries, Inc.
15. Sensor-Operated Faucets and Devices:
  - a. Sloan Valve Co.
  - b. Zurn Industries, LTD. "Aqua Spec"
16. Stop Valves & Supplies:
  - a. Brass Craft Subsidiary; Masco Co.

- b. Chicago Faucet Co.
- c. Engineered Brass Company
- d. Kohler Co.
- e. McGuire Manufacturing Co., Inc.
- f. PROFLO
- g. Royal Brass Mfg. Co.
- h. T & S Brass and Bronze Works, Inc.
- i. Watts Brass and Tubular
- j. Zurn Industries
- 17. P-traps, Drains & Miscellaneous Fittings:
  - a. Brass Craft Subsidiary; Masco Co.
  - b. Dearborn Brass
  - c. Engineered Brass Company
  - d. Franke
  - e. McGuire Manufacturing Co., Inc.
  - f. PROFLO
  - g. Watts Brass and Tubular
  - h. Zurn Industries
- 18. Supports:
  - a. Josam Co.
  - b. Smith (Jay R.) Mfg. Co.
  - c. Wade Div.; Tyler Pipe.
  - d. Watts Drainage Products
  - e. Zurn Industries, Inc.; Hydromechanics Div.
  - f. Mifab Manufacturing, Inc.
- 19. Insulation Kits
  - a. Brocar
  - b. McGuire
  - c. Plumberex
  - d. PROFLO
  - e. Trap-Wrap
  - f. Truebro, Inc.

## 2.2 PLUMBING FIXTURES GENERAL

- A. Provide plumbing fixtures and trim, fittings, other components, and supports as specified on the drawings and below:

## 2.3 FAUCETS

- A. Faucets General: As described on the drawings.
  - 1. Electronic faucets shall be of the same manufacturer as the water closet and urinal flush valves.

## 2.4 STOP VALVES & SUPPLIES

- A. Supplies General: As described on the drawings.
  - 1. Exposed piping and parts shall be polished chrome plated.

## 2.5 P-TRAPS DRAINS AND MISCELLANEOUS FITTINGS

- A. Fittings General: As described on the drawings, except as listed below.
  - 1. Exposed piping and fittings shall be polished chrome plated.
  - 2. Fittings installed concealed inside a plumbing fixture or within wall construction may be without chrome plate finish.

3. Fitting and faucet bodies for domestic water distribution shall be of lead free brass or lead free cast bronze.
- B. Sink Continuous Wastes: Polished chrome-plated, tubular brass, 1-1/2 inches, 17 gauge, with brass nuts on slip inlets, and of configurations indicated.
- C. Scullery sink Continuous Wastes: Polished chrome-plated, tubular brass, 2 inches, 17 gauge, with brass nuts on slip inlets, and of configurations indicated.
- D. Escutcheons: Wall flange with set screw.
- E. Escutcheons: Polished chrome-plated, sheet steel wall flange with friction clips.
- F. Deep Pattern Escutcheons: Wall flange with set screw or sheet steel wall flange with friction clips, of depth adequate to conceal protruding roughing-in fittings.

## 2.6 FLUSHOMETERS

- A. Provide flushometers compatible with fixtures, with features and of consumption indicated As described on the drawings.
  1. Exposed metal parts shall be polished chrome plated.
  2. Flush valves installed within wall construction may be without chrome plate finish.

## 2.7 TOILET SEATS

- A. General: As described on the drawings.

## 2.8 PLUMBING FIXTURE SUPPORTS

- A. Supports: ASME A112.6.1M, categories and types as required for wall-hanging fixtures specified, and wall reinforcement.
- B. Support categories are:
  1. Carriers: Supports for wall-hanging water closets and fixtures supported from wall construction. Water closet carriers shall have an additional faceplate and coupling when used for wide pipe spaces. Provide tiling frame or setting gauge with carriers for wall-hanging water closets.
  2. Chair Carriers: Supports with steel pipe uprights for wall-hanging fixtures. Urinal chair carriers shall have bearing plates.
  3. Chair Carriers, Heavy Duty: Supports with rectangular steel uprights for wall-hanging fixtures.
- C. Support Types: Provide support of category specified, of type having features required to match fixture.
- D. Provide supports specified as part of fixture description, in lieu of category and type requirements above.

## 2.9 INSULATION KITS

- A. Insulation kits for lavatory and sink waste and supplies of vinyl plastic with reusable fasteners and openings for access to supply stop handles.

## PART 3 - EXECUTION

### 3.1 INSTALLATION GENERAL

- A. Install fixtures, trim and supports in accordance with manufacturer's installation instructions.

**3.2 APPLICATION**

- A. Install plumbing fixtures and specified components, in accordance with designations and locations indicated on Drawings.
- B. Install supports for plumbing fixtures in accordance with categories indicated, and of type required:
  - 1. Carriers for following fixtures:
    - a. Wall-hanging water closets.
    - b. Wall hanging lavatories
    - c. Wall hanging electric water coolers and drinking fountains.
    - d. Wall-hanging fixtures supported from wall construction.
  - 2. Chair carriers for the following fixtures:
    - a. Wall-hanging urinals.
    - b. Wall-hanging lavatories and sinks.
    - c. Wall-hanging drinking fountains and electric water coolers.
  - 3. Heavy-duty chair carriers for the following fixtures:
    - a. Accessible lavatories.
    - b. Fixtures where specified.
  - 4. Reinforcement for the following fixtures:
    - a. Floor-mounted lavatories required to be secured to wall.
    - b. Floor-mounted sinks required to be secured to wall.
    - c. Wall mounted and mop sink faucets.
    - d. Urinal flush valve solid pipe ring supports.

**3.3 INSTALLATION OF PLUMBING FIXTURES**

- A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturers' written installation instructions, roughing-in drawings, and referenced standards.
- B. Install wall-hanging, back-outlet water closets with support manufacturer's tiling frame or setting gauge.
- C. Install wall-hanging, back-outlet urinals with gasket seals.
- D. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.
- E. Fasten floor-mounted fixtures and special fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.
- F. Fasten wall-mounted fittings to reinforcement built into walls.
- G. Fasten counter-mounting-type plumbing fixtures to casework.
- H. Secure supplies behind wall or within wall pipe space, providing rigid installation.
- I. Set mop basins in leveling bed of cement grout.
- J. Install stop valve in an accessible location in each water supply to each fixture.
- K. Install trap on fixture outlet except for fixtures having integral trap.
- L. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.
- M. Seal fixtures to walls, floors, and counters using a sanitary-type, one-part, mildew-resistant, silicone sealant in accordance with sealing requirements specified in Division 7 Section "Joint Sealers." Match sealant color to fixture color.
- N. Install insulation kits on ADA compliant sink and lavatory waste, continuous wastes, hot and cold water supplies where indicated on the drawings and as required by the ADA.

**3.4 CONNECTIONS**

- A. Piping installation requirements are specified in other sections of Division 22. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other sections of Division 22.
  2. Install piping connections indicated between appliances and equipment specified in other sections, direct connected to plumbing piping systems.

**3.5 FIELD QUALITY CONTROL**

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

**3.6 ADJUSTING AND CLEANING**

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust disposers, hot water dispensers, and controls. Replace damaged and malfunctioning units and controls.
- C. Adjust water pressure at drinking fountains, electric water coolers, and faucets, shower valves, and flushometers having controls, to provide proper flow and stream.
- D. Replace washers of leaking and dripping faucets and stops.
- E. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.
- F. Adjust faucet wrist blade handles perpendicular to the spout while in the closed position.
- G. Review the data in Operating and Maintenance Manuals. Refer to Division 1 Section "Project Closeout."
- H. Set each shower valve temperature limit stop to 110°F. Perform work after the shower head is installed and the domestic water heater is in operation. Allow the hot water to run for 5 minutes minimum or until temperature reaches equilibrium. Allow cold to run for 5 minutes minimum or until temperature reaches equilibrium. Provide the architect a report and schedule indicating the hot, cold and mixed maximum water temperature at each shower.

**3.7 FIXTURE SCHEDULE**

- A. Provide plumbing fixtures as specified on the drawings.
- B. Install rough-in for plumbing fixtures as scheduled on the drawings.

**3.8 MOUNTING HEIGHTS SCHEDULE**

- A. Refer to the architectural drawings for plumbing fixture mounting heights. Unless indicated otherwise, install plumbing fixtures with the mounting heights as listed below with final approval by the Architect:

FIXTURE	MOUNTING HEIGHT
Lavatory or Sink	



	Standard Height	31" floor to rim
	ADA Accessible	34" floor to rim
Urinal		
	Standard Height	24" floor to rim
	ADA Accessible	17" floor to rim
Water Closet		
	Standard	15" floor to rim
	ADA Accessible	17" to 19" floor to top of seat
Water Cooler or Drinking Fountain		
	Standard Height	41" floor to spout
	ADA Accessible	36" floor to spout
Shower Valves		
	Standard Height	48" men and 42" women floor to centerline
	ADA Accessible	38" minimum to 48" maximum floor to centerline
Shower heads		
	Standard Height	7'-6" men, 7'-0" women floor to centerline
Ice Maker Outlet Boxes		24" floor to center of box
Washing Machine Outlet Boxes		42" floor to rim
Janitor's Sink Faucet Fittings		42" floor to centerline
Hose Bibbs		36" AFF to centerline
Non Freeze Wall Hydrant		18" AFG to centerline
Interior Wall Hydrant		18" AFF to centerline

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 22 70 00 - NATURAL GAS SYSTEMS****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes distribution piping systems for natural gas, liquid petroleum-gas and manufactured gas within the building and extending from the point of delivery to the connections with gas utilization devices. Piping materials and equipment specified in this Section include:
1. Pipes, fittings, and specialties.
  2. Special duty valves.
  3. Pressure regulators.
- B. This Section does not apply to liquid petroleum piping; industrial gas applications using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen and nitrogen; gas piping, meters, gas pressure regulators and other appurtenances used by the serving gas supplier in distribution of gas.
- C. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 22 Section "General plumbing Requirements," for trenching, excavation, backfill and compaction materials and methods for underground piping installations.
  2. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls.
  3. Division 9 Section "Painting," for materials and methods for painting pipe.
  4. Division 12 Section "Laboratory Casework and Fixtures," for laboratory trim installed in the casework.
  5. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations and wall and floor penetrations.
  6. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, unions, dielectric flanges, and mechanical sleeve seals.
  7. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting gas distribution piping.
  8. Division 26 Section "Common Work Results for Electrical" required electrical devices.
- D. Gas pressures for systems specified in this Section are limited to 5 psig.
- E. Products furnished under this Section include gas meters and gas service piping, which will be provided by the utility company to the site. The following is the name and address of the utility company:
- Contact: Jim Bray  
Company: Spire Gas  
Address: 2828 Dauphin St. Mobile AL 36606  
Telephone number: (251) 591-0106

**1.2 DEFINITIONS**

- A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).
- B. Gas Distribution Piping: A pipe within the building which conveys gas from the point of delivery to the points of usage.
- C. Gas Service Piping: The pipe from the gas main or other source of supply including the meter, regulating valve, or service valve to the gas distribution system of the building served.
- D. Point of Delivery: The outlet of the service meter assembly, or the outlet of the service regulator (service shutoff valve when no meter is provided).

**1.3 SUBMITTALS**

- A. Product data for each gas piping specialty and special duty valves. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.
- B. Shop drawings detailing dimensions, required clearances, for connections to gas meter.
- C. Coordination drawings for gas distribution piping systems in accordance with Division 22 Section "General Plumbing Requirements."
- D. Maintenance data for gas specialties and special duty valves, for inclusion in operating and maintenance manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."
- E. Welders' qualification certificates, certifying that welders comply with the quality requirements specified under "Quality Assurance" below.
- F. Test reports specified in Part 3 below.

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Installation and replacement of gas piping, gas utilization equipment or accessories, and repair and servicing of equipment shall be performed only by a qualified installer. The term qualified is defined as experienced in such work (experienced shall mean having a minimum of 5 previous projects similar in size and scope to this project), familiar with precautions required, and has complied with the requirements of the authority having jurisdiction. Upon request, submit evidence of such qualifications to the Architect.
- B. Qualifications for Welding Processes and Operators: Comply with the requirements of ASME Boiler and Pressure Vessel Code, "Welding and Brazing Qualification."
- C. Regulatory Requirements: Comply with the requirements of the following codes:
  - 1. NFPA 54 - National Fuel Gas Code, for gas piping materials and components, gas piping installation and inspections, testing, and purging of gas piping systems.
  - 2. 2021 International Fuel Gas Code
- D. Local Gas Utility Requirements: Comply with local gas utility installation rules and regulations.
- E. Pipe, pipe fittings and pipe specialties shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

**1.5 SPARE PARTS**

- A. Valve Wrenches: Furnish to Owner, with receipt, 2 valve wrenches for each type of gas valve installed, requiring same.

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. Manufacturer: Subject to compliance with requirements, provide gas piping system products from one of the following:
  - 1. Gas Ball Valves – 2" and Smaller:
    - a. Apollo Valves # 77F-1XX-01
    - b. Hammond Valve # 8901
    - c. Milwaukee Valve # BA-475B
    - d. Nibco Inc. # T-FP 600A
    - e. Watts # FBV-3C
  - 2. Gas Ball Valves – 2-1/2" to 4":
    - a. Apollo Valve # 77F-1XX-01

- b. Hammond Valve # 8901
- c. Milwaukee Valve # BA-475B
- d. Nibco Inc. # T-FP 600A
- 3. Gas Cocks – 2" and Smaller:
  - a. Homestead # 601
  - b. Milliken #200M
  - c. RM Energy Systems # D125
- 4. Gas Cocks – 2-1/2" and Larger:
  - a. Homestead # 602
  - b. Milliken #200MF
  - c. RM Energy Systems "Hercules" # D126
- 5. CSA Listed Gas Pressure Regulators
  - a. Karl Dungs, Inc.
  - b. Maxitrol
  - c. Pietro-Fiorentini
- 6. Polyethylene Pipe and Pipe Fittings:
  - a. Cresline Plastic Pipe Co. PE 2708
  - b. Charter Plastics PE 2708
  - c. Chevron Phillips DriscoPlex Series 6500
- 7. Polyethylene to Steel Pipe Transition Fittings:
  - a. Perfection Corporation
  - b. R.W. Lyall
  - c. Central Plastics
- 8. Insect Screens
  - a. Northtown Pipe Protection Products "BUGSCRN Series"
- 9. Gas Relief Vents
  - a. Richards "GV Series"

## 2.2 PIPE AND TUBING MATERIALS

- A. General: Refer to Part 3, Article "PIPE APPLICATIONS" for identification of systems where the specified pipe and fitting materials listed below are used.
- B. Steel Pipe: ASTM A 53, Grade B, Schedule 40, (Type E electric-resistance welded or Type S seamless, black steel pipe, beveled ends).
- C. Plastic Pipe: Medium Density, SDR-11 iron pipe size polyethylene pipe, meeting ASTM D 2513, with heat fusion connections. Pipe shall meet Plastic Pipe Institute Material Designation of PE 2708.

## 2.3 FITTINGS

- A. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- B. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.
  - 1. 1-1/4" and smaller shall be socket type
  - 2. 1-1/2" and larger shall be butt weld type.
- C. Forged Steel Flanges and Flanged Fittings: ASME B16.5, Class 150, butt weld ends, standard pattern with bolts, nuts and gaskets of material group 1.1.
- D. Plastic Fittings: Medium density polyethylene socket fusion fittings, meeting ASTM D 2515 compatible with the piping system.
- E. Transition Fittings – Steel to Polyethylene: Factory assembled and pressure tested one piece design, with steel half of Schedule 40 steel pipe with beveled edge for welding and polyethylene half shall be of ample length for making welds. Steel pipe shall have epoxy protective coating.

- F. Insect screens: Black steel body with 20 mesh stainless steel screen and MNPT end.
- G. Gas Relief Vents: Galvanized steel body with 90 degree inlet to screened outlet, 20 mesh stainless steel screen and FNPT end.

## 2.4 JOINTING MATERIALS

- A. Joint Compound: Suitable for the gas being handled.
- B. Gasket Material: Thickness, material, and type suitable for gas to be handled, and for design temperatures and pressures.

## 2.5 PIPING SPECIALTIES

- A. Protective Coating: When piping will be in contact with material or atmosphere exerting a corrosive action, pipe and fittings shall be factory-coated with polyethylene tape, having the following properties:
  - 1. overall thickness; 20 mils;
  - 2. synthetic adhesive;
  - 3. water vapor transmission rate, gallons per 100 square inch: 0.10 or less.
  - 4. water absorption, percent: 0.02 or less.
- B. Prime pipe and fittings with a compatible primer prior to application of tape.
- C. Strike Plates: 16 gauge carbon steel, tested and listed by CSA International.
- D. In wall Strike Protection Hose: UL listed spiral wound interlocking galvanized steel reduced wall flexible conduit.
- E. Nonmetallic Watertight Conduit: Schedule 80 rigid PVC, UL 651, with fittings to match to conduit type and material.
- F. Multiple Port Manifolds: ANSI LC1b, plastic coated malleable iron, of the same manufacturer of the corrugated stainless steel tubing, tested and listed by CSA International.

## 2.6 VALVES

- A. Gas Ball Valves – 2" and Smaller: Full port brass body with brass ball, PTFE seats, threaded ends 150psi steam, 600 WOG, UL listed for natural gas service.
- B. Gas Ball Valves – 2-1/2" to 4": Standard port brass body with brass ball, PTFE seats, threaded ends 150psi steam, 400 WOG, UL listed for natural gas service.
- C. Gas Cocks 2 Inch and Smaller: 175 psi, lubricated plug type, ASTM A126 Grade B semi-steel body, brass or semi-steel plug with full area rectangular port, straightaway pattern, square head, threaded ends.
- D. Gas Cocks 2-1/2 Inch and Larger: 175 psi, lubricated plug type, ASTM A126 Grade B semi-steel body and plug with full area rectangular port, straightaway pattern, single gland, wrench operated, flanged ends.
- E. Solenoid Valves: As specified on the drawings.
- F. Gas Line Pressure Regulators: Single stage, steel jacketed, corrosion-resistant gas pressure regulators; with atmospheric vent, elevation compensator; internal relief vent, vent limiter for indoor installation, with threaded ends for 2 inch and smaller, flanged ends for 2-1/2 inch and larger; for inlet and outlet gas pressures, specific gravity, and volume flow as indicated on the drawings.
  - 1. CSA listed for 2 PSI gas systems

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Install pipe, fittings, valves and specialties in accordance with manufacturer's installation instructions.

**3.2 PREPARATION**

- A. Precautions: Before turning off the gas to the premises, or section of piping, turn off all equipment valves. Perform a leakage test as specified in "FIELD QUALITY CONTROL" below, to determine that all equipment is turned off in the piping section to be affected.
- B. Conform with the requirements in NFPA 54, for the prevention of accidental ignition.

**3.3 PREPARATION FOUNDATION FOR UNDERGROUND GAS SERVICE PIPING**

- A. Pipe Beds for PE Pipe and PVC Pipe Conduit: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement or fusion process. After pressure testing is complete, gradually install bedding to maintain continuous pipe slope and prevent pipe deflection and then install subbase. Refer to Division 22 Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.

**3.4 PIPE APPLICATIONS**

- A. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger.
- B. Install PE plastic pipe with fusion bond plastic fittings below grade outside the building slab.

**3.5 PIPING INSTALLATION**

- A. General: Conform to the requirements of NFPA 54 - National Fuel Gas Code.
- B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Design locations and arrangements of piping take into consideration pipe sizing, flow direction, slope of pipe, expansion, and other design considerations. So far as practical, install piping as indicated.
- C. Concealed Locations: As specified below:
  - 1. Inaccessible Above-Ceiling Locations: Install concealed gas piping in inaccessible above-ceiling spaces without valves or unions.
  - 2. Accessible Above-Ceiling Locations: Gas piping may be installed in accessible above-ceiling spaces (subject to the approval of the authority having jurisdiction), whether or not such spaces are used as a plenum. Valves and unions shall not be located in such spaces used as a plenum.
  - 3. In Floors: Install concealed gas piping in concrete floor slabs in an air-tight conduit constructed of Schedule 40 PVC with socket weld joints two pipe sizes larger than the gas pipe served. Extend conduit a minimum of 12" above finish floor and cap air tight at both ends. Vent conduit to the outside with a minimum 2" pipe and terminate with a screened vent cap.
  - 4. Piping In Partitions: Install concealed gas piping in hollow partitions with welded joint (subject to the approval of the authority having jurisdiction) and protect gas piping against

- physical damage. Install gas piping passing through partitions with no joints or unions inside the partition.
5. Concrete or Masonry Walls: Do not install gas piping in masonry or concrete walls.
  6. Prohibited Locations: Do not install gas piping in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumbwaiter or elevator shaft. This does not apply to accessible above-ceiling space specified above.
- D. Fire Barrier Penetrations: Where pipes pass through fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.
  - E. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of No-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Basic Piping Materials and Methods" for special sealers and materials.
  - F. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves, packing, and sealant. Refer to Division 22 Section "Common Work Results for Plumbing" for additional information.
  - G. Dirt legs and Sediment Traps: Install a dirt leg at points where condensate and impurities may collect, at the outlet of the gas meter, as close to the inlet of each gas appliance or equipment as possible, and in a location readily accessible to permit cleaning and emptying.
    1. Construct dirt legs and sediment traps using a tee fitting with the bottom outlet plugged or capped. Provide a 3" length of pipe and screwed cap for the dirt leg. Use line size pipe for dirt leg, refer to the drawings for sizes. Enter the tee with flow from the top and exit the tee from the side outlet. Install the dirt leg a minimum of 3-1/2" above the roof or floor readily accessible to permit cleaning and emptying.
    2. Install line size gas cock, union and dirt leg at each equipment connection; refer to the drawings for sizes. Provide reducers at the equipment connection as required. Unions are specified in Division 22 section "Basic Piping Materials and Methods".
  - H. Use fittings for all changes in direction and all branch connections.
  - I. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
  - J. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
  - K. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
  - L. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Allow sufficient space above removable ceiling panels to allow for panel removal.
  - M. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
  - N. Install gas piping at a uniform grade of 1/4 inch in 15 feet, upward to risers, and from the risers to the meter, or service regulator when meter is not provided, or the equipment.
  - O. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.
  - P. Connect branch outlet pipes from the top or sides of horizontal lines, not from the bottom.
  - Q. Install unions in pipes 2 inch and smaller, adjacent to each valve, and elsewhere as indicated. Unions are not required on flanged devices. Unions are specified in Section "Basic Piping Materials and Methods".



- R. Joints Containing Dissimilar Metals: Provide dielectric unions for 2" and smaller and dielectric flanges for piping 2-1/2" and larger. Dielectric unions and flanges are specified in Section "Basic Piping Materials and Methods".
- S. Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.
- T. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, and elsewhere as indicated.
- U. Anchor piping to ensure proper direction of expansion and contraction. Install expansion loops and joints as indicated on the Drawings and specified in Division 22 Section "Expansion Fittings and Loops for Plumbing Piping."
- V. Paint Exposed Outdoor Gas Piping: Cleaning and painting of exposed outdoor gas piping is specified in Division 9 Section "Painting".
  - 1. Final color per the architect.

### 3.6 HANGERS AND SUPPORTS

- A. General: Hanger, support, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.
- B. Pipe Attachments: Install the following:
  - 1. Adjustable clevis hangers, MSS SP-69 Type 1, for steel pipe 2-1/2" and larger for individual horizontal runs.
  - 2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.
  - 3. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual exposed runs on walls.
  - 4. Engineered strut support system may be provided, at the contractor's option, in lieu of individual hangers for horizontal pipes as specified in Division 22 "Hangers and Supports for Plumbing Piping". Provide two piece straps for uninsulated pipe secured to the bare pipe and provide plastic galvanic isolators for bare copper tube.
  - 5. Provide roll hangers for individual horizontal runs 100 feet or longer.
  - 6. Provide roll hangers for individual horizontal runs 20 feet or longer for exposed piping installed on roofs.
  - 7. Provide 316 stainless steel rods, nuts, washers, beam clamps, channels, adjustable band hangers, MSS SP-69 Type 7, or clevis hangers, MSS SP-69 Type 1, for piping located in Hydrotherapy and Pool Equipment Rooms. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58 and SP-69, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

<u>Nom. Pipe Size in Inches</u>	<u>Max Span In Feet</u>	<u>Min. Rod Dia. - Inches</u>
1/2	6	3/8
3/4 to 1	8	3/8
1-1/4 to 2	10	3/8
2-1/2 to 3	10	3/8
4	10	3/8
6	10	1/2
8	10	3/4

- C. Support vertical piping at every floor.
- D. Support gas piping within 12" of each elbow or tee and for gas piping 2-1/2" and larger at each valve or pressure regulator.

- E. Support gas piping located on roof with pre-engineered roof supports, pre-engineered roof supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table above for maximum spacing of supports. Support pipe at a minimum 7" above the roof.
- F. Provide vibration isolation for piping connected to rotating equipment. Vibration isolators are specified in Division 22 specification Section "Vibration Isolation for Plumbing Piping and Equipment".

### 3.7 PIPE JOINT CONSTRUCTION

- A. Welded Joints: Comply with the requirements in ASME Boiler and Pressure Vessel Code, Section IX.
- B. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:
  - 1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint. Refer to NFPA 54, for guide for number and length of threads for field threading steel pipe.
  - 2. Align threads at point of assembly.
  - 3. Apply thread compound for use with gas systems to the external pipe threads. Pipe thread tape is not accepted.
  - 4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
  - 5. Damaged Threads: Do not use pipe with threads which are corroded, or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- C. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.
- D. Fusion Welded: Joints shall be made by a qualified and approved operator in accordance with Title 49, CFR, Part 192.283 and be made in accordance with pipe manufacturer's recommendations.
- E. Semi-rigid Corrugated Stainless Steel Tubing: Joints shall be made by a qualified and approved operator in accordance with pipe manufacturer's recommendations.

### 3.8 VALVE APPLICATIONS

- A. General: The Drawings indicate valve types, locations, and arrangements.
- B. Shut-off duty: Use gas cocks specified in Part 2 above.

### 3.9 VALVE INSTALLATIONS

- A. Install valves in accessible locations, protected from physical damage. Tag valves with a metal tag attached with a metal chain indicating the piping systems supplied.
- B. Install the emergency natural gas shutoff valve furnished with exhaust hood fire extinguishing system in an accessible location.
- C. Install line size gas cock at the outlet of the gas meter set or gas riser and install a line size union downstream of the gas cock outside of the building.
- D. Installation of Gas Pressure Regulators:

1. Install a gas cock 10 pipe diameters upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve is not required at the second regulator.
2. Install line pressure regulators a minimum of 10 pipe diameters upstream of each atmospheric or power burner equipment connection.
3. Install line pressure regulators a minimum of 10'-0" upstream of each condensing boiler or water heater connection.
4. Install gas pressure regulator relief devices so they can be readily operated to determine if the valve is free; so they can be tested to determine the pressure at which they will operate; and examined for leakage when in the closed position.
5. Install gas pressure regulators with listed vent limiters indoors where allowed by the AHJ. Install with regulator dome vertically upright and level.
6. Install gas pressure regulators located outside the building with the relief port facing down to prevent the entry of moisture with the relief port a minimum of 18" above the roof or finish grade. Remove vent limiter and provide with line size (same size as gas vent relief port) insect screen or gas relief vent and 1" long schedule 40 black steel nipple.
  - a. Where manufacturer does not allow the gas pressure regulator to be installed upside down, install gas pressure regulator with regulator dome in the horizontal or vertically upright with factory breather plug.
7. Gas Pressure Regulator Relief Vents: Provide for gas pressure regulators that require them or for vent less regulators where the AHJ requires them. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger. Route vent to the outdoors thru building side wall and turn down or thru the roof and turn down minimum 18" above the roof or grade. Provide with line size (same size as gas relief) insect screen or gas relief vent. Provide vent sizes per the following developed length and include 3 feet of length for each elbow:
  - a. 10 feet developed length size vent one pipe size larger than relief vent outlet size
  - b. 20 feet developed length size vent two pipe size larger than relief vent outlet size
  - c. 30 feet developed length size vent three pipe size larger than relief vent outlet size
  - d. 40 feet developed length size vent four pipe size larger than relief vent outlet size

### **3.10 TERMINAL EQUIPMENT CONNECTIONS**

- A. Install line size gas cock upstream and within 6 feet of gas appliance. Install a line size union or flanged connection downstream from the gas cock to permit removal of controls. Install reducer at the gas appliance connection, if required.
- B. Install stainless steel flexible gas pipe connector, of size and length as required to complete equipment hook-up of foodservice equipment. Verify appropriate length of flexible gas pipe connector for movement of the foodservice equipment for cleaning.

### **3.11 ELECTRICAL BONDING AND GROUNDING**

- A. Install above ground portions of gas piping systems, upstream from equipment shutoff valves electrically continuous and bonded to a grounding electrode in accordance with NFPA 70 - "National Electrical Code."
- B. Do not use gas piping as a grounding electrode.
- C. Conform to NFPA 70 - "National Electrical Code," for electrical connections between wiring and electrically operated control devices.

### **3.12 FIELD QUALITY CONTROL**

- A. Piping Tests: Inspect, test, and purge natural gas systems in accordance with NFPA 54, and local utility requirements.

END OF SECTION

**TABLE OF CONTENTS****DIVISION 23 - HEATING VENTILATING AND AIR-CONDITIONING SPECIFICATION**

230010	GENERAL MECHANICAL REQUIREMENTS
230015	ELECTRICAL COORDINATION FOR MECHANICAL EQUIPMENT
230500	COMMON WORK RESULTS FOR HVAC
230510	BASIC PIPING MATERIALS AND METHODS
230513	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230514	VARIABLE FREQUENCY DRIVES
230516	EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING
230519	METERS AND GAUGES FOR HVAC PIPING
230523	GENERAL-DUTY VALVES FOR HVAC PIPING
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
230550	VIBRATION ISOLATION FOR HVAC
230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC
230700	HVAC INSULATION
230800	COMMISSIONING OF HVAC SYSTEMS
230913	INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
230914	REFRIGERANT MONITORING SYSTEMS
230923	DIRECT-DIGITAL CONTROL FOR HVAC
232113	HYDRONIC PIPING
232113.13	BURIED HYDRONIC AND STEAM PIPING
232113.23	MECHANICALLY JOINED HYDRONIC PIPING SYSTEMS
232114	HYDRONIC SPECIALTIES
232123	HYDRONIC PUMPS
232500	HVAC WATER TREATMENT
233113	METAL DUCTS
233300	AIR DUCT ACCESSORIES
233423	HVAC POWER VENTILATORS
233433	AIR CURTAINS
233600	AIR TERMINAL UNITS
233713	DIFFUSERS, REGISTERS & GRILLES
234000	PARTICULATE AIR FILTRATION
235100	BREECHINGS, CHIMNEYS AND STACKS
235113	DRAFT CONTROL DEVICES
235216	CONDENSING BOILERS
235323	BOILER ACCESSORIES
236416	CENTRIFUGAL WATER CHILLERS
236500	COOLING TOWERS
237200	AIR-TO-AIR ENERGY RECOVERY EQUIPMENT
237313	CENTRAL STATION AIR HANDLING UNITS
238200	TERMINAL HEATING AND COOLING UNITS
238414	SELF-CONTAINED HUMIDIFIERS
238417	DESICCANT WHEEL UNITS
238419	HYDROTHERAPY AIR HANDLING UNITS

END OF DIVISION 23 TABLE OF CONTENTS



12/11/2024

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 23 00 10 - GENERAL MECHANICAL REQUIREMENTS****PART 1 - GENERAL REQUIREMENTS****1.1 DESCRIPTION OF WORK**

- A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
- B. Division 23 of the Specifications and Drawings numbered with prefixes M, MP or ME, or MEP generally describe these systems, but the scope of the Mechanical work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.
- C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, ductwork, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

**1.2 QUALITY ASSURANCE**

- A. All work under this Division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.
- B. All work shall be installed in strict conformance with manufacturers' requirements, recommendations, and installation instructions. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.
- C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.
- D. Unless specified otherwise, manufactured items shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this project.

**1.3 CODES REFERENCES AND STANDARDS**

- A. Execute Work in accordance with the National Fire Protection Association and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.
- B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient

time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.

- C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.
- D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes:

BOCA	Building Officials Code Administration
UPC	Uniform Plumbing Code
IBC	International Building Code
IMC	International Mechanical Code
IPC	International Plumbing Code
IECC	International Energy Conservation Code
IFC	International Fire Code
IFGC	International Fuel Gas Code
ADA	American Disabilities Act
ADC	Air Diffusion Council
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
AHRI	Air Conditioning, Heating and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
ETL	Electrical Testing Laboratories
HI	Hydraulic Institute
MSS	Manufacturer's Standardization Society of the Valve and Fitting Industry
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufacturers' Association
OSHA	Occupational Safety and Health Act
PDI	Plumbing and Drainage Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc.
UL	Underwriter's Laboratories

- E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.
- F. All mechanical work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the mechanical work shall be provided by the Contractor.

#### 1.4 DEFINITIONS

- A. General:
  1. Furnish: The term "furnish" is used to mean "supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations."
  2. Install: The term "install" is used to describe operations at the project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."



3. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use. When 'furnish', 'install', 'perform', or 'provide' is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.
  4. Furnished by Owner or Furnished by Others: The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
  5. Engineer: Where referenced in this Division, "Engineer" is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the "Architect".
  6. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
  7. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
  8. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
    - a. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
    - b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
  9. Value Engineering: A systematic method to improve the "value" of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.
- B. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.
- C. The following definitions apply to excavation operations:
1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
  2. Bedding: Bedding as used in this section refers to the compacted sand or pea gravel installed in the bottom of a trench to immediately support and cover a pipe or duct.
  3. Subbase: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
  4. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
  5. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.

**1.5 COORDINATION**

- A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.
- B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping and ductwork in the manner anticipated in the design.
- C. The Contractor shall confirm and coordinate the final location and routing of all mechanical, electrical, plumbing, fire protection, control and audio-visual systems with all architectural features, structural components, and other trades. The contractor shall locate equipment, components, ductwork, piping, conduit, and related accessories to maintain the desired ceiling heights as indicated on the architectural drawings. The contractor shall inform the architect of any areas where conflicts may prevent the indicated ceiling height from being maintained. The contractor shall not proceed with any installation in such areas until the architect has given written approval to proceed or has provided modified contract drawings or written instructions to resolve the apparent conflict.
- D. The Contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finishes actually installed.
- E. The Contractor shall maintain a foreman on the jobsite at all times to coordinate the work with other contractors and subcontractors so that various components of the mechanical systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the Work in such a manner that the Work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.
- F. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and their subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

**1.6 COORDINATION DRAWINGS**

- A. Coordination Drawings, General: Prepare coordination drawings according to the requirements of individual Sections. Additionally, prepare coordination drawings as required scope of installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one trade.
  - 1. Information shall be project specific and drawn accurately to a scale large enough to resolve conflicts. Do not base coordination drawings on standard dimensional data.
  - 2. Prepare floorplans, sections, elevations, and details as needed to adequately describe relationship of various systems and components.
  - 3. Clearly indicate functional and spatial relationships of components of all systems specified in the Contract Documents, including but not limited to: architectural, structural, civil, mechanical, electrical, fire protection, and specialty systems.
  - 4. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
  - 5. Show location and size of access doors required for access to concealed equipment, fittings, controls, terminations, and cabling.

6. Indicate required installation sequence to minimize conflicts between entities.
  7. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Contract Administrator indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
  8. The details of the coordination are the responsibility of the Contractor and, where indicated on the Drawings, minor adjustments in raceway routing, device placement, device type, or equipment arrangement are not to be considered changes to the Contract.
- B. Equipment Room Coordination Drawings: In accordance with the submittal procedures outlined within these Specifications, provide dimensioned layouts of electrical equipment locations within electrical rooms/closets, mechanical rooms, generator rooms, and fire pump rooms with equipment drawn to scale and identified therein.
1. Clearly identify all required working clearances and access provisions required for installation and maintenance.
  2. Equipment layouts should be arranged accounting for considerations for required door openings and the clearances required by the equipment manufacturer.
  3. Indicate path to allow for the future removal of each large piece of equipment (up to and including generators and unit sub-station transformers) without removal of non-related equipment or architectural elements.
  4. Include work provided by others routed through the equipment rooms.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
  2. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.
    - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Contract Administrator.
  3. Where the Engineer's digital data files are provided to the Contractor for use in preparing coordination digital data files, the Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings or Specifications.
  4. Submit coordination drawings in accordance with the submittal procedures outlined within these Specifications.

## 1.7 MEASUREMENTS AND LAYOUTS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

## 1.8 SUBMITTALS

- A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.
- B. Refer to Division 01 for acceptance of electronic submittals. If not specified by Division 01, provide electronic submittals. If Division 01 requires paper submittals, provide the quantity of submittals required, but no fewer than seven (7) sets.

- C. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Contract Administrator and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 01, Contractor shall include the website, username and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Contract Administrator's and Engineer's designated representatives. Contractor shall allow for the Engineer Review Time as specified. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.
- D. Engineer Review Time: Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time or time specified in the Engineer's Agreement with the Client, plus to/from mailing time via the Contract Administrator, plus a duplication of this time for resubmittal if required. Transmit submittals as soon as possible after Notice to Proceed and before Mechanical construction starts.
- E. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.
- F. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division as noted in each individual Section. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.
- G. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.
- H. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.
- I. Refer to individual Sections for additional submittal requirements.
- J. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- K. Submittals shall contain the following information:
  - 1. The project name.
  - 2. The applicable specification section and paragraph.
  - 3. Equipment identification acronym as used on the drawings.
  - 4. The submittal date.
  - 5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
  - 6. Submittals not so identified will be returned to the Contractor without action.
- L. The checking and subsequent acceptance by the Engineer and/or Contract Administrator of submittals shall not relieve responsibility from the Contractor for (1) deviations from Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Contract Administrator prior to implementing any deviation.
- M. Provide welders' qualification certificates.

- N. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.

### 1.9 ELECTRONIC DRAWING FILES

- A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of 200 for a drawing set up to 12 sheets and 15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

### 1.10 SUBSTITUTIONS

- A. Refer to Division 01 and General Conditions for Substitutions in addition to requirements specified herein.
- B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.
- D. Request for Substitution:
1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
  2. The burden of proof of the merit of the proposed substitution is upon the proposer.
  3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:
    - a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
    - b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
    - c. Proposed substitution has received necessary approvals of authorities having jurisdiction.
    - d. Same warranty will be furnished for proposed substitution as for specified Work.
    - e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
    - f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.
- E. Substitution Consideration:
1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
  2. No substitutions will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.
  3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
  4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

**1.11 OPERATION AND MAINTENANCE MANUALS**

- A. Refer to Division 01 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.
- B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.
- C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.
- D. Prior to Substantial Completion of the project, furnish to the Architect, for Engineer's review, and for the Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.
- E. Each manual shall contain data listed in each individual Section.
- F. Refer to Division 01 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 01, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representative.

**1.12 SPARE PARTS**

- A. Provide to the Owner the spare parts specified in the individual sections in Division 23 of this specification.

**1.13 RECORD DRAWINGS**

- A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.
- B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.
- C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.

**1.14 TRAINING**

- A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video record the training sessions in format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

**1.15 PAINTING**

- A. Exposed ductwork and ferrous surfaces, including pipe, pipe hangers, equipment stands and supports and exposed insulated piping shall be painted by the Contractor using materials and methods as specified under Division 09 of the Specifications; colors shall be as selected by the Architect.
- B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.
- C. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

**1.16 DELIVERY STORAGE AND HANDLING**

- A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.
- B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.
- C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.
- D. The Contractor shall be responsible for the safe storage of their own tools, material and equipment.

**1.17 GUARANTEES AND WARRANTIES**

- A. Refer to Division 01 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.
- B. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.
- C. The following additional items shall be guaranteed:
  - 1. Piping shall be free from obstructions, holes or breaks of any nature.
  - 2. Insulation shall be effective.
  - 3. Proper circulation of fluid in each piping system.
- D. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.
- E. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.
- F. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed to the Owner and stating the commencement date and term.

**1.18 TEMPORARY FACILITIES**

- A. Refer to Division 01 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.
- B. Temporary Utilities: The types of services required include, but are not limited to, water, sewerage, surface drainage and gas. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.
  - 1. Provide the necessary backflow prevention devices where connecting to the potable water system. Protect water service from freezing by draining system or by providing adequate heat. Where non-potable water is used, mark each outlet with health hazard warning signs.
  - 2. Sewer Sediment: Maintain sewers and temporary connecting sewers in a clean, non-clogged condition during construction period.
- C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.
  - 1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.
  - 2. Heating: Provide heat, as necessary, to protect work, materials and equipment from damage due to dampness and cold. In areas where building is occupied, maintain a temperature not less than 65 degrees Fahrenheit. Use steam, hot water, or gas from piped distribution system where available. Where steam, hot water or piped gas are not available, heat with self-contained LP gas or fuel oil heaters, bearing UL, FM or other approval labels appropriate for application. Vent fuel-burning heaters, and equip units with individual-space thermostatic controls. Use electric-resistance space heaters only where no other, more energy-efficient, type of heater is available and allowable.

**1.19 PROJECT CONDITIONS****PART 2 - PRODUCTS AND MATERIALS****2.1 SOIL MATERIALS**

- A. Bedding Material: Provide clean sand, pea gravel or flowable fill material (per the geotechnical or structural engineer's recommendations).
- B. Subbase Material: Where applicable, provide natural soils with 10% by volume of rocks less than 2" diameter or artificially graded crushed aggregate. Corrosive fill materials shall be not be utilized. When CL clay, rock, or gravel is used, it shall not be larger than 2 inches in any dimension and shall be free of debris, waste, frozen materials, vegetable and other deleterious matter.
- C. Drainage Fill: Provide washed, evenly graded mixture of 3/4" open graded aggregate stone or gravel, around drainage pipes to a level above pipe as detailed by Architect. Provide open graded aggregate, crushed stone, crushed or uncrushed gravel with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve for drainage fill to subgrade or around equipment structures.
- D. Filter Fabric: Flat needle punched PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.



**PART 3 - EXECUTION****3.1 PERMITS**

- A. Secure and pay for permits required in connection with the installation of the Mechanical Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

**3.2 EXISTING UTILITIES**

- A. Schedule and coordinate with the Utility Company, Owner and with the Engineer connection to, or relocation of, or discontinuation of normal utility services from existing utility lines. Premium time required for any such work shall be included in the bid.
- B. Existing utilities damaged due to the operations of utility work for this project shall be repaired to the satisfaction of the Owner or Utility Company without additional cost.
- C. Utilities shall not be left disconnected at the end of a work day or over a weekend unless authorized by representatives of the Owner or Engineer.
- D. Repairs and restoration of utilities shall be made before workmen leave the project at the end of the workday in which the interruption takes place.
- E. Contractor shall include in their bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

**3.3 EXCAVATION AND BACKFILLING**

- A. Refer to Division 01, Division 02, and Division 31, Geotechnical Soils Report and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.
- B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this Division. Excavation and Trenching shall be in conformance with applicable Division and section of the General Specifications.
- C. Roads, alleys, streets and sidewalks damaged during this work shall be restored to the satisfaction of Authorities Having Jurisdiction.
- D. Trenches close to walks or columns shall not be excavated without prior consultation with the Architect.
- E. Erect barricades around excavations and trenches for safety. Provide an adequate number of amber lights on or near the work and keep them burning from dusk to dawn. Contractor shall be held responsible for any damage that any parties may sustain due to neglecting the necessary precautions when performing the work.
- F. Slope sides of excavations and trenches to comply with Geotechnical Report, local, state and federal codes and ordinances. Shore and brace as required for stability of excavation.
- G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations and trenches regardless of time period excavations and trenches will be open.
  - 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- H. Install sediment and erosion control measures in accordance with local codes and ordinances.
- I. Dewatering of Excavation and Trenches: Prevent surface water and subsurface or ground water from flowing into excavations and trenches.

1. Do not allow water to accumulate in excavation or trenches. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations and trenches.
  2. Establish and maintain temporary drainage ditches and other diversions outside excavation and trench limits to convey surface water to collecting or run-off areas.
  3. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.
- J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
1. Locate and retain soil materials away from edge of excavations and trenches. Do not store within drip-line of trees indicated to remain.
  2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- K. Excavation for Underground Tanks, Basins, and Mechanical Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
  2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.
- L. Trenching: Excavate trenches as follows:
1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.
  2. Excavate trenches to depth indicated or required to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
  3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
  4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of sand or pea gravel prior to installation of pipe. Provide a minimum of 6 inches of sand or pea gravel cushion between rock bearing surface and pipe.
  5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment bedding on undisturbed soil.
- M. Cold Weather Protection: Protect excavation and trench bottoms against freezing when atmospheric temperature is less than 35°F.
- N. Bedding:
1. Fill bottom of pipe trench and fill unevenness with compacted bedding material to ensure continuous bearing of the pipe barrel on the bearing surface. Additional bedding installation requirements are in the following piping specifications. Compact bedding as described below.
  2. Fill bottom of equipment trench and fill unevenness with compacted sand backfill to ensure continuous bearing of the equipment on the bearing surface. Compact bedding as described below.
- O. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
1. Under pipes, use bedding materials in layers to 6 inches above top of the pipe.
  2. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
  3. Under building slabs, use subbase materials.
  4. Under piping and equipment, use bedding and subbase materials over rock bearing surface and for correction of unauthorized excavation.

5. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete protection slab. After installation and testing of pipes, provide a 4-inch thick concrete protection top slab prior to backfilling and placement of roadway subbase. Contractor shall coordinate with local AHJ as to requirements for colored concrete in this application.
  6. Other areas, use excavated or borrowed materials where applicable.
  7. Backfill excavations as promptly as work permits, but not until completion of the following:
    - a. Inspection, testing, approval, and locations of underground utilities have been recorded.
    - b. Removal of concrete formwork.
    - c. Removal of shoring and bracing, and backfilling of voids.
    - d. Removal of trash and debris.
  8. Where gravel fill (drainage fill) is used as building fill material in lieu of natural soils, provide filter fabric material to line the trench to support the bedding fill material and subgrade materials to ensure that backfill materials will not segregate within the trench nor create voids and sags within the pipe trench.
  9. Ductwork under slab shall be backfilled with a minimum of 4" bedding material on all sides for protection from soils (per Code). Subbase materials shall be utilized above the bedding material to the subgrade level.
    - a. If concrete encasement is required, a minimum of 4" thickness all sides shall be provided unless otherwise noted. Contractor shall provide hold down straps as per manufacturer's recommendations.
    - b. If a concrete ballast pad is required, size of ballast pad shall be as noted on the drawings or as per manufacturer's recommendations.
- P. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
  2. Removal of concrete formwork.
  3. Removal of shoring and bracing, and backfilling of voids.
  4. Removal of trash and debris.
- Q. Subgrade Placement and Compaction: Place subgrade backfill materials in maximum layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- R. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- S. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.
- T. Placement and Compaction: Place bedding backfill materials in maximum layers of not more than 6 inches loose depth for material compacted by hand-operated tampers. Place subbase backfill materials in maximum layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
1. Use of pneumatic backhoe as compaction method is disallowed as an acceptable process for compaction of excavations or trenches.
  2. For vertical and/or diagonal pipe installations greater than 1/2" rise/lf, thoroughly support pipes from permanent concrete structures or undisturbed earth at no less than 10-foot intervals, while placing backfill materials, so that pipes are not deflected, crushed, broken, or otherwise damaged by the backfill placement or settlement.
  3. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or

- relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
4. Place backfill and/or drainage fill materials evenly adjacent to structures, piping, and equipment to required elevations. Coordinate with Architect and/or Civil Engineer backfill requirements prior to installation. Prevent displacement of pipes and equipment by carrying material uniformly around them to approximately same elevation in each layer or lift.
  5. Compaction: control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below:
  6. Percentage of maximum density requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 or ASTM D 698 and not less than the following percentages of relative density, determined in accordance with ASTM D 4253, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
    - a. Areas under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 95 percent maximum density for cohesive material listed, or 95 percent relative density for cohesionless material.
    - b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 95 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    - c. Other Areas: Compact top 6 inches of subgrade and each layer of subbase backfill or fill material to 90 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
- U. Subsidence: Where subsidence occurs at mechanical installation excavations and trenches during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

### **3.4 CUTTING AND PATCHING**

- A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.
- B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.
- C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work.
- D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.
- E. Patch around openings to match adjacent construction, including fire ratings, if applicable.
- F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.

### **3.5 CLEANING**

- A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Mechanical Contractor shall cooperate in maintaining reasonably clean premises at all times.
- B. Immediately prior to the final inspection, the Mechanical Contractor shall clean material and equipment installed under the Mechanical Contract. Dirt, dust, plaster, stains, and foreign matter

shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

### **3.6 SUBSTANTIAL COMPLETION REVIEW**

- A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:
  - 1. Submit complete Operation and Maintenance Manuals.
  - 2. Submit complete Record Drawings.
  - 3. Perform special inspections as required in each individual Section.
  - 4. Start-up testing of systems.
  - 5. Removal of temporary facilities from the site.
  - 6. Comply with requirements for Substantial Completion in the "General Conditions".
- B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days notice prior to the review.
- C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.
- D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.
- E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, the Contractor shall reimburse the Architect/Engineer for time and expenses incurred for the visit.
- F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.
- G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.
- H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. The Contractor shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION

**SUBSTITUTION REQUEST FORM**

To Project Engineer: \_\_\_\_\_ Request # (GC Determined): \_\_\_\_\_

Project Name: \_\_\_\_\_

Project No/Phase: \_\_\_\_\_ Date: \_\_\_\_\_

Specification Title: \_\_\_\_\_

Section Number: \_\_\_\_\_ Page: \_\_\_\_\_ Article/Paragraph: \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_

Manufacturer: \_\_\_\_\_ Model No.: \_\_\_\_\_

Address: \_\_\_\_\_ Phone: \_\_\_\_\_

History:  New product  1-4 years old  5-10 years old  More than 10 years old

Differences between proposed substitution and specified Work: \_\_\_\_\_

Point-by-point comparative data attached – REQUIRED BY ENGINEER  
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached:  Drawings  Product Data  Samples  
 Tests  Reports  Other: \_\_\_\_\_

Reason for not providing specified item: \_\_\_\_\_

Similar Installation:  
Project: \_\_\_\_\_ Architect: \_\_\_\_\_

Address: \_\_\_\_\_ Owner: \_\_\_\_\_

\_\_\_\_\_ Date Installed: \_\_\_\_\_

Proposed substitution affects other parts of Work:  No  Yes; explain: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

**Substitution Certification Statement:**

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

- ▲ A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
- B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
- C. Proposed substitution does not affect dimensions and functional clearances.
- D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
- E. Same warranty will be furnished for proposed substitution as for specified Work.
- F. Same maintenance service and source of replacement parts, as applicable, is available.
- G. Proposed substitution will not adversely affect other trades or delay construction schedule.
- H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

_____	_____	_____
Submitting Contractor	Date	Company

**Manufacturer's Certification of Equal Quality:**

I \_\_\_\_\_ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

_____	_____	_____
Manufacturer's Representative	Date	Company

**Engineer Review and Recommendation Section**

Recommend Acceptance       Yes       No

Additional Comments:       Attached       None

**Acceptance Section:**

_____	_____	_____
Contractor Acceptance Signature	Date	Company
_____	_____	_____
Owner Acceptance Signature	Date	Company
_____	_____	_____
Architect Acceptance Signature	Date	Company
_____	_____	_____
Engineer Acceptance Signature	Date	Company

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 23 00 15 - ELECTRICAL COORDINATION FOR MECHANICAL EQUIPMENT****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. This Section specifies the basic requirements for electrical components which are an integral part of packaged mechanical equipment. These components include, but are not limited to factory furnished motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for mechanical equipment are scheduled on the Drawings.
- C. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

**1.2 SUBMITTALS**

- A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification Sections.

**1.3 QUALITY ASSURANCE**

- A. Electrical components and materials shall be UL labeled.
- B. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section and Division 26.

**PART 2 - PRODUCTS AND MATERIALS****2.1 GENERAL**

- A. The Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Division 23 Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, this Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.
- B. Refer to Division 26, "COMMON WORK RESULTS FOR ELECTRICAL" for specification of motor connections.
- C. Refer to Division 26, "ENCLOSED CONTROLLERS" for specification of motor starters.
- D. Refer to Division 26, "ENCLOSED SWITCHES AND CIRCUIT BREAKERS" for specification of disconnect switches and enclosed circuit breakers.

**PART 3 - EXECUTION****3.1 CONTRACTOR COORDINATION**

- A. Unless otherwise indicated, all motors, equipment, controls, etc. shall be furnished, set in place and wired in accordance with Table 1. Any items not listed but shown on the drawings shall be considered part of the Contract Documents and brought to the attention of the Architect.
- B. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

**TABLE 1 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT**

ITEM	FURN BY	SET BY	POWER WIRING	CONTROL WIRING
Equipment motors	DIV23m	DIV23m	DIV26	---
Motor control centers	DIV26	DIV26	DIV26	DIV23t
Factory furnished motor starters contactors and disconnects	DIV23m	DIV23m	DIV26	DIV23t
Overload heaters	DIV23m	DIV26	---	---
Loose motor starters, disconnect switches, thermal overloads and heaters.	DIV26	DIV26	DIV26	DIV23t
Variable speed drives	DIV23m	DIV23m	DIV26	DIV23t
Manual operating multi-speed switches	DIV23m	DIV26	DIV26	DIV23t
Control relays	DIV23t	DIV23t	DIV26	DIV23t
Thermostats (low voltage)	DIV23t	DIV23t	---	DIV23t
Thermostats (line voltage)	DIV23m	DIV23m	DIV26	---
Time switches (for mechanical equipment)	DIV23t	DIV23t	DIV26	DIV23t
Control power transformers	DIV23t	DIV23t	DIV26	DIV23t
Control power transformers furnished with equipment	DIV23m	DIV23m	DIV26	DIV23t
Temperature control panels (housing controllers)	DIV23t	DIV23t	DIV26	DIV23t
Building controllers, advanced application controllers, and application specific controllers	DIV23t	DIV23t	DIV23t	DIV23t
Motor and solenoid operated valves	DIV23t	DIV23m	DIV23t	DIV23t
Pressure independent control valves	DIV23t	DIV23m	DIV23t	DIV23t
Damper operators, PE & switches	DIV23t	DIV23t	DIV23t	DIV23t
Smoke dampers and combination fire/smoke dampers	DIV23m	DIV23m	DIV26	DIV28
Smoke dampers for smoke control system	DIV23t	DIV23m	DIV26	DIV23t/28
Duct Smoke detectors	DIV28	DIV23m	DIV28	DIV28
Refrigeration equipment and controls	DIV23m	DIV23m	DIV26	DIV23t
Pushbutton stations and connections	DIV23m	DIV23m	DIV26	DIV23t
Temporary heating connections	DIV23m	DIV23m	DIV26	DIV23m
Interlocks between cooling tower or evaporative condenser and chemical treatment pump(s)	---	---	---	DIV23m
Interlocks between basin heater for cooling tower or evaporative condenser and sump temperature sensor	---	---	---	DIV23m
Interlocks between chiller control panel and pump(s)	---	---	---	DIV23m
Interlocks between air handling units and exhaust fans	---	---	---	DIV23m
Interlocks between HVAC fans and damper operators	---	---	DIV26	DIV23t
Interlocks between kitchen exhaust hood(s) and make-up air unit(s)	---	---	---	DIV23m

DIV23m Mechanical Contractor  
 DIV26 Electrical Contractor

DIV23t Temperature Controls Sub-Contractor

DIV28 Electronic Safety and Security

END OF SECTION

**SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Access panels and doors in walls, ceilings, and floors for access to mechanical materials and equipment.
- B. Mechanical equipment nameplate data.
- C. Concrete for bases and housekeeping pads.
- D. Non-shrink grout for equipment installations.
- E. Sleeves for mechanical penetrations.
- F. Drip Pans with detection.
- G. Miscellaneous metals for support of mechanical materials and equipment.
- H. Wood grounds, nailers, blocking, fasteners, and anchorage for support of mechanical materials and equipment.
- I. Joint sealers for sealing around mechanical materials and equipment.
- J. Sealing penetrations through noise critical spaces.
- K. Firestopping

**1.2 SUBMITTALS**

- A. General: Submit the following in accordance with Division 01 and Division 23 Section General Mechanical Requirements.
  - 1. Product data for the following products:
    - a. Access panels and doors.
    - b. Joint sealers.
    - c. Through and membrane-penetration firestopping systems.
    - d. Plenum insulation.
  - 2. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for mechanical materials and equipment.
  - 3. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.
  - 4. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
    - a. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 01 Section "Summary of Work."
  - 5. Through and Membrane Penetration Firestopping Systems Product Schedule: Submit a schedule for each piping system penetration that includes UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.
    - a. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

**1.3 QUALITY ASSURANCE**

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
  - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
  - 1. Provide UL Label on each fire-rated access door.
- C. Through and Membrane Penetration Firestopping Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

**1.4 NOISE CRITICAL SPACES**

- A. Many areas of the building, referred to as "noise-critical spaces", require special attention (special acoustical provisions and restrictions). The table below designates the noise-critical spaces; noise levels due to equipment, ductwork, grilles, registers, terminal devices, diffusers, etc., shall permit attaining sound pressure levels in all 8 octave bands in occupied spaces conforming to RC levels per ASHRAE handbook as indicated.

<u>Space</u>	<u>RC Levels</u>
Sound/Lighting Control Rooms	25
A/V Spaces	25
TV Production Studio	25
Teleconference Rooms	25
Meeting/Banquet Rooms	30
Conference Rooms	30

**PART 2 - PRODUCTS AND MATERIALS****2.1 ACCESS TO EQUIPMENT**

- A. Manufacturers:
  - 1. Bar-Co., Inc.
  - 2. Elmdor Stoneman.
  - 3. JL Industries
  - 4. Jay R. Smith Mfg. Co.
  - 5. Karp Associates, Inc.
  - 6. Milcor
  - 7. Nystrom Building Products
  - 8. Wade
  - 9. Zurn
- B. Access Doors:
  - 1. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
  - 2. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.

- a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
  - b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
  - c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
3. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
    - a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
  4. Locking Devices: Flush, screwdriver-operated cam locks.

## 2.2 MECHANICAL EQUIPMENT NAMEPLATE DATA

- A. For each piece of power operated mechanical equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

## 2.3 CONCRETE EQUIPMENT BASES HOUSEKEEPING PADS

- A. Provide concrete equipment bases and housekeeping pads for various pieces of floor mounted mechanical equipment. Concrete equipment bases/housekeeping pads shall generally conform to the shape of the piece of equipment it serves with a minimum 4" margin around the equipment and supports.
- B. Form concrete equipment bases and housekeeping pads using framing lumber or steel channel with form release agent. Chamfer top edges and corners. Trowel tops and sides of each base/pad to a smooth finish, equal to that of the floors.
- C. Concrete equipment bases and housekeeping pads shall be made of a minimum 28 day, 4000 psi concrete conforming to American Concrete Institute Standard Building Code for Reinforced Concrete (ACI 318-99) and the latest applicable recommendations of the ACI standard practice manual. Concrete shall be composed of cement conforming to ASTM C 150 Type I, aggregate conforming to ASTM C33, and potable water. All exposed exterior concrete shall contain 5 to 7 percent air entrainment.
- D. Unless otherwise specified or shown on the structural drawings, reinforce equipment bases and housekeeping pads with No. 4 reinforcing bars conforming to ASTM A 615 or 6x6 – W2.9 x W2.9 welded wire mesh conforming to ASTM A185. Reinforcing bars shall be placed 24" on center with a minimum of two bars each direction.
- E. Provide galvanized anchor bolts for all equipment placed on concrete equipment bases and housekeeping pads or on concrete slabs. Anchor bolts size, number and placement shall be as recommended by the Manufacturer of the equipment.
- F. Concrete equipment bases and housekeeping pads shall have height as specified on the drawings or minimum height if not specified in accordance with the following table:

Equipment	Minimum Height
Other Equipment Not Listed	3-1/2"
Air Handling Units w/TSP less than or equal to 3.5", Boilers (See Note 1)	3-1/2"
Chillers, Condensate Pumps, Base Mounted Pumps up to 30 HP, Air Handling Units w/TSP greater than 3.5", All Vertical Inline Pumps, (See Note 1)	5-1/2"

## NOTES:

- Height of equipment bases applies to equipment installed on slab-on-grade. For equipment installed on floors above grade and/or roof, reference the drawings.
- Coordinate final pad heights for air handling units with required condensate trap depths. Increase pad heights as needed to allow for unit trap height and required slope to drain.

**2.4 GROUT**

- Provide nonshrink, nonmetallic grout conforming to ASTM C 1107, Grade B, in premixed and factory-packaged containers.
- Grout shall have post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement characteristics and shall be as recommended by manufacturer for interior and exterior applications.
- Grout shall have 5,000 psi, 28-day compressive strength design mix.

**2.5 PENETRATIONS**

- Sleeves:
  - Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.
  - Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.
- Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

**2.6 DRIP PANS**

- Drip pans for pipes in protected areas shall be 20 gauge galvanized steel with 2" lapped and soldered joints. Drip pan shall have a depth of 2" and a width of 6" in addition to the diameter of the associated pipe. Provide 3/4" galvanized pipe with male NPT outlet at low point of drip pan. Connect 3/4" type "L" copper indirect drain line to drip pan outlet. Route and discharge to receptor with air gap outside of the protected area.
- Drip pan supports shall be 1/4" X 2" galvanized bar stock welded to the drip pan without holes. Provide 1/4" galvanized threaded rods through bar stock on each side of the drip pan and attached with 2 nuts per rod. Attach rods to structure with MSS SP-58 compliant components.
- Flood Detector: Flood detector switch utilizing hydrophilic pad and stainless steel sensor array to detect moisture. Switch shall be provided with integral feet to prevent pad from contacting the pan. Provide with solid state electronics and double throw relay to allow switch to shut down unit and provide an auxiliary alarm output.



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Diversitech
  - b. RCT/Aquaguard
  - c. Approved equivalent

## 2.7 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, welded.
- E. Fasteners: Zinc-coated, type, grade, and class as required.

## 2.8 MISCELLANEOUS LUMBER

- A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPB rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
- B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.

## 2.9 JOINT SEALERS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect from manufacturer's standard colors.
- C. Nonacid Curing Sealer: One-part, nonacid-curing, silicone sealant complying with ASTM C920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
  1. Manufacturers:
    - a. Dow Corning, Dowsil 790.
    - b. Dow Corning, Dowsil 795.
    - c. GE, Silglaze II SCS 2350.
    - d. GE, Silpruf SCS 2000.
    - e. Owens Corning, Energy Complete.
    - f. Pecora, 864 NST.
    - g. Tremco, Spectrem 1.
    - h. Tremco, Spectrem 2.
- D. High Humidity Sealer: One-part, mildew-resistant, silicone sealant complying with ASTM C920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
  1. Manufacturers:
    - a. Dow Corning, Dowsil 786.
    - b. GE, Momentum SCS1700.
    - c. Pecora, 898 Silicone NST.

- E. Hybrid Joint Sealer: One-part, non-sag, paintable complying with ASTM C920, Type S, Grade NS, Class 50, recommended for exposed applications on interior and exterior locations involving joint movement of not more than plus or minus 50 percent.
  - 1. Manufacturers:
    - a. BASF, MasterSeal NP 100.
    - b. Pecora, DyanTrol I-XL.
    - c. Tremco, Dymonic FC.
- F. Acrylic Latex Joint Sealer: One-part, non-sag, mildew-resistant, paintable acrylic latex or siliconized acrylic latex, complying with ASTM C834, Type OP, Grade NF, recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.
  - 1. Manufacturers:
    - a. Pecora, AC-20
    - b. Sherwin Williams 950A
    - c. Tremco, Tremflex 834

## 2.10 ACOUSTICAL SEALANTS

- A. General: Penetrations by ducts, pipes and conduit through surfaces that are around and between noise critical spaces shall be sleeved, packed and sealed airtight with foam rod, non-hardening sealant and/or packing material as described herein.
- B. Foam Rod: Foam backer rod shall be closed cell polyethylene suitable for use as a backing for non-hardening sealant.
- C. Non-Hardening Sealant: Sealant for penetrations shall be non-hardening. Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.
- D. Packing Material: Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 pcf (40 kg/m<sup>3</sup>).
- E. Acoustical Joint Sealant: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90. Meeting ASTM E84 for a smoke flame spread index of less than 25 / 50.
- F. Manufacturers:
  - 1. Pecora, AC-20 FTR.
  - 2. Pecora, AIS-919.
  - 3. USG, SHEETROCK Acoustical Sealant.

## 2.11 FIRESTOPPING

- A. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E814, or other NRTL acceptable to AHJ.
- B. Manufacturers:
  - 1. 3M Corp., Fire Barrier Sealant.
  - 2. Hilti.
  - 3. Owens Corning, Firestopping Insulation.
  - 4. Pecora, AC-20 FTR.
  - 5. RectorSeal.
  - 6. Specified Technologies Inc., Firestop.
  - 7. USG SHEETROCK Firecode Compound.

8. Tremco, Tremstop Fyre-Sil.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION GENERAL**

- A. Install products in accordance with manufacturer's instructions.

#### **3.2 INSTALLATION OF ACCESS DOORS**

- A. Provide access doors for all concealed equipment and duct and piping accessories that require service where indicated or as required, except where above lay-in ceilings. Refer to Section "Identification for HVAC Piping and Equipment" for labeling of access doors.
- B. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
- C. Access doors must be of the proper construction for type of construction where installed.
- D. The exact location of all access doors shall be verified with the Architect prior to installation.
- E. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- F. Adjust hardware and panels after installation for proper operation.

#### **3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGE**

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

#### **3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGE**

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

#### **3.5 PREPARATION FOR JOINT SEALERS**

- A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
- B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

#### **3.6 APPLICATION OF JOINT SEALERS**

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
  1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.

2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
- B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

### 3.7 PENETRATIONS

- A. New Construction:
1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support piping or ductwork penetrations.
- B. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.
- C. The General Contractor will provide only those openings specifically indicated on the Architectural or Structural Drawings as being provided under the General Contractor's work.
- D. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.
- E. Floor sleeves shall be fitted with means for attachment to forms and shall be of length to extend at least two inches above the floor level.
- F. All sleeves shall be of ample size to allow for movement of conduit, duct or pipe and insulation through the sleeves without damage to the insulation.
- G. Cut sleeves to length for mounting flush with both surfaces of walls.
- H. Extend sleeves installed in floors 2 inches above finished floor level.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- J. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.
- K. All circular and oval openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 23 Section "Basic Piping Materials and Methods". All rectangular openings through underground exterior walls shall be flanged and flashed with non-corrosive material on each side and the gap sealed with weatherproof sealant.

### 3.8 DRIP PANS

- A. Provide drip pans in locations indicated on drawings.
- B. Provide drip pans under piping or equipment that is installed in spaces that have sensitive electronics/electrical equipment such as electrical, IT/AV, telecom, data equipment, elevator machinery rooms, etc. Obtain approval from the Architect prior to installation.
- C. Provide drip pans for piping directly above a two hour rated ceiling of an elevator machine room.
- D. Provide drip pans, only with written approval obtained prior to installation, installed beneath piping above electrical rooms, telecom rooms, data rooms, servers or any other protected area not clearly indicated by drawings.
- E. Provide drip pan supports every 4'-0".
- F. Place flood detector in the lowest location in the drip pan. Interlock detector with the HVAC equipment per manufacturer's recommendations.

- G. Wire flood detector to remote alarm, Diversitech Universal Alarm or equivalent. Coordinate location of the remote alarm with building owner prior to installation.
- H. Coordinate interlock of "Water Present" alarm and "Cable Fault" alarm with building automation system. Refer to Division 23 Section "Direct Digital Controls for HVAC" for integration with building automation system and low voltage power wiring.

### 3.9 ACOUSTICAL PENETRATIONS

- A. General: There shall be no direct contact of Sheet Metal or piping with shaft walls, floor slabs and/or partitions. All openings around pipes and ducts in the structure surrounding the mechanical equipment and surrounding noise-critical spaces shall be sealed, packed with caulking for the full depth of the penetration, as described herein.. This includes all slab penetrations and penetrations of noise critical walls.
- B. Duct Penetrations: Where each duct passes through a wall, floor or ceiling of a noise critical space, there shall be a clear annular space of 1 inch between the duct and structure. After all of the ductwork is installed, the Contractor shall check the clearance, pack the voids full depth with packing material and caulk both ends with non-hardening sealant backed by foam rod or permanently flexible firestop material. Where there is not sufficient access space to pack around all sides of a duct (for example, at the underside of a slab), place a short stub duct in the wall, pack and caulk around it and then attach the inlet and outlet ducts to each end.
- C. HVAC Piping:
  - 1. Provide a steel sleeve cast or grouted into the structure. The internal diameter of the sleeve shall be 2 inches larger than the external diameter of the pipe passing through it. After all of the piping is installed in that area, verify the specified clearance and correct it, if necessary, to within 1/2 inch. Pack the void full depth with packing material sealed at both ends, 1 inch deep, with non-hardening sealant backed by foam rod.
  - 2. Provide factory fabricated split seal clamp around the pipe filled with closed-cell neoprene sponge insulation, thickness as required to match adjacent insulation, minimum 3/4 inch. Cast or grout the sleeve into the structure. Provide fiberglass insulation if the pipe is subject to temperatures greater than 225 degrees F. Provide Mason Industries Type SWS or approved equal.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 23 05 10 - BASIC PIPING MATERIALS AND METHODS****PART 1 - GENERAL REQUIREMENTS****1.1 SECTION INCLUDES**

- A. Joining materials.
- B. Escutcheons.
- C. Nipples.
- D. Unions.
- E. Dielectric unions.
- F. Dielectric waterway fittings.
- G. Dielectric flanges and flange kits.
- H. Mechanical sleeve seals.
- I. Pipe roof curbs.

**1.2 SUBMITTALS**

- A. Refer to Division 01 and Division 23 Section "General Mechanical Requirements" for administrative and procedural requirements for submittals.
- B. Product Data, including, rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties and accessories, and installation instructions.
- C. Quality Assurance Submittals: Submit welders' certificates specified in Article "Quality Assurance" below.
- D. Piping Schedule: Submit a piping schedule that states the material being proposed for each piping system application in the project including manufacturer's catalog information, pipe materials, sizes, fittings, Type, Grade, Schedule, applicable ASTM standard, and connection method(s).
- E. Submit a schedule of dissimilar metal joints and dielectric flanges, flange kits, unions, or waterway fittings. Include proposed product, joint type materials, and connection method to isolate dissimilar metals. Refer to the individual Division 23 piping system specification sections for piping materials and fittings relative to that particular system and additional requirements.
- F. Submit certification that fittings and specialties are manufactured in plants located in the United States or certified that they comply with applicable ANSI and ASTM standards.
- G. Manufacturer's Installation Instructions: Indicate hanging and support methods and joining procedures.
- H. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- I. Shop Drawings: Include detailed fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure.
- J. Coordination Drawings: Include piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Other building services.
  - 3. Structural members.

- K. As-built drawings for each piping system in electronic and PDF format.
- L. Refer to the individual piping system specification sections in Division 23 for additional requirements.

### 1.3 QUALITY ASSURANCE

- A. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code (BPVC), Section IX, "Welding, Brazing, and Fusing Qualifications."
- B. Comply with ASME B31.9 - Building Services Piping, most recent edition.
- C. Comply with American Welding Society (AWS), Welding Handbook, most recent edition.
- D. Soldering and Brazing procedures shall conform to ANSI B9.1 Safety Code for Mechanical Refrigeration.
- E. Pipe specialties and fittings shall be manufactured in plants located in the United States or certified to meet the specified ASTM, ASME, and ANSI standards.
- F. Refer to the individual piping system specification sections in Division 23 for additional requirements.

### 1.4 DELIVERY STORAGE AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- C. Refer to the individual piping system specification sections in Division 23 for additional requirements.

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 PIPE AND FITTINGS

- A. Refer to the individual piping system specification sections in Division 23 for specifications on piping and fittings relative to that particular system.

### 2.2 JOINING MATERIALS

- A. Refer to individual Division 23 Piping Sections for special joining materials not listed below.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- C. Welding Materials: Comply with AWS D10.12 and Section II, Part C, ASME BPVC for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.
- D. Brazing Filler Metals: Comply with SFA-5.8, Section II, ASME BPVC for brazing filler metal materials appropriate for the materials being joined.
  - 1. AWS A5.8, Classification BAg-5:
    - a. Silver (Ag) 44.0 – 46.0 percent.
    - b. Zinc (Z) 23.0 – 27.0 percent.
    - c. Copper (Cu) 29.0 – 31.0 percent.
  - 2. AWS A5.8, Classification BCuP-5:
    - a. Phosphorus (P) 4.8 - 5.2 percent.
    - b. Silver (Ag) 14.5 - 15.5 percent.
    - c. Copper (Cu) remainder.



- E. Soldering Filler Metals: ASTM B32, 95-5 Tin-Antimony and water flushable flux in accordance with ASTM B813.
- F. Plastic Pipe Solvent Cement:
  - 1. PVC: ASTM D2564.
  - 2. CPVC: ASTM F493.
- G. Gaskets for Flanged Joints: ASME B16.21, full-faced for cast-iron flanges and raised-face for steel flanges. Select material, thickness, and type to suit the service of the piping system in which installed and which conform to their respective ASME Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

### 2.3 ESCUTCHEONS

- A. Manufacturers:
  - 1. AWI Manufacturing.
  - 2. Keeney Manufacturing Company.
  - 3. Wal-Rich Corp.
  - 4. Jones Stephens Corp.
  - 5. Approved equal.
- B. Chrome-plated, stamped-steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

### 2.4 NIPPLES

- A. Steel: ASTM A733, made of ASTM A53, Schedule 40, black steel; Type S seamless for pipe sizes 2 inch and smaller, Type E electric-resistance welded for pipe sizes 2-1/2 inch and larger.

### 2.5 UNIONS

- A. Manufacturers:
  - 1. Anvil International.
  - 2. Hart Industries.
  - 3. Mueller Streamline Co.
  - 4. Victaulic Company of America.
  - 5. Watts Regulator Co.
  - 6. Approved equal.
- B. Hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
  - 1. Malleable-iron: ASME B16.39, class as specified in section "Hydronic Piping" for the piping system used.
  - 2. Bronze: ASME B16.15, cast bronze body meeting ASTM B62, class as specified in section "Hydronic Piping" for the piping system used.
  - 3. Copper: ASME B16.22 wrought copper body.
    - a. For hydronic systems, provide class as specified in section "Hydronic Piping" for the piping system used.
    - b. For refrigerant systems, provide pressure rating as required for the refrigerant type used.

### 2.6 DIELECTRIC UNIONS

- A. Manufacturers:
  - 1. Hart Industries.

2. Victaulic Company of America.
  3. Watts Regulator Co.
  4. Approved equal.
- B. Factory-fabricated with cast bronze body meeting ASTM B584 and galvanized or black steel body with plastic dielectric gasket, class 125 for low pressure service and class 250 for high pressure service, and appropriate end connections for the pipe materials in which installed (screwed or soldered) to effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

## 2.7 DIELECTRIC WATERWAY FITTINGS

- A. Manufacturers:
1. Grinnell Mechanical Products.
  2. Victaulic Company of America (Sweat and threaded connections only).
  3. Approved equal.
- A. Electroplated steel, brass, bronze, or nylon encapsulated nipple, with an inert and non-corrosive, thermoplastic lining, and appropriate end connections for the pipe materials in which installed (screwed, soldered, grooved, or flanged) to effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

## 2.8 DIELECTRIC FLANGES AND FLANGE KITS

- A. Manufacturers:
1. Advance Products & Systems, Inc.
  2. Calpico, Inc.
  3. Pipeline Seal & Insulator, Inc.
  4. Tampa Rubber & Gasket Co. Inc.
  5. Watts Water Technologies.
  6. Approved equal.
- B. Full-faced gasket with same outside diameter and bolt hole arrangement as the flange. Conform to ANSI B16.5. Pressure rating of 200 psi for low pressure service and 400 psi for high pressure service at a continuous operating temperature of 180F.
- C. Steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.
- D. Flanges: Cast bronze meeting ASTM B584, class 125 solder type or cast iron meeting ASTM A536, class 125 threaded type for low pressure service, bronze class 250 solder type or cast iron class 250 threaded type for high pressure service.

## 2.9 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
1. Thunderline/Link Seal.
  2. Calpico, Inc.
  3. Metraflex Co.
  4. Approved equal.
- B. Sleeves: Refer to Division 23 Section "Common Work Results for HVAC" for sleeve materials.
- C. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

**2.10 PIPE ROOF CURBS**

- A. Manufacturers:
  - 1. AES Industries.
  - 2. Custom Curb, Inc.
  - 3. Pate Company.
  - 4. Thybar.
- B. Provide factory-fabricated, pipe roof curbs with the following features:
  - 1. Factory installed treated wood nailer.
  - 2. Welded, 18 gauge galvanized steel shell, base plate and flashing.
  - 3. 1-1/2 inch thick, 3 pound rigid insulation.
  - 4. Fully mitered 3-inch raised cant.
  - 5. Cover of weather-resistant, weather-proof material.
  - 6. Pipe collar of weather-resistant material with stainless steel pipe clamps.

**PART 3 - EXECUTION****3.1 PREPARATION**

- A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

**3.2 INSTALLATION GENERAL**

- A. Install products in accordance with manufacturer's instructions.
- B. Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.
- C. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view. Install escutcheons at each wall, floor and ceiling penetration in exposed finished locations. Provide deep pattern escutcheons where required to conceal protruding pipe fittings.
- D. Install piping free of sags and bends and with ample space between piping to permit proper insulation applications.
- E. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.
- F. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- H. Support piping from structure. Do not support piping from ceilings, equipment, ductwork, conduit and other non-structural elements.
- I. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4 inch ball valve, and short 3/4 inch threaded nipple and cap.
- J. Verify final equipment locations for roughing in.

- K. Use fittings for all changes in direction and all branch connections.
- L. Remake leaking joints using new materials.
- M. Install components with pressure rating equal to or greater than system operating pressure.
- N. Piping Protection:
  - 1. Protect piping during construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
  - 2. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

### 3.3 PENETRATIONS

- A. Mechanical penetrations occur when piping or ductwork penetrate concrete slabs, concrete or masonry walls, or fire / smoke rated floor and wall assemblies. Reference Division 23 Section "Common Work Results for HVAC" for additional penetration requirements.
- B. Above Grade Concrete or Masonry Penetrations:
  - 1. Provide sleeves for pipes passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs.
    - a. Provide Schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
    - b. Provide galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 10 gauge (0.1382 inches).
    - c. Provide welded galvanized sheet metal for rectangular sleeves with the following minimum metal thickness:
      - 1) For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 18 gauge (0.052 inches).
      - 2) For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 10 gauge (0.1382 inches).
    - d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.
  - 2. Extend pipe insulation for insulated pipe through floor, wall and roof penetrations, including fire rated walls and floors. The vapor barrier shall be maintained. Size sleeve for a minimum of 1 inch annular clear space between inside of sleeve and outside of insulation.
  - 3. Seal elevated floor, exterior wall and roof penetrations watertight and weathertight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of 1/2 inch of sealant.
- C. Underground, Exterior-Wall Penetrations:
  - 1. Install cast-iron sleeves. Size sleeves to allow for 1-inch (or larger, if required by the mechanical sleeve manufacturer) annular clear space between pipe and sleeve. Provide mechanical sleeve seal.
  - 2. Use type and number of sealing elements recommended by manufacturer for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
  - 3. Inspect installed sleeve and sleeve-seal installations for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade to seal against hydrostatic pressure.
- D. Above Ground, Exterior Wall Penetrations:
  - 1. Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of 1/2 inch of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.

2. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1 inch annular clear space between inside of sleeve and outside of insulation.
- E. Elevated Floor Penetrations of Waterproof Membrane:
1. Provide cast-iron sleeves, extend top of sleeve minimum 1 inch above finish floor. Size sleeve for minimum 1/2 inch annular space between pipe and sleeve.
  2. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1 inch annular clear space between inside of sleeve and outside of insulation.
  3. Pack with mineral wool and seal both ends with minimum of 1/2 inch of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
  4. Secure waterproof membrane flashing between clamping flange and clamping ring. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
  5. Extend bottom of sleeve below floor slab as required and secure underdeck clamp to hold sleeve rigidly in place.
- F. Interior Foundation Penetrations:
1. Provide sleeves for horizontal pipe passing through or under foundation. Sleeves shall be cast iron soil pipe two nominal pipe sizes larger than the pipe served.
- G. Concrete Slab on Grade Penetrations:
1. Provide schedule 40 PVC pipe sleeves for vertical pressure pipe passing through concrete slab on grade. Sleeves shall be one nominal pipe size larger than the pipe served and two pipe sizes larger than pipe served for ductile iron pipes with restraining rods. Seal water-tight with silicone caulk.
  2. Provide 1/2 inch thick cellular foam insulation around perimeter of non-pressure pipe passing thru concrete slab on grade. Insulation shall extend to 2 inches above and below the concrete slab.
- H. Interior Penetrations of Non-Fire-Rated Walls:
1. Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of 1/2 inch of sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
  2. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1 inch annular clear space between inside of sleeve and outside of insulation.
- I. Fire / Smoke Rated Floor and Wall Assemblies:
1. Seal around penetrations of fire rated assemblies to maintain fire resistance rating of fire-rated assemblies. Coordinate fire ratings and locations with the architectural drawings. Install sealants in compliance with the manufacturer's UL listing. Refer to Division 07 Section "Penetration Firestopping" for special sealers and materials.
- J. Acoustical Barrier Penetrations:
1. Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. Refer to Section "Common Work Results for HVAC" for noise critical spaces. The internal diameter of the sleeve shall be minimum of 2 inches larger than the external diameter of the pipe. After the piping is installed, the Contractor shall check the clearance and correct it to within 1/2-inch. Contractor shall pack the void full depth with glass/mineral fiber insulation and seal at both ends, 1-inch deep, with sealant backed by foam rod.
  2. Penetration of sound isolating ceilings by sprinkler pipes and heads shall be sleeved and sealed and shall have no rigid connections between them.

**3.4 PIPE JOINT CONSTRUCTION**

- B. Threaded Joints:
1. Provide tapered pipe threads for field cut threads. Cut threads full and clean using sharp dies.
  2. Ream threaded pipe ends to remove burrs and restore full inner diameter.
  3. Note the internal length of threads in fittings or valve ends and proximity of internal seat or wall to determine how far pipe should be threaded into joint.
  4. Align threads at point of assembly.
  5. Apply appropriate tape or thread compound to the male pipe threads except where dry seal threading is specified.
  6. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded. Tighten joint to leave not more than 3 threads exposed.
  7. Damaged Threads: Do not use pipe or pipe fittings with threads which are corroded or damaged.
- C. Flanged Joints:
1. Select appropriate gasket material, size, type, and thickness for service application.
  2. Install gasket concentrically positioned.
  3. Align flanges surfaces parallel.
  4. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible.
  5. Use suitable lubricants on bolt threads.
  6. Tighten bolts gradually and uniformly using torque wrench.
- D. Welded Joints:
1. Comply with the requirement in ASME Code B31.9, "Building Services Piping."
  2. Damaged Welds: Do not use pipe sections that have cracked or open welds.
- E. Brazed and Soldered Joints:
1. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."
  2. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
  3. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
  4. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.
    1. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making joint.
    2. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
    5. Copper-to-copper joints shall be made using BCuP-5 brazing filler metal without flux.
    6. Dissimilar metals such as copper and brass shall be jointed using an appropriate flux with either BCuP-5 or BAg-5 brazing filler metal. Apply flux sparingly to the clean tube only and in a manner to avoid leaving any excess inside the completed joint.
    7. Continuously purge the pipe and fittings during brazing with an inert gas (i.e., dry nitrogen or carbon dioxide) to prevent formation of scale. Maintain purge until the joint is cool to the touch.
    8. Heat joints using oxy-acetylene torch. Heat to proper and uniform temperature.
    9. Provide temporary cap or cover on completed joints with open ends to prevent entry of contaminating materials.
- F. Socket Joints:
1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
  2. Prepare surfaces to be solvent cemented by wiping with a clean cloth moistened with acetone or methylethyl ketone.
  3. CPVC Joints: Solvent cement joints in accordance with ASTM D2846.
  4. PVC Joints: Solvent cement joints in accordance to ASTM D2672.

- B. Joints for other piping materials are specified within the respective piping system Sections.

### **3.5 UNIONS**

- A. Install unions on pipes 2 inch and smaller, adjacent to each valve, at final connections to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

### **3.6 DIELECTRIC UNIONS**

- A. Install dielectric unions for piping 2 inch and smaller to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum) for the following conditions:
  - 1. Copper or brass connected to carbon steel, stainless steel, cast or ductile iron.
- B. Install dielectric unions for piping 2 inch and smaller to connect piping materials of dissimilar metals in wet piping systems (water, steam) for the following conditions:
  - 1. Copper or brass connected to carbon steel, stainless steel, cast or ductile iron.
  - 2. Install waterway fittings where installation is concealed. Do not install dielectric unions in concealed spaces.

### **3.7 DIELECTRIC WATERWAY FITTINGS**

- A. Install dielectric waterway fittings for piping 2 inch and smaller for copper or brass pipe connections to carbon steel equipment connections.

### **3.8 DIELECTRIC FLANGES AND FLANGE KITS**

- A. Install dielectric flanges for piping 2-1/2 inch and larger to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum) for the following conditions:
  - 1. Copper or brass connected to carbon steel, stainless steel, cast or ductile iron.
- B. Install dielectric flanges for piping 2-1/2 inch and larger to connect piping materials of dissimilar metals in wet piping systems (water, steam) for the following conditions:
  - 1. Copper or brass connected to carbon steel, stainless steel, cast or ductile iron.
  - 2. Install waterway fittings where installation is concealed. Do not install dielectric flanges in concealed spaces.
- C. Provide brass nipples between the equipment connection and dielectric flange for screwed connections. Provide an iron flange for the equipment side and a bronze flange for the copper or brass piping side of the joint.
- D. Provide a bronze flange for the copper or brass piping connection to a cast iron, ductile iron or steel flange.
- E. Provide full face gasket with pressure rating equal to system served.
- F. At each bolt provide steel washers, thermoplastic washers, and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.

### **3.9 PIPE FIELD QUALITY CONTROL**

- A. Testing: Refer to individual piping system specification sections.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 23 05 13 - COMMON MOTOR REQUIREMENT FOR HVAC EQUIPMENT****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.
- D. Three phase electric motors.
- E. Electronically Commutated Motors (ECM).
- F. Capacitors.

**1.2 SUBMITTALS**

- A. Conform with the submittal procedures in Division 01.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements. Provide nameplate data and ratings, mounting arrangements, size and location of winding termination lugs, overload relays, conduit entry, grounding lug, and coatings.
- C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- E. Operation Data: Include instructions for safe operating procedures.
- F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

**1.3 QUALITY ASSURANCE**

- A. Comply with NFPA 70 National Electrical Code.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**1.4 DELIVERY STORAGE AND HANDLING.**

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

**1.5 WARRANTY**

- A. Provide five year manufacturer warranty for motors larger than 20 horsepower.

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. Baldor Electric Company.
- B. General Electric.
- C. Gould.
- D. Marathon.
- E. Regal-Beloit Corporation (Century).
- F. Westinghouse

**2.2 GENERAL CONSTRUCTION AND REQUIREMENTS**

- A. Electrical Service: All motors shall be supplied in accordance with the following voltage and phase unless noted otherwise on the Drawings.
  - 1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
  - 2. Motors 3/4 HP and Larger: Voltage as scheduled, three phase, 60 Hz.
- B. Construction:
  - 1. Open drip-proof except where noted otherwise.
  - 2. Design for continuous operation in 104 degrees F environment.
  - 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
  - 4. Motors with frame sizes 254T and larger: Energy Efficient Type.
- C. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.
- D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- E. Wiring Terminations:
  - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
  - 2. For fractional horsepower motors where connection is made directly, provide flexible conduit connection in end frame. Maximum length of flexible conduit shall be five feet.

**2.3 APPLICATIONS**

- A. Exception: Motors less than 250 Watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.
- B. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.
- C. Single phase motors for fans, pumps, blowers and air compressors: Capacitor start type.
- D. Single phase motors for fans less than 1 hp and greater than 1/12 hp: Electronically commutated type.
- E. Motors located in exterior locations, air cooled condensers, humidifiers and explosion proof environments: Totally enclosed fan cooled type.
- F. Motors located outdoors in wet airstreams, including but not limited to cooling towers, evaporative condensers, and sprayed coils: Totally enclosed weatherproof epoxy-sealed type.

**2.4 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS**

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

**2.5 SINGLE PHASE POWER - CAPACITOR START MOTORS**

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated ball bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

**2.6 THREE PHASE POWER - SQUIRREL CAGE MOTORS**

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
- E. Insulation System: NEMA Class B or better.
- F. Drip-proof Enclosure: NEMA Service Factor.
- G. All motors controlled by variable frequency controllers shall have a 1.15 Service Factor.
- H. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- I. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- J. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Division 26 - Motor Controlling Equipment.
- K. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- L. Sound Power Levels: To NEMA MG 1.

- M. All totally enclosed motors shall be fan cooled type. Non-ventilated type motors are not acceptable.
- N. Motors controlled by variable frequency drives:
  - 1. Rated for voltage peaks and minimum rise times in accordance with NEMA MG1, Part 31.
  - 2. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 3. Inverter-Duty Motors: Class B temperature rise; Class F insulation.
  - 4. Shaft Bearing Protection:
    - a. Provide shaft grounding system as listed below. Install system in accordance with manufacturer's recommendations.
      - 1) AEGIS SGR Bearing Protection Ring,
      - 2) Inpro/Seal Current Diverter Ring (CDR).
      - 3) Helwig Carbon Products BPK.
    - b. Provide magnetic core as listed below. Install system in accordance with manufacturer's recommendations.
      - 1) VLT MCC 105.
      - 2) CoolBLUE Inductive Absorbers.
  - 5. Motor Overload Relay: When a single drive is used to supply power to multiple motors, provide a solid state 3-phase adjustable overload relay between the drive and each motor.
    - a. Relay shall have manual reset.
    - b. Provide alarm contact with automatic reset overloads.
- O. Part Winding Start, Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
- P. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
- Q. Nominal Efficiency: Motors shall have minimum NEMA premium efficiency at full load and rated voltage when tested in accordance with IEEE 112.
- R. Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

## **2.7 ELECTRONICALLY COMMUTATED MOTORS (ECM)**

- A. Minimum efficiency: 70 percent when rated in accordance with NEMA Standard MG 1 at full load rating conditions.
- B. Motor shall be permanently lubricated with heavy-duty ball bearings to match the equipment load and prewired to the specific voltage and phase.
- C. Internal motor circuitry shall convert AC power supplied to the equipment to DC power to operate the motor.
- D. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted on the motor or by a 0-10 VDC signal.

## **2.8 CAPACITORS**

- A. Furnish capacitors for power factor correction as specified herein on motors furnished under Division 23 that are not connected to variable frequency drives. KVAR size shall be as required to correct motor power factor to 90 percent or better and shall be installed on all motors 1 horsepower and larger, that have an uncorrected power factor of less than 85 percent at rated load.

- B. Features:
  - 1. Individual unit cells.
  - 2. All welded steel housing.
  - 3. Each capacitor internally fused.
  - 4. Non-flammable synthetic liquid impregnated.
  - 5. Craft tissue insulation.
  - 6. Aluminum foil electrodes.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install securely on firm foundation.
- C. Check line voltage and phase and ensure agreement with nameplate.
- D. Install motor overload relays in a common enclosure adjacent to the variable frequency drive

**3.2 NEMA OPEN MOTOR SERVICE FACTOR SCHEDULE**

HP	3600 RPM	1800 RPM	1200 RPM	900 RPM
1/6-1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15
3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
1.5-150	1.15	1.15	1.15	1.15

**3.3 PERFORMANCE SCHEDULE THREE PHASE - OPEN DRIP-PROOF**

HP	RPM(Sync)	NEMA Frame	Minimum Percent Efficiency	Minimum Power Factor
1	1200	145T	80	72
1-1/2	1200	182T	84	73
2	1200	184T	85.5	75
3	1200	213T	86.5	60
5	1200	215T	87.5	65
7-1/2	1200	254T	88.5	73
10	1200	256T	90.2	74
15	1200	284T	90.2	77
20	1200	286T	91	78
25	1200	324T	91.7	74
30	1200	326T	92.4	78
40	1200	364T	93	77
50	1200	365T	93	79
1	1800	143T	82.5	84
1-1/2	1800	145T	84	85
2	1800	145T	84	85
3	1800	182T	86.5	86
5	1800	184T	87.5	87
7-1/2	1800	213T	88.5	86
10	1800	215T	89.5	85
15	1800	256T	91	85
20	1800	256T	91	86
25	1800	284T	91.7	85
30	1800	286T	92.4	88
40	1800	324T	93	83
50	1800	326T	93	85
60	1800	364T	93.6	88
75	1800	365T	94.1	88

1-1/2	3600	143T	82.5	85
2	3600	145T	84	87
3	3600	145T	84	85
5	3600	182T	85.5	86
7-1/2	3600	184T	87.5	88
10	3600	213T	88.5	86
15	3600	215T	89.5	89
20	3600	254T	90.2	89
25	3600	256T	91	92
30	3600	284T	91	91
40	3600	286T	91.7	92
50	3600	324T	92.4	89
60	3600	326T	93	91
75	3600	364T	93	88
100	3600	365T	93	88

### 3.4 PERFORMANCE SCHEDULE THREE PHASE-ENERGY EFFICIENT TOTALLY ENCLOSED FAN COOLED

HP	RPM(Sync)	NEMA Frame	Minimum Percent Efficiency	Minimum Power Factor
1	1200	145T	80	72
1-1/2	1200	182T	85.5	65
2	1200	184T	86.5	68
3	1200	213T	87.5	63
5	1200	215T	87.5	66
7-1/2	1200	254T	89.5	68
10	1200	256T	89.5	75
15	1200	284T	90.2	72
20	1200	286T	90.2	76
25	1200	324T	91.7	71
30	1200	326T	91.7	79
40	1200	364T	93	78
50	1200	365T	93	81
60	1200	404T	93.6	83
1	1800	143T	82.5	84
1-1/2	1800	145T	84	85
2	1800	145T	84	85
3	1800	182T	87.5	83
5	1800	184T	87.5	83
7-1/2	1800	213T	89.5	85
10	1800	215T	89.5	84
15	1800	254T	91	86

## MOBILE ARENA CONSTRUCTION DOCUMENTS

MOBILE, ALABAMA

20	1800	256T	91	85
25	1800	284T	92.4	84
30	1800	286T	92.4	86
40	1800	324T	93	83
50	1800	326T	93	85
60	1800	364T	93.6	87
75	1800	365T	94.1	87
100	1800	405T	94.5	86
125	1800	444T	94.5	87
150	1800	445T	95	88
200	1800	447T	95	87

END OF SECTION



**SECTION 23 05 14 - VARIABLE FREQUENCY DRIVES****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Variable speed drives shall be furnished for those units so indicated on the drawings. All variable speed drives provided under this section shall be by the same manufacturer.
- B. Type of variable speed drive specified in this Section include the following:
  - 1. Pulse Width Modulated

**1.2 CODES AND STANDARDS**

- A. The VFD shall meet the following standards.
  - 1. Institute of Electrical and Electronic Engineers (IEEE)
    - a. Standard 519-2022 IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems
  - 2. Nationally recognized testing lab such as UL or ETL
    - a. UL 508C (Variable frequency drive)
    - b. UL 508A (Bypass)
  - 3. NEMA – ICS 7.0, AC Adjustable Speed Drives

**1.3 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
  - 1. Product Data: Submit manufacturer's technical product data for variable speed drive including dimensions, capacities, component performance data, ratings, features, motor electrical characteristics, over current protection rating, gages and finishes of material, and installation instructions.
  - 2. Shop Drawings: Submit assembly-type shop drawings including unit dimensions, required clearances, control description, construction details, and field connection details.
  - 3. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to variable speed drives. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
  - 4. Maintenance Data: Submit maintenance instructions, including instructions for adjustments, troubleshooting, operation, testing and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals; in accordance with requirements of Division 1 and Division 23 Section "General Mechanical Requirements."
  - 5. Harmonic Analysis Report: Provide project-specific calculations and manufacturer's statement of compliance with IEEE 519.

**1.4 QUALITY ASSURANCE**

- A. Testing: The variable speed drive, all components and subassemblies shall be factory tested. The variable speed drive shall be tested and cycled under motor load.
- B. Reliability: A complete description of supplier's Quality Assurance and Testing program shall be provided.
  - 1. Component Testing: All power semiconductors and integrated circuits shall be 100% tested.

2. Computerized ATE Testing: Computerized Automated Testing Equipment (ATE) testing shall be used to evaluate functional performance of printed circuit boards. Printed circuit boards shall receive a thermal stress test where temperatures are cycled between 0°C and 65°C and receive electrical power-on and power-off cycle tests.
3. Burn In: All VFD's shall be tested/run in the equivalent of a NEMA 1 for interior or NEMA 3R for exterior enclosure and burned in at rated ambient (40°C) with a fully loaded motor.

## 1.5 WARRANTY

- A. Provide warranty including on site parts and labor for minimum 36 months from date of shipment.

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 GENERAL

- A. Provide factory assembled and factory tested variable speed drives as indicated, of sizes and capabilities as scheduled, and as specified herein.

### 2.2 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering variable speed drives which may be incorporated in the work are limited to the following:
  1. ABB.
  2. Danfoss.
  3. Delta Controls
  4. Eaton/Cutler-Hammer.
  5. Franklin Control Systems.
  6. Invertek.
  7. Square D, a division of Schneider Electric.
  8. Yaskawa Electric America.

### 2.3 VARIABLE FREQUENCY DRIVES

- A. The VFD shall provide the following design features as standard:
  1. Input Section: Full wave rectification shall be achieved with input diodes in a conventional bridge configuration and shall be used to supply voltage to the DC bus. Drive shall be provided with dual DC bus chokes or AC line reactors, as required, for a total input impedance of 5% or better.
  2. Output Section: The inverter shall use power transistors to provide three phase output power to the motor.
  3. Input Displacement Power Factor: The input displacement power factor shall be 0.97 or higher at all operating speeds and loads.
  4. Microprocessor Logic: The VFD shall be microprocessor based and utilize digital input for all parameter adjustments. Use of potentiometers for parameter adjustment is not acceptable.
  5. Auto Restart: The VFD shall automatically attempt to restart after a malfunction or an interruption of power. The number of attempted restarts shall be customer selectable (0 to 5). If the drive reaches the limit of restarts without successfully restarting and running for a customer selectable length of time (60 to 600 seconds), the restart circuit shall lockout and shall provide contact annunciation. Delay between attempts to restart shall be customer selectable from 3 to 300 seconds.
  6. Current Limit: A current limit circuit shall be provided to limit motor current to a preset adjustable maximum level by reducing the drive operating speed or acceleration rate when the limit is reached. Range of adjustment shall be from 50 to 110%.

7. Digital Output Displays and Input Parameter Programming: The VFD shall include a digital display and digital input programming capability on the main logic board. The display shall be programmable for indication of output speed in rpm, frequency, and percent of base speed, motor amps, output motor volts, and output load. The display shall also function as a first fault indicator.
  8. Critical Frequency Avoidance (Frequency Jump Points): The VFD shall provide selectable frequency jump points to be used to avoid critical resonance frequencies of the mechanical system.
  9. Input Signal Follower: The input signal follower circuit shall have selectable differential inputs and accept an electrical speed command from an external source rated at 4-20 mA or 0-10Vdc. The input follower circuit shall be capable of operating directly or inversely proportional to the listed speed commands.
  10. Motor Overload Protection: Electronic motor protection shall be provided which is capable of predicting motor winding temperature based on inputting specific parameters including motor design type (TEFC, ODP, or other) and speed range. The protection shall provide an orderly shutdown should the motor's thermal capabilities be exceeded. This protection also eliminates the requirement for motor overload relays on single motor applications when a bypass is not used.
  11. Open Collector Outputs: The VFD shall include three (3) open collector outputs to indicate drive run, drive fault, and drive ready.
  12. Output Signals: The VFD shall include analog output signals for output load, output speed, instantaneous kw and motor voltage. The signals shall be 4-20 ma or 0-10 Vdc @ 1 mA.
  13. Stop Mode Functions: The VFD stopping mode functions shall be selectable for coast-to-rest or stopping at programmed deceleration rate.
  14. V/Hz Profiles: The VFD shall provide selectable V/Hz profiles.
  15. Loss of Control Signal: The VFD shall revert to the last speed on loss of input control signal. Owner shall be able to field select a preset speed for the VFD to run when control signal is lost, if preferred. In either case, an open collector output shall be selected to indicate loss of control signal for remote indication purposes.
- B. The VFD supplier shall provide the same design/technology to cover the HP range for all VFD's.
- C. Output Ratings: The VFD shall operate within the following ratings:
1. Frequency range: 1-120 Hz
  2. Overload rating: 110% for one minute
- D. Motor Performance: The VFD shall provide 3% speed regulation.
- E. Input Power: The VFD shall operate within ( 5%/-10%) of the nominal rated voltage.
- F. Set-up Adjustments: Standard setup adjustments shall include:
1. Minimum speed: 0 to 100%
  2. Maximum speed: 0 to 100%
  3. Linear accel: 0.5 to 600 seconds
  4. Linear decel: 0.5 to 600 seconds
  5. Maximum output voltage: Adjustable
  6. V/Hz: Adjustable with selectable profiles
  7. Current limit: 50 to 110%
- G. Environmental Ratings: The VFD shall operate within the following parameters without the requirement for derating:
1. Operating temperature: 0°C to 40°C
  2. Altitude: Up to 1000m (3300 ft.)
  3. Humidity: 95% non-condensing
- H. Enclosure: Refer to VFD schedule or drawings for enclosure type. At minimum, the enclosure shall be suitable for environment installed. Finned heatsinks and/or cooling fans shall be provided as necessary for proper heat dissipation.

- I. Protective Features: The VFD shall be designed to meet the following specifications and operate within the following parameters:
1. AC Input Overcurrent Protection: The VFD's power circuit shall be isolated internally with respect to ground and provided with a 100,000 AIC interrupting rated input circuit breaker. As an alternate to the circuit breaker, fuses may be used to accomplish the 100,000 A interrupting rating.
  2. Logic Common: The power unit's logic common shall be at ground potential.
  3. Phase Loss Protection: Phase loss protection shall be provided to prevent single phasing.
  4. Power Loss Ride-Through: The VFD shall be capable of continued operation during an intermittent loss of power. Opening of the VFD's input and/or output line switches while operating shall not result in damage to the power circuit components.
  5. Short Circuit and Ground Fault Protection: The VFD shall have an instantaneous electronic trip circuit to protect the VFD from output line-to-line and line-to-ground short circuits. The VFD must be capable of withstanding short circuits at nominal rated voltage plus 10%(i.e., 480V rated drive 10% 528V short circuit voltage). The VFD shall be capable of providing 110% motor current intermittently. The VFD shall include an instantaneous overcurrent trip and shall not restart after electronic overcurrent trip until reset through the run/stop circuit, or unless the auto restart function has been enabled.
  6. Transient and Surge Voltage Protection: Transient and surge voltage protection shall be provided through the use of Metal Oxide Varistors (MOVs). The VFD shall withstand a 6000 volt, 80 joule surge voltage when tested in accordance with UL 1449 with the test circuit adjusted for a 2100 amp peak 8x20 us short circuit discharge current pulse.
  7. Rotating Motor Start: The VFD shall be able to start into a motor rotating in either direction and at any speed, and accelerate to set speed without any time delay, tripping or component loss.
  8. DV/DT Filters: Dv/dt filters shall be provided per the VFD schedule, or if recommended by the VFD manufacturer to ensure that the VFD is applied correctly and to maintain the manufacturer's full warranty.
- J. Maintainability
1. All control circuit voltages (12VAC, 24VDC, 160VDC and 120VAC) shall be physically and electrically isolated from power circuit voltages (200 to 600VAC, 600VDC) to ensure safety to maintenance personnel.
  2. The VFD shall be furnished with an alphanumeric diagnostic display with fault indications to include the following: bus overvoltage, bus undervoltage, overcurrent, overtemperature, ground fault, and timed overload.
  3. VFD shall be capable of starting and operating without a motor connected for ease of service.
  4. All setup and operating parameters shall be stored in nonvolatile memory. The static memory module shall be to be removed and installed in replacement logic boards with all setup and operating parameters intact requiring no adjustment of replacement boards.
- K. Communications
1. The VFD shall have an RS-485 port as standard. The standard protocols shall be BACnet, Modbus, Johnson Controls N2 bus, and Siemens Building Technologies FLN. Optional protocols for LonWorks, Profibus, Ethernet, and DeviceNet shall be available. Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority. Use of non-certified protocols is not allowed.
  2. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the building management system to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The building management system shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic

warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus – keypad “Hand” or “Auto” selected, bypass selected, the ability to change the PID setpoint, and the ability to force the unit to bypass (if bypass is specified). The building management system shall also be able to monitor if the motor is running in the VFD mode or bypass mode (if bypass is specified) over serial communications. A minimum of 15 field parameters shall be capable of being monitored.

3. The VFD shall allow the building management system to control the drive’s digital and analog outputs via the serial interface. This control shall be independent of any VFD function. For example, the analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive’s digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive’s digital and analog inputs shall be capable of being monitored by the building management system.
4. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass value control, chilled water value control, etc. Both the VFD control PID loop and the independent PID loop shall continue functioning even if the serial communications connection is lost. The VFD shall keep the last good set-point command and last good DO & AO commands in memory in the event the serial communications connection is lost.

L. Required Optional Features

1. Operator Panel: A door-mounted Softouch Operator Panel shall be included with the following features:
  - a. Shall digitally display motor speed, load, amps, and output volts. (and controller setpoint and system pressure when setpoint controller is included).
  - b. Shall have indication for drive run, drive ready, drive fault, plus operator function/status indication such as auto speed reference, and auto restart.
  - c. Shall provide selection for Hand/Off/Auto control. In Hand mode, the VFD shall be started and stopped from the operator’s panel. In the Auto mode, the VFD shall be started and stopped by remote contact closure. In the Off mode, the VFD shall be locked out.
  - d. Shall provide selection for Manual/Auto Speed Reference. In the Manual Reference mode, the VFD speed reference shall be set from the operator’s panel. In the Auto Reference mode, the VFD speed reference shall be set by the external source instrument signal. Selecting between Manual and Auto speed reference shall have no bearing on the Hand/Off/Auto start/stop selector, or vice versa.
  - e. Shall name all parameters in English, not codes or numbers.
  - f. Keypad shall include electronic lock-out feature to prevent unauthorized personnel from parameter access.
  - g. Shall store from three to six drive faults in a history batch file in the order they occur to simplify trouble-shooting. This file will automatically be updated should new faults occur.
2. Bypass Systems: Bypass control circuitry shall be mounted integrally to the VFD enclosure. The bypass shall utilize an input circuit breaker to feed both the VFD and the bypass starter. An input service switch shall be utilized to feed the VFD and isolate the VFD for trouble shooting. An output contactor which is electrically and mechanically interlocked with the bypass starter shall be utilized on the VFD to provide a positive disconnect between the VFD and the motor. Separate Hand/Off/Auto and Inverter/Bypass switches shall be included to allow manual or automatic transfer to across-the-line operation. If the VFD trips on a fault, power will automatically transfer across the line to run the motor at full speed. If the VFD auto restart function has been enabled, the drive will first attempt to restart itself after a fault. If it is unable to do so within the number of times programmed, power will then automatically transfer across the line. The bypass system shall NOT depend on the VFD to be installed for bypass operation. Bypass stand

alone operation shall be completely functional in both Hand and Automatic modes even if the VFD has been removed for repair/replacement. Bypass system serial communications shall remain functional with the VFD removed to provide HVAC system temperature control. Serial communications in the bypass system and its' programmable inputs and outputs shall be monitored and controlled via serial communications to provide HVAC system temperature control.

3. Input Overcurrent Protection Device: The operating mechanism shall be designed so that the door can be padlocked in the "OFF" position.
4. Elapsed Time Meter: Meter shall provide indication of how long the drive has been running.
5. Smoke Purge/Load Shed: VFDs for smoke control system fans shall provide smoke purge or load shedding when activated by a remote contact closure. This circuit shall override all other speed commands (local or remote) to operate the VFD at a preset, field adjustable speed.
6. Firestat/Freezestat: VFDs for air system fans requiring shutoff from safety devices per sequences of operation shall provide terminals for connecting normally closed remote safety devices. This emergency shutdown shall operate in any mode of operation.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION**

- A. Examine areas and conditions under which variable speed drive is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

#### **3.2 INSTALLATION**

- A. General: Install systems and materials in accordance with manufacturer's instruction.
- B. Maintain minimum clearance of 12 inches on each side and 36 inches in front of the variable speed drive.
- C. Install variable speed drive in the vertical position.
- D. Provide separate conduits for input and output power cables.
- E. Provide separate conduits for control cables and the output cables to the motor.
- F. Install power and control cabling in separate conduits.
- G. Provide dedicated conduits for power cables to the motors.
- H. Load Side Disconnects: Provide a disconnect switch on the load side of the VFD near the motor for ease of service and safety. Disconnect switch shall be lockable in the open position when the VFD is not within sight of the motor. Operating the switch with the VFD running shall not cause any component failure. In dual motor applications, VFD shall be able to operate either motor with the other motor disconnected without requiring jumpers, parameter modifications, or other adjustments. As part of start-up, VFD supplier shall certify all load side disconnects can be opened or closed with drive running at full speed without damage to the drive.
  1. When a separate disconnect is provided at the motor, provide auxiliary contact in the disconnect switch that will shut down the variable speed drive when the disconnect switch is turned off.

#### **3.3 START UP**

- A. All units shall be started up at the jobsite by a factory trained and authorized representative.

**3.4 TRAINING**

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
  - 1. Overview of the system and/or equipment as it relates to the facility as a whole.
  - 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
  - 3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."
- C. Certification: Contractor shall submit to the Engineer a certification letter written by the Contractor stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided. Copies of the startup report shall be attached to the certification letter.
- D. Schedule: Schedule training with Owner with at least 14 days' advance notice.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 23 05 16 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Expansion joints for grooved piping.
- B. Flexible expansion loops.
- C. Expansion loops.
- D. Alignment guides and anchors.

**1.2 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Product Data: Submit product data for each type of pipe expansion joints specified. Submit expansion compensation schedule showing manufacturer's figure number, size, location, connections, material, and displacement for each required expansion joint.
- C. Shop Drawings:
  - 1. Submit assembly-type shop drawings for each type of expansion compensation product, indicating dimensions, weights, required clearances, and methods of assembly of components. Detail fabrication of pipe anchors, hangers, special pipe support assemblies, and their attachment to the building structure. Submit calculations of pipe expansion forces at anchor points for structural engineer review.
  - 2. Submit shop drawings for field-fabricated expansion loops indicating location, dimensions, pipe sizes, calculations for compression or tension required, and location. Detail fabrication of pipe anchors, hangers, special pipe support assemblies, and their attachment to the building structure. Submit calculations of pipe expansion forces at anchor points for structural engineer review.
- D. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
- E. Maintenance Data: Submit maintenance adjustment instructions for expansion fittings for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 23 Section "General Mechanical Requirements."

**1.3 QUALITY ASSURANCE**

- A. Regulatory Requirements: Comply with the provisions of the following codes:
  - 1. Comply with ASME B31.9 for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
  - 2. ASME BVPC.IX for qualifications for Welding Processes and Operators.
- B. Expansion joints shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

**PART 2 - PRODUCTS AND MATERIALS****2.1 PIPE EXPANSION JOINTS GENERAL**

- A. Pipe expansion joints shall provide 200 percent absorption capacity of piping expansion between anchors.

**2.2 EXPANSION JOINTS FOR GROOVED PIPING**

- A. Manufacturers:
  - 1. Grooved Piping Couplings and Nipples Expansion Joints:
    - a. Grinnell Corp.
    - b. Gustin - Bacon Div., Tyler Pipe
    - c. Stockham Valves & Fittings, Inc.
    - d. Victaulic Co. of America.
  - 2. Grooved Piping Slip-Type Expansion Joints:
    - a. Victaulic Co. of America
- B. Combination Couplings and Nipples: Cut grooved short ASTM A 53 steel pipe nipples and ductile iron or malleable iron couplings, with removable ties to hold joint compressed or expanded during piping fabrication.
- C. Slip-Type Expansion Joints: Ductile iron or malleable iron housing, ASTM A 53 steel pipe body, and polytetrafluoroethylene (PTFE) modified polyphenylene coated steel pipe slide.
- D. Select suitable gasket material for piping system.

**2.3 FLEXIBLE EXPANSION LOOPS**

- A. Manufacturers:
  - 1. Flex-Hose Co., Inc.
  - 2. Flexicraft Industries
  - 3. Keflex HVAC Products Div., Flex-Weld, Inc.
  - 4. Metraflex Co. Metraloop
  - 5. Twin City Hose.
- B. Provide prefabricated expansion compensator loops with inlet and outlet elbow fittings and two (2) sections of metal hose and braid joined by long-radius, 180-degree return bend or center section of metal hose and braid, suitable for working pressures and temperatures specified on the drawings. End connections shall match rest of piping system and as required for the size specified in Division 23 Section "Hydronic Piping".
  - 1. For steel piping, provide wetted components of stainless steel.
  - 2. For copper piping, provide wetted components of bronze.

**2.4 EXPANSION LOOPS**

- A. Provide pipe expansion loop constructed of main pipe material. Acceptable methods include use of elbows in a U or Z shape as defined by ASHRAE or ASME; or a detailed stress analysis may be utilized to define areas of expansion.

**2.5 ALIGNMENT GUIDES AND ANCHORS**

- A. Provide alignment guides and anchors as specified in specification Division 23 Section "Hangers & Supports for HVAC Piping & Equipment".

**PART 3 - EXECUTION****3.1 INSTALLATION GENERAL**

- A. Install products in accordance with manufacturer's instructions.
- B. Install expansion joints and expansion loops where indicated on the drawings and where required for adequate expansion of installed piping system.
- C. Anchor piping to ensure proper direction of expansion and contraction.

**3.2 EXPANSION JOINTS**

- A. Align joints to avoid end loading and torsional stress.

**3.3 EXPANSION COMPENSATION FOR RISERS AND TERMINALS**

- A. Install connection between piping mains and risers with at least 5 pipe fittings including tee in main. Install connections between piping risers and terminal heating and cooling units with at least 4 pipe fittings including tee in riser.

**3.4 FLEXIBLE EXPANSION LOOPS**

- A. Install loops at locations indicated on plans. Amount of expansion shall be as indicated on plans. Loop shall be installed horizontally for steam systems. If installed vertically in chilled or hot water systems, drains and manual air vents shall be installed as required in Division 23 Section "Hydronic Piping". Support loop as required by manufacturer and to prevent binding or sagging per Division 23 Section "Hangers & Supports for HVAC Piping and Equipment".

**3.5 EXPANSION LOOPS**

- A. Base expansion loop locations and dimensions on routing shown on plans. If routing is modified, coordinate locations with engineer.
- B. Fabricate expansion loops to dimensions indicated on plans.
- C. Provide air vents and drains for piping in vertical runs in accordance with Division 23 Section "Hydronic Piping". Provide hangers and supports in accordance with Division 23 Section "Hangers & Supports for HVAC Piping and Equipment". For expansion loops with horizontal and vertical components, design supports for the horizontal legs for full weight of the pipe with maximum load variation of 25%.
- D. Provide alignment guides at locations indicated on plans and as required for piping expansion. At a minimum, install alignment guides on both sides of expansion loop, spaced at twice the height of the U or Z loop (height defined as perpendicular distance of piping from primary pipe direction) or as required by the expansion joint manufacturer. Alignment shall be sufficient to allow for proper installation of expansion joints to prevent binding or torsional stress on joint.
- E. Provide anchors at locations indicated on plans and as required for piping expansion. At a minimum install anchors on both sides of straight pipe length incorporating expansion loop.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 23 05 19 - METERS AND GAUGES FOR HVAC PIPING****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Flow meters.
- B. BTU meters
- C. Pressure gauges and fittings.
- D. Thermometers and thermometer wells.
- E. Test plugs.

**1.2 SUBMITTALS**

- A. Submit in accordance with conditions of Contract and Division 01 submittal procedures.
- B. Product Data: Provide schedule that indicates the following for each manufactured component:
  - 1. Model or figure number.
  - 2. Use.
  - 3. Rating.
  - 4. Operating range.
  - 5. Total range.
  - 6. Calibrated performance curves, certified where indicated.
  - 7. Figure number.
  - 8. Location.
  - 9. Accessories.
- C. Product Certificates: Signed by manufacturer certifying accuracy under specified operating conditions and product compliance with specified requirements.
- D. Samples: Submit two of each type of instrument specified.
- E. Project Record Documents: Record actual locations of components and instrumentation.
- F. Operation and Maintenance Data: Furnish data for each manufactured component for inclusion in operating and maintenance manual.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Pressure Gauges: One of each type and size.

**1.3 FIELD CONDITIONS**

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

**PART 2 - PRODUCTS****2.1 FLOW METERS**

- A. General:
  - 1. Select meter size using the design flow rate of the connected equipment or system.
  - 2. Permanently Mounted Meters: Include 6 inch dial or equivalent monitoring device, integral with meter construction or suitable for mounting on wall or bracket with fittings connecting to flow element.

3. Portable Meters: Include differential-pressure gauge and two 12 foot hoses in carrying case with handle.
  4. Scale unless otherwise indicated:
    - a. Water: GPM.
  5. Range: Inclusive of the design flow rate of the pipe in which the meter is installed.
  6. Construction:
    - a. Components shall be suitable for the operating temperatures and pressures.
    - b. Components shall be compatible for the fluid being measured.
    - c. Materials which will be wetted shall be made from non-corrosive materials and shall not contaminate fluid in contact.
  7. Connections:
    - a. In-line: Threaded or flanged, meeting the connection and pressure rating requirements of the adjoining piping system.
    - b. Clamp-on: Adjustable metallic mounting straps.
  8. Calibration: Individually calibrated and tagged accordingly against the manufacturer's primary standards which must be accurate to within 0.1 percent and NIST traceable.
  9. Output: 0-10 Vdc or 4 to 20 mA output linearly proportional to flow.
    - a. Transmitter Housing: Minimum NEMA 1.
- B. Electromagnetic Meter:
1. Manufacturers:
    - a. Badger Meter.
    - b. Emerson Electric, Rosemount.
    - c. Onicon Incorporated.
    - d. Spirax Sarco Flow Systems.
    - e. Veris.
  2. Sensing Method: Magnetic field generating device with electrodes to sense induced voltage within the fluid. The meter shall have no moving parts.
  3. Mounting: Insertion or inline.
  4. Volumetric Accuracy: Plus/minus 1.0 percent of reading over a 10:1 calibrated flow velocity range.
  5. Repeatability: Plus/minus 0.1 percent of reading within the calibrated flow range.
- C. Ultrasonic Meter:
1. Manufacturers:
    - a. Badger Meter.
    - b. Belimo.
    - c. Onicon Incorporated.
    - d. Sierra Instruments.
    - e. Spirax Sarco Flow Systems.
    - f. Veris.
  2. Sensing Method: Ultrasonic transducers utilizing direct beam path transit time to measure flow.
  3. Mounting: In-line or clamp-on.
  4. Volumetric Accuracy: Plus/minus 1.0 percent of reading over a 25:1 calibrated flow range.
  5. Repeatability: Plus/minus 0.25 percent of reading within the calibrated flow range.

## 2.2 BTU METERS

- A. Manufacturers:
1. Badger Meter.
  2. Onicon Incorporated.
  3. Veris.
- B. In-Line Meter:
1. Components: Pipe-mounted flow meter, integral solid-state control board, 2 temperature sensors pre-wired to the control board.

2. Flow Meter: Comply with specifications in paragraph section, "Flow Meters" above.
  3. Size: Up to and including 2 inches, sized for the design flow rate of the pipe in which it shall be installed.
  4. Construction: Brass body, polysulfone electronics enclosure, brass thermowell, threaded or sweat union fittings.
  5. Programming: Factory application specific programmed.
  6. Memory: Non-volatile memory shall retain totalized values in the event of power failure.
  7. Input: Nominal 24 Vdc.
  8. Output Signal:
    - a. 0 to 10 VDC or 4-20 mA analog signal, or serial connection compatible with building automation system network.
    - b. Available Control Points: As scheduled on the control drawings.
- C. Remote Meter:
1. Components: Pipe mounted flow meter, 2 temperature sensors, and remote mounted solid-state meter.
  2. Flow meter shall be as specified in paragraph section, "Flow Meters" above.
  3. Temperature Sensors: Comply with Section 230913.
  4. Remote Solid-State Meter:
    - a. Programming: Factory programmed, field programmable at front panel interface.
    - b. Memory: Non-volatile EEPROM memory shall retain all program parameters and totalized values in the event of power loss.
    - c. Display: Alphanumeric LCD displays total energy, energy rate, flow rate, supply temperature and return temperature..
  5. Enclosure:
    - a. NEMA 250, Type 12 or 13 for indoor applications.
    - b. NEMA 250, Type 4 or 4X for outdoor applications.
  6. Input: Nominal 24 VDC.
  7. Output Signal: Serial connection compatible with building automation system.
    - a. Available Control Points: As scheduled on the control drawings.

## 2.3 PRESSURE GAUGES

- A. Manufacturers:
1. Ametek, U.S. Gauge Div.
  2. Ashcroft Dresser Industries Instrument Div.
  3. Dwyer Instruments, Inc.
  4. H.O. Trerice Co.
  5. Marsh Instrument Co., Unit of General Signal.
  6. Marshalltown Instruments, Inc.
  7. Miljoco Corp.
  8. Weiss Instruments, Inc.
  9. Weksler Glass Thermometer Corp.
  10. WIKA Instruments Corp.
  11. Winters Instruments.
- B. Description: ASME B40.100, UL 393, rotary brass movement, white with black markings and black pointer.
- C. Case: Drawn steel, cast aluminum, or stainless steel with phosphor bronze bourdon tube and front or rear recalibration adjustment. Provide silicone fluid damping where required by Part 3.
- D. Size: 4-1/2 inch diameter.
- E. Lens: Clear glass.
- F. Stem: Brass for separable socket, length to suit installation.
- G. Scale: Progressive, satin-faced, non-reflective aluminum, permanently etched markings.

- H. Accuracy: Plus or minus 1 percent of range span.
- I. Liquid-Filled: Provide liquid filled gauges where specified in Part 3 of this section.

## 2.4 PRESSURE GAUGE TAPPINGS

- A. Manufacturers: Same as pressure gauge manufacturers.
- B. Gauge Cock: Tee or lever handle, brass, rated for system pressure.
- C. Needle Valve: Brass, 1/4 inch NPT, rated for system pressure.
- D. Pulsation Damper: Pressure snubber, brass with 1/4 inch threaded connections, corrosion-resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure.
- E. Syphon: Brass, 1/4-inch NPT angle or straight pattern.

## 2.5 STEM TYPE THERMOMETERS

- A. Manufacturers:
  - 1. Dwyer Instruments, Inc.
  - 2. H.O. Trerice Co.
  - 3. Marsh Instruments, Inc.
  - 4. Miljoco Corp.
  - 5. Weiss Instruments, Inc.
  - 6. Weksler Glass Thermometer Corp.
  - 7. Winters Instruments.
- B. Thermometers - Adjustable Angle:
  - 1. Description: Red- or blue-appearing non-toxic liquid in glass tube; ASTM E1.
  - 2. Adjustable Joint: Finish to match case with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
  - 3. Case: Cast aluminum with enamel finish.
  - 4. Size: 9 inch scale.
  - 5. Window: Clear Lexan.
  - 6. Stem: Brass, copper-plated steel, or aluminum for separable socket, length to suit installation.
  - 7. Scale: Progressive, satin-faced, non-reflective aluminum, with permanently etched markings.
  - 8. Accuracy: Plus or minus 1 percent of range span or plus or minus 1 scale division to maximum of 1.5 percent of range span.
  - 9. Calibration: Degrees F.

## 2.6 DIAL THERMOMETERS

- A. Thermometer – Direct Mount, Bimetal Actuated:
  - 1. Manufacturers:
    - a. Ashcroft Dresser Industries Instruments Div.
    - b. H.O. Trerice Co.
    - c. Marshalltown Instruments, Inc.
    - d. Miljoco Corp.
    - e. Tel-Tru Manufacturing Co., Inc.
    - f. Weiss Instruments, Inc.
    - g. Weksler Glass Thermometer Corp.
    - h. Winters Instruments.
  - 2. Description: Dial type, ASTM E1 bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer.



3. Adjustable joint: Finish to match case with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
  4. Case: Stainless steel with front or rear recalibration.
  5. Size: 5 inch diameter dial.
  6. Lens: Clear glass, hermetically sealed.
  7. Stem: Stainless steel for separable socket. Length to suit installation.
  8. Scale: Progressive, satin-faced, non-reflective aluminum, permanently etched markings.
  9. Accuracy: Plus or minus 1.0 percent of range span or plus or minus 1 scale division to maximum of 1.5 percent of range span.
  10. Calibration: Degrees F.
- B. Thermometers – Direct Mount, Vapor Actuated:
2. Manufacturers:
    - a. Ashcroft Dresser Industries Instruments Div.
    - b. H.O. Trerice Co.
    - c. Miljoco Corp.
    - d. Weiss Instruments, Inc.
    - e. Weksler Glass Thermometer Corp.
    - f. Winters Instruments.
  2. Description: Dial type vapor or liquid actuated; ASTM E1; copper bulb, copper or phosphor bronze bourdon tube, white with black markings and black pointer.
  3. Adjustable joint: Finish to match case with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
  4. Case: Drawn steel, cast aluminum, or stainless steel.
  5. Size: 4-1/2 inch diameter dial.
  6. Lens: Clear glass.
  7. Stem: Brass, copper-plated steel, or aluminum for separable socket. Length to suit installation.
  8. Scale: Progressive, satin-faced, non-reflective aluminum, permanently etched markings.
  9. Accuracy: Plus or minus 1.0 percent of range span or plus or minus 1 scale division to maximum of 1.5 percent of range span.
  10. Calibration: Degrees F.
- C. Thermometers – Remote Reading:
3. Manufacturers:
    - a. Ashcroft Dresser Industries Instruments Div.
    - b. H.O. Trerice Co.
    - c. Miljoco Corp.
    - d. Tel-Tru Manufacturing Co., Inc.
    - e. Weiss Instruments, Inc.
    - f. Weksler Glass Thermometer Corp.
    - g. Winters Instruments.
  2. Description: Dial type vapor or liquid actuated; ASTM E1; white with black markings and black pointer.
  3. Case: Drawn steel, cast aluminum, or stainless steel.
  4. Size: 4-1/2 inch diameter dial.
  5. Lens: Clear glass.
  6. Bulb: Copper for separable socket for liquids, averaging element for air.
  7. Scale: Progressive, satin-faced, non-reflective aluminum, permanently etched markings.
  8. Capillary: Copper or bronze double-braided capillary for separable socket. Length to suit installation, minimum 5 feet.
  9. Accuracy: Plus or minus 1.0 percent of range span or plus or minus 1 scale division to maximum of 1.5 percent of range span.
  10. Calibration: Degrees F.

**2.7 THERMOMETER SUPPORTS**

- A. Thermowell Socket: ASTM A536 ductile iron, brass, or stainless steel, compatible with adjacent piping to eliminate dielectric corrosion, with separable socket for thermometer stems and 2 inch extension for insulated piping, pressure rated to match piping system design pressure, with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

**2.8 TEST PLUGS**

- A. Manufacturers:
  - 1. Flow Design, Inc.
  - 2. MG Piping Products Co.
  - 3. Peterson Equipment Co., Inc.
  - 4. Sisco, A Spedco, Inc. Co.
  - 5. Watts Regulator.
- B. Test Plug: 1/2 inch nickel-plated brass fitting, rated for 500 psig, extension for insulation, and threaded cap with retention chain for receiving 1/8 inch outside diameter pressure or temperature probe.
- C. Core Material:
  - 1. Neoprene core for temperatures up to 200 degrees F.
  - 2. Nordel core for temperatures up to 350 degrees F.
  - 3. Viton core for temperatures up to 400 degrees F.
- D. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gauge, one gauge adapter with 1/8 inch probes, two 1 inch bimetal dial thermometers.

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install flow meters in a readily accessible location.
- C. Install flow meters with isolating valves on inlet and outlet.
- D. Install differential pressure-type flow elements with minimum straight lengths of pipe upstream and downstream from element in accordance with manufacturer's instructions.
- E. Install in-line BTU meters in piping where indicated in the hydronic supply line. Install thermal well in return line for remote sensor.
- F. Install remote mounted BTU meters on wall or bracket in an accessible location.
- G. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- H. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Provide siphon on gauges in steam systems. Extend nipples and siphons to allow clearance from insulation.
- I. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- J. Install thermometers in air duct systems on flanges.

- K. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets. Where thermometers are provided on local panels, duct or pipe mounted thermometers are not required.
- L. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.
- M. Coil and conceal excess capillary on remote element instruments.
- N. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- O. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- P. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- Q. Locate test plugs adjacent thermometers and thermometer sockets.

### 3.2 SCHEDULE

- A. Flow Meters: Reference plans for location.
- B. Pressure Gages, Location and Scale Range:
  - 1. Location: Install device at inlet and outlet of each of the following:
    - a. Headers to central equipment.
    - b. Heat exchangers.
    - c. Pumps. Provide silicone damping gauge.
    - d. Boilers.
    - e. Chillers.
    - f. After major coils. Reference details on plans.
    - g. Expansion tanks.
    - h. Pressure reducing valves.
  - 2. Scale Range:
    - a. Vacuum: 30 inches Hg to 15 psig.
    - b. All fluids: 2 times operating pressure.
- C. Pressure Gage Tappings, Location:
  - 1. Control valves 3/4 inch & larger – inlets and outlets.
  - 2. Major coils – inlets and outlets.
  - 3. Chiller – inlets and outlets.
  - 4. Boiler – inlets and outlets.
- D. Stem Type Thermometers, Location and Scale Range:
  - 1. Location: Install device at inlet and outlet of each of the following:
    - a. Headers to central equipment.
    - b. Boilers.
    - c. Chillers.
    - d. Hydronic zone supply and return.
    - e. After major coils. Reference details on plans.
  - 2. Scale Range:
    - a. Hot Water: 30 to 300 degrees F with 2-degree scale divisions
    - b. Condenser Water: 0 to 160 degrees F with 2-degree scale divisions.
    - c. Chilled Water: 0 to 100 degrees F with 2-degree scale divisions.
    - d. Steam and Condensate: 50 to 400 degrees F with 5-degree scale divisions.
- E. Thermometer Sockets, Location:
  - 1. Control valves 1 inch & larger - inlets and outlets.
  - 2. Reheat coils - inlets and outlets.
  - 3. Cabinet heaters - inlets and outlets.

4. Unit heaters - inlets and outlets.
- F. Dial Thermometers, Location and Scale Range:
1. Each supply air zone, minus 32 to 150 degrees F.
  2. Outside air, minus 32 to 150 degrees F.
  3. Return air, minus 32 to 150 degrees F.
  4. Mixed air, minus 32 to 150 degrees F.

END OF SECTION

**SECTION 23 05 23 - GENERAL DUTY VALVES FOR HVAC PIPING****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Applications.
  - 1. General duty valves common to most mechanical piping systems.
  - 2. Special purpose valves are specified in individual piping system specifications.
- B. General requirements.
- C. Globe valves.
- D. Ball valves.
- E. Butterfly valves.
- F. Check valves.
- G. Chainwheels.

**1.2 ABBREVIATIONS AND ACRONYMS**

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene diene monomer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. SWP: Steam working pressure.
- I. TFE: Tetrafluoroethylene.

**1.3 SUBMITTALS**

- A. Submit in accordance with conditions of Contract and Division 01 submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, pressure and temperature classifications, valve design, body material, seating materials, trim material, dimensions, clearances, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- E. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.

**1.4 QUALITY ASSURANCE**

- A. Manufacturer:
  - 1. Obtain valves for each valve type from a single manufacturer.
  - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
  - 3. Subject to compliance requirements, provide products from one of the manufacturers listed in Valve Schedule in Part 3.
- B. Valves shall be certified to meet the specified ASTM, ASME, ANSI, and MSS standards in Part 2 Products, and as follows:
  - 1. ASME B31.9 for building services piping.
  - 2. ASME B31.1 for power piping.
- C. Welding Materials and Procedures: Conform to ASME BPVC-IX.

**1.5 DELIVERY STORAGE AND HANDLING**

- A. Prepare valves for shipping as follows:
  - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
  - 2. Protect valve parts exposed to piped medium against rust and corrosion.
  - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
  - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
  - 5. Secure check valves in either the closed position or open position.
  - 6. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection and protect flanges and specialties from dirt.
    - a. Provide temporary inlet and outlet caps.
    - b. Maintain caps in place until installation.
  - 2. Store valves in shipping containers and maintain in place until installation.
    - a. Store valves indoors in dry environment.
    - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.
- C. Exercise the following precautions for handling:
  - 1. Avoid the use of operating handles or stems as rigging or lifting points.

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. Subject to compliance with requirements, provide products from one of the manufacturers listed in the Valve Schedule in Part 3.

**2.2 APPLICATIONS**

- A. Provide the following valves for the applications if not indicated on Drawings:
  - 1. Throttling (Hydronic): Butterfly, Ball, and Globe.
  - 2. Isolation (Hydronic): Butterfly and Ball.
  - 3. Dead-End: Butterfly and Ball.
- B. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.
- C. Required Valve End Connections for Non-Wafer Types:
  - 1. Steel Pipe:
    - a. 2 NPS and Smaller: Threaded ends.

- b. 2-1/2 NPS and Larger: Grooved or flanged ends.
      - 2. Copper Tube:
        - a. 2 NPS and Smaller: Threaded or solder-joint valve ends.
          - 1) Exception: Solder ends not acceptable for hot water or steam pipe.
        - b. 2-1/2 NPS and Larger: Grooved or flanged ends.
      - 3. Steam and Steam Condensate Pipe: Solder and grooved ends not acceptable.
  - D. Chilled Water Valves:
    - 1. 2 NPS and Smaller:
      - a. Minimum Class: 125.
      - b. Body: Bronze.
      - c. Allowable Valve Types:
        - 1) Ball: Two piece. Forged brass body is acceptable to bronze body.
          - a) Brass components.
          - b) Stainless steel components.
        - 2) Lift check.
        - 3) Swing check.
        - 4) Wafer plate-type check.
        - 5) Globe.
    - 2. 2-1/2 NPS and Larger:
      - a. Minimum Class: 125.
      - b. Body: Cast iron, except as noted below.
      - c. Allowable Valve Types:
        - 1) Ball: 2-1/2 inch to 3 inch: Three piece, bronze, forged brass, carbon steel, or stainless steel body.
          - a) Brass components.
          - b) Stainless steel components.
        - 2) Butterfly: Ductile iron body.
        - 3) Lift check.
        - 4) Swing check.
        - 5) Wafer plate-type check.
        - 6) Globe.
- E. Condenser Water Valves:
  - 1. 2 NPS and Smaller:
    - a. Minimum Class: 125.
    - b. Body: Bronze.
    - c. Allowable Valve Types:
      - 1) Ball: Two piece. Forged brass body is acceptable to bronze body.
        - a) Brass components.
        - b) Stainless steel components.
      - 2) Lift check.
      - 3) Swing check.
      - 4) Wafer plate-type check.
      - 5) Globe.
  - 2. 2-1/2 NPS and Larger:
    - a. Minimum Class: 125.
    - b. Body: Cast iron, except as noted below.
    - c. Allowable Valve Types:
      - 1) Ball: 2-1/2 inch to 3 inch: Three piece, bronze, forged brass, carbon steel, or stainless steel body.
        - a) Brass components.
        - b) Stainless steel components.
      - 2) Butterfly: Ductile iron body. Furnish aluminum bronze or stainless steel disc in open loop systems.
      - 3) Lift check.
      - 4) Swing check.

- 5) Wafer plate-type check.
  - 6) Globe.
- F. Heating Hot Water Valves:
1. 2 NPS and Smaller:
    - a. Minimum Class: 125.
    - b. Body: Bronze.
    - c. Allowable Valve Types:
      - 1) Ball: Two piece. Forged brass body is acceptable to bronze body.
        - a) Brass components.
        - b) Stainless steel components.
      - 2) Lift check.
      - 3) Swing check.
      - 4) Wafer plate-type check.
      - 5) Globe.
  2. 2-1/2 NPS and Larger:
    - a. Minimum Class: 125.
    - b. Body: Cast iron, except as noted below.
    - c. Allowable Valve Types:
      - 1) Ball: 2-1/2 inch to 3 inch: Three piece, bronze, forged brass, carbon steel, or stainless steel body.
        - a) Brass components.
        - b) Stainless steel components.
      - 2) Butterfly: Ductile iron body.
      - 3) Lift check.
      - 4) Swing check.
      - 5) Wafer plate-type check.
      - 6) Globe.

### 2.3 GENERAL REQUIREMENTS

- A. Mechanically Joined General Duty Valves:
1. Contractor may provide mechanically joined general duty valves as an option in lieu of, in whole of, or in part of, the general duty valve fitting and joining methods for the specific systems indicated in Article "Applications." Reference Division 23 Section "Mechanically Joined Hydronic Piping Systems."
- B. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- C. Valve Sizes: Match upstream piping unless otherwise indicated.
- D. Valve Stem Design:
1. Rising stem or rising outside screw and yoke stems.
  2. Non-rising stem valves may be used on water systems where headroom prevents full extension of rising stems.
- E. Valve Actuator Types:
1. Gear Actuator: Quarter-turn valves 8 NPS and larger.
  2. Handwheels: Valves other than quarter-turn types.
  3. Hand Lever: Quarter-turn valves 6 NPS and smaller, vinyl-covered.
  4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- F. Valves in Insulated Piping: Provide stem extensions so valve operator extends a minimum of 1/2 inches outside of the insulation and the following features:
1. Gate Valves: Rising stem.



2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  3. Butterfly Valves: Extended neck.
  4. Memory Stops: Fully adjustable after insulation is installed.
- G. Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
  2. Flanges: ASME B16.1 for cast iron.
  3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5 for steel, ASME B16.24 for bronze.
  4. Solder Joint Connections: ANSI B16.18.
  5. Grooved End Connections: AWWA C606.
- H. General ASME Compliance:
1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
  2. Power Piping Valves: ASME B31.1.
  3. Building Services Piping Valves: ASME B31.9.
- I. Bronze Valves:
1. Fabricate from dezincification resistant material.
  2. Copper alloys containing more than 15 percent zinc are not permitted.
- J. Valve Bypass and Drain Connections: MSS SP-45.
- K. Source Limitations: Obtain each valve type from a single manufacturer.

## 2.4 BRONZE GLOBE VALVES

- A. Class 150, 300 psig CWP:
1. Comply with MSS SP-80, Type 2, nonmetallic disc to metal seat.
  2. Body: Bronze; ASTM B62, with integral seat and union bonnet.
  3. Ends: Threaded or solder joint.
  4. Stem and Disc: Bronze stem, PTFE disc.
  5. Packing: Asbestos free, brass gland.
  6. Operator: Malleable iron handwheel.

## 2.5 IRON GLOBE VALVES

- A. Class 125, 200 psig CWP and Class 250, 500 psig CWP:
1. Comply with MSS SP-85, Type 1.
  2. Body: Gray iron; ASTM A126, with bolted bonnet.
  3. Ends: Grooved or flanged.
  4. Trim: Bronze.
  5. Packing and Gasket: Asbestos free, two-piece backing gland assembly.
  6. Operator: Handwheel or chainwheel.

## 2.6 BRONZE BALL VALVES

- A. Two Piece, Class 150, bronze trim, for valves 2 inch and smaller:
1. Comply with MSS SP-110.
  2. CWP Rating: 600 psi.
  3. Body: Bronze, ASTM B584.
  4. Trim: Bronze.
  5. Ends: Threaded or solder joint.
  6. Seats and Seals: PTFE.
  7. Stem: Blowout-proof.
  8. Ball: Full port, chrome plated brass.

9. Operator: Vinyl-covered steel handle.
- B. Two Piece, Class 150, stainless steel trim, for valves 2 inch and smaller:
1. Comply with MSS SP-110.
  2. CWP Rating: 600 psi.
  3. Body: Bronze, ASTM B584.
  4. Trim: Stainless steel.
  5. Ends: Threaded or solder joint.
  6. Seats and Seals: PTFE.
  7. Stem: Blowout-proof, stainless steel..
  8. Ball: Full port, ASTM A276 Type 316 stainless steel.
  9. Operator: Vinyl-covered steel handle.
- C. Three Piece, Class 150, bronze trim, for valves 2-1/2 inch to 3 inch:
1. Comply with MSS SP-110.
  2. CWP Rating: 600 psig.
  3. Body: Bronze, ASTM B584.
  4. Trim: Bronze.
  5. Ends: Threaded or solder joint.
  6. Seats and Seals: PTFE.
  7. Stem: Blowout-proof.
  8. Ball: Full port, chrome plated brass.
  9. Operator: Vinyl-covered steel handle.
- D. Three Piece, Class 150, stainless steel trim, for valves 2-1/2 inch to 3 inch:
1. Comply with MSS SP-110.
  2. CWP Rating: 600 psi.
  3. Body: Bronze, ASTM B584.
  4. Trim: Stainless steel.
  5. Ends: Threaded or solder joint.
  6. Seats and Seals: PTFE.
  7. Stem: Blowout-proof, stainless steel..
  8. Ball: Full port, ASTM A276 Type 316 stainless steel.
  9. Operator: Vinyl-covered steel handle.

## 2.7 BRASS BALL VALVES

- A. Two Piece, Class 150, brass trim, for valves 2 inch and smaller:
1. Standard: MSS SP-110.
  2. CWP Rating: 600 psig.
  3. Body Design: Two piece.
  4. Body Material: Forged brass, ASTM B283 or DZR forged brass, ASTM B283 UNS No. C48640.
  5. Trim: Brass.
  6. Ends: Threaded or soldered.
  7. Seats: PTFE.
  8. Stem: Blowout-proof ,brass.
  9. Ball: Chrome plated brass.
  10. Port: Full.
- B. Two Piece, Class 150, stainless trim, for valves 2 inch and smaller:
1. Standard: MSS SP-110.
  2. CWP Rating: 600 psig.
  3. Body Design: Two piece.
  4. Body Material: Forged brass, ASTM B283 or DZR forged brass, ASTM B283 UNS No. C48640.
  5. Trim: Stainless steel.
  6. Ends: Threaded or soldered.

7. Seats: PTFE.
  8. Stem: Blowout-proof, stainless steel.
  9. Ball: ASTM A276 Type 316 stainless steel.
  10. Port: Full.
- C. Two Piece, Class 150, Brass Trim, for valves 2-1/2 inch to 3 inch:
1. Standard: MSS SP-110.
  2. CWP Rating: 600 psig.
  3. Body Design: Three piece.
  4. Body Material: Forged brass, ASTM B283 or DZR forged brass, ASTM B283 UNS No. C48640.
  5. Trim: Brass.
  6. Ends: Threaded or soldered ends.
  7. Seats: PTFE.
  8. Stem: Blowout-proof, brass.
  9. Ball: Chrome plated brass.
  10. Port: Full
- D. Two Piece, Class 150, Stainless Steel Trim, for valves 2-1/2 inch to 3 inch:
1. Standard: MSS SP-110.
  2. CWP Rating: 600 psig.
  3. Body Design: Three piece.
  4. Body Material: Forged brass, ASTM B283 or DZR forged brass, ASTM B283 UNS No. C48640.
  5. Trim: Stainless steel.
  6. Ends: Threaded or soldered ends.
  7. Seats: PTFE.
  8. Stem: Blowout-proof, stainless steel.
  9. Ball: ASTM A276 Type 316 stainless steel.
  10. Port: Full

## 2.8 IRON BUTTERFLY VALVES

- A. Lug type: Bi-directional dead-end service without downstream flange.
1. Comply with MSS SP-67, Type I.
  2. CWP Rating: 200 psig and 250 psig.
  3. Body Material: ASTM A536 ductile iron.
  4. Stem: One or two-piece stainless steel.
  5. Seat and Seal: EPDM.
  6. Disc: Aluminum-bronze, stainless steel, or one-piece Nylon-coated ductile iron.
  7. Operator:
    - a. Size 2-1/2 through 6 inches: Lever operator, 10 position minimum, with locks and stops.
    - b. Size 8 inch and larger: Gear type with position indicator.

## 2.9 BRONZE SWING CHECK VALVES

- A. Class 150:
1. Comply with MSS SP-80, Type 3.
  2. CWP Rating: 300 psig.
  3. Design: Horizontal swing, Y-pattern, capable of being refitted and ground while valve remains in the line.
  4. Body: Bronze, ASTM B62.
  5. Ends: Threaded.
  6. Disc: PTFE.
  7. Disc: Bronze.

**2.10 IRON FLANGED END SWING CHECK VALVES**

- A. Class 125, 200 psig CWP.
  - 1. Comply with MSS SP-71, Type I.
  - 2. Design: Horizontal swing, clear or full waterway, capable of being refitted and ground while valve remains in the line.
  - 3. Body: Cast iron with bolted bonnet in accordance with ASTM A126, Class B.
  - 4. Ends: Flanged.
  - 5. Trim: Bronze.
  - 6. Disc Holder: Bronze face ring and seat ring.
  - 7. Disc: Bronze or ductile iron.
  - 8. Gasket: Asbestos free.

**2.11 IRON WAFER PLATE-TYPE CHECK VALVES**

- A. Class 125 Dual-Plate (Twin Disc):
  - 1. Comply with API STD 594.
  - 2. 2-1/2 NPS to 12 NPS, CWP Rating: 200 psig.
  - 3. 14 NPS to 24 NPS, CWP Rating: 150 psig.
  - 4. Design: Wafer, non-slam, spring-loaded plates, designed to open and close at approximately 0.5 psi differential.
  - 5. Body: ASTM A126, cast iron.
  - 6. Ends: Flanged.
  - 7. Trim: Stainless steel.
  - 8. Disc: Replaceable bronze.
  - 9. Seat: EPDM, or NBR.

**2.12 CHAINWHEELS**

- A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
  - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
  - 2. Sprocket Rim with Chain Guides: Ductile iron include zinc coating.
  - 3. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. If valve is determined to be defective, replace with new valve.

**3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Locate valves for easy access. Provide access doors and fire rated access doors as required.
- C. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

- D. Install shut-off duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, and elsewhere as indicated.
- E. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, elsewhere as indicated.
- F. Install three-valve bypass around each pressure reducing valve using throttling-type valves.
- G. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- H. Install valves in a position to allow full stem movement.
- I. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- J. Valves with soldered end connections:
  - 1. Use solder with a melting point as follows:
    - a. Below 840 degrees F for gate, globe, and check valves.
    - b. Below 421 degrees F for ball valves.
- K. Install check valves where necessary to maintain direction of flow as follows:
  - 1. Lift Check: Install horizontal style with stem plumb and vertical.
  - 2. Swing Check: Install horizontal maintaining hinge pin level.
  - 3. Orient plate-type into horizontal or vertical position, between flanges.
- L. Provide chainwheels on operators for valves 2-1/2 NPS and larger where located 72 inches or more above finished floor in mechanical rooms, terminating 60 NPS above finished floor.

### 3.3 FIELD QUALITY CONTROL

- A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leak; replace valves if leak persists.

### 3.4 ADJUSTING AND CLEANING

- A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.
- B. Inspect valves for leaks after piping systems have been tested and put into service, but before final adjusting and balancing. Adjust or replace packing, as required, on valves with leaks. Replace valve if leak persists.

### 3.5 VALVE SCHEDULE

A. Bronze Globe Valves, Class 150:

MANUFACTURER	THREADED	THREADED	SOLDER
	NRS	RS	RS
Apollo	--	122T	--
Crane	--	7TF	1310
Hammond	--	IB413T	IB423
Jenkins	--	106BJ	--
Milwaukee	--	590T	1590T
Nibco	--	T-235-Y	S-235-Y
Powell	150	--	--
Stockham	--	B-22T	--

## B. Iron Globe Valves:

MANUFACTURER	CLASS 125	CLASS 125
	STRAIGHT BODY	ANGLE BODY
Apollo	711F	--
Bray	DG	--
Crane	351	353
Hammond	IR116	IB463
Jenkins	2342J	2344J
Milwaukee	F2981A	--
Nibco	F-718-B	F-818-B
Powell	241	--
Stockham	G-512	G-515

## C. Bronze Ball Valves – 2 inch and smaller, Class 150:

1. Model for chrome plated brass ball indicated. Furnish SS ball if specified in Part 2.

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Apollo	77C-140	77C-240
Hammond	8301A	8311A
Milwaukee	BA-400	BA-450
Nibco	T-585-70	S-585-70
Watts	LFB6080G2	LFB6081G2

## D. Bronze Ball Valves - 2-1/2 inch to 3 inch, Class 150:

1. Model for chrome plated brass ball indicated. Furnish SS ball if specified in Part 2.

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Apollo	82-100	82-200
Hammond	8604	8614
Milwaukee	BA-300	BA-350
Nibco	T-595-Y	S-595-Y
Watts	LFB6080G2	LFB6081G2

## E. Brass Ball Valves – 2 inch and smaller, Class 150:

1. Model for chrome plated brass ball indicated. Furnish SS ball if specified in Part 2.

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Apollo	77F-100	77F-200
Bray	S51	
Hammond	8901	8911
Kitz Corporation	AKTFLL	CTFLL
Milwaukee	BA-475B	BA-485B
Nexus Valve Inc.	UX-#F-#F	UX-#S-#S
Nibco	T-FP-600A	S-FP-600A
Watts	FBV-3C	FBVS-3C

## F. Brass Ball Valves - 2-1/2 inch to 3 inch, Class 150:

1. Model for chrome plated brass ball indicated. Furnish SS ball if specified in Part 2.

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Hammond	8901	8911
Kitz Corporation	AKTAFP	--
Milwaukee	BA-475B	BA-485B
Nexus Valve Inc.	UX-#F-#F	UX-#S-#S
Nibco	T-595-Y	S-595-Y
Watts	C-FBV-1	

## G. Iron Butterfly Valves, 200 psig CWP:

<u>MANUFACTURER</u>	<u>SERIES</u>
Apollo	LD141
Bray	30/31
Crane Center Line	44
Keystone	222
Nibco	LD-2000
Stockham	LD-712 & 722
Watts	BF-03
Milwaukee	ML
Hammond	6411

## H. Bronze Swing Check Valves:

<u>MANUFACTURER</u>	<u>CLASS 150 THREADED</u>
Apollo	164T
Crane	141TF
Hammond	1B946
Jenkins	4475TJ
Milwaukee	510-T
Nibco	T-433-Y
Powell	--
Stockham	B322

## I. Iron Flanged End Swing Check Valves:

<u>MANUFACTURER</u>	<u>CLASS 125</u>
Apollo	910F
Crane	373
Hammond	IR1124
Jenkins	587J
Milwaukee	F2974
Nibco	F-918-B
Powell	559
Stockham	G-931

## J. Iron Wafer Plate-Type Check Valves:

<u>MANUFACTURER</u>	<u>CLASS 125</u>
Apollo	910WB
Center Line	800
Crane	DuoChek StyleG
Metraflex	CVOSSXXX
Nibco	W-920-W
Stockham	WG970

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Support and attachment components.
- B. Horizontal piping hangers and supports.
- C. Saddles and shields.
- D. Vertical piping clamps.
- E. Pipe alignment guides.
- F. Pipe anchors.
- G. Pre-engineered roof equipment supports.
- H. Anchors and fasteners.
- I. Miscellaneous materials.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

**1.3 SUBMITTALS**

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each type of hanger and support. Include a hanger and support schedule showing manufacturer's figure number, size, location, and features for each hanger and support. Submit style and type to Structural Engineer for approval prior to installation.
- B. Product Certificates: Signed by the manufacturer of hangers and supports certifying the products meet the specified requirements.
- C. Welder Certificates: Signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.
- D. Maintenance Data: For inclusion in Operating and Maintenance manual specified in Division 01 and Division 23 Section "General Mechanical Requirements."

- E. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution. Include dimensions, weights, required clearances, and method of assembly.
  - 1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.
- F. Installer's Qualifications: Include evidence of compliance with specified requirements.
- G. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Deferred Submittals: Submit signed and sealed drawings that indicate the design and installation requirements of pre-engineered roof supports can withstand the design criteria listed in this specification. Include installation requirements for anchoring to the roof structure. The Engineer is not responsible and will not provide the seal and signature. Deliver submittal to the local AHJ for approval prior to installation of the contractor provided, pre-engineered roof supports.

#### **1.4 QUALITY ASSURANCE**

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Field-Welding:
  - 1. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
  - 2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
  - 3. Qualify welding processes and welding operators in accordance with ASME BPVC Section IX, "Welding and Brazing Qualifications."
- D. Flame/Smoke Ratings: Provide hangers and supports with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- F. Deferred Submittals: Signed and sealed by a professional engineer or National Institute for Certification in Engineering Technologies (NICET) stamp and signature. The professional engineer shall be licensed in the same state in which the project is located.

#### **1.5 DELIVERY STORAGE AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

#### **1.6 DEFINITIONS**

- A. Terminology used in this Section is defined in MSS SP-90.

### **PART 2 - PRODUCTS AND MATERIALS**

#### **1.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test fluid. Include the weight of the pipe, valves, insulation and piping accessories.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

## 1.2 SUPPORT AND ATTACHMENT COMPONENTS

### B. General Requirements:

1. Comply with MSS SP-58.
2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of work.
3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
6. Materials: Products and materials listed in this specification are based on indoor, dry locations. Use corrosion resistant materials suitable for the environment where installed.
  - a. Indoor Dry Locations: Provide painted carbon steel, galvanized steel or zinc-plated steel. Where supports will be field painted in exposed locations, provide carbon steel.
  - a. Indoor Damp or Wet Locations: Galvanized steel or type 304 stainless steel.
  - b. Natatorium or other treated pool environments: Type 316 stainless steel.
  - b. Outdoor Locations: Galvanized steel or Type 304 stainless steel.
  - c. Dielectrics Barriers: Provide dielectric barriers between metallic supports and metallic piping and associated items of dissimilar type. Acceptable barriers include rubber, or copper-plated coatings where attachments are in direct contact with copper.
  - d. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
  - e. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
  - f. Stainless Steel: Type 304 or 316 in accordance with ASTM A240.

### C. Metal Channel (Strut) Framing Systems:

1. Manufacturers:
  - a. Cooper B-Line.
  - b. Ferguson Enterprises/FNW.
  - c. PHD Manufacturing.
  - d. Thomas & Betts Corporation.
  - e. Unistrut, a brand of Atkore International Inc.
  - f. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
2. Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
3. Comply with MSS SP-58, Type 59, MSS SP-89, and MFMA-4. Welds shall comply with AWS D1.1.
4. Channel Material:
  - a. Indoor Dry Locations: Provide carbon steel, galvanized steel or zinc-plated steel. Where supports will be field painted in exposed locations, provide carbon steel .
  - b. Indoor Damp or Wet Locations: Galvanized steel or Type 304 stainless steel.
  - c. Outdoor Locations: Galvanized steel or Type 304 stainless steel.
  - d. Natatorium or other treated pool environments: Type 316 stainless steel.

- e. All nuts, brackets, and clamps shall have the same finish as the channel.
  5. Minimum Channel Thickness: Steel sheet, 14 gage, 0.0747 inch.
  6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height with factory-punched attachment holes.
  7. Provide plastic galvanic isolators for connecting bare copper pipe for use with pre-engineered support strut system where indicated.
- D. Hanger Rods:
1. Material:
    - a. Indoor Dry Locations: Zinc-plated steel.
    - b. Indoor Damp or Wet Locations or Outdoor Locations: Zinc-plated steel or type 304 stainless steel.
    - c. Natatorium or other treated pool environments: Type 316 stainless steel.
  2. Threaded both ends or continuously threaded.
  3. Minimum Size: Reference piping specification sections for rod thicknesses.
  4. Threaded Rods: Threaded rods are not allowed for floor supports except when the maximum length of the rod is less than 12". Threaded rod sizes shall be the same size diameter as specified for pipe hanger rods based upon pipe size being supported. Refer to system piping specification sections for rod size requirements.
- E. Wire Rope Pipe Hanging Systems:
1. Manufacturers:
    - a. ASC Engineered Solutions.
    - b. Gripple.
  2. General: Wire rope hanger system shall have a minimum 5 to 1 safety factor based upon the applied working load being supported.
  3. Source Limitations: Furnish associated fittings, accessories, and hardware produced by a single manufacturer.
  4. Cast-in-place Concrete Insert: Pressed steel body with sintered steel wedge, 302 stainless steel spring and UV stabilized homopolymer polypropylene end cap. Model: Gripple Spider Hanging Kit.
  5. Cable Stud: Carbon steel, zinc-coated, designed for attachment to concrete inserts. Model: ASC Engineered Solutions C120.
  6. Cable Coupling: Carbon steel, zinc-coated, designed for attachment to threaded rods. Model: ASC Engineered Solutions C130.
  7. Cable Eyelet: Carbon steel, zinc-coated, designed to be directly attached to structural supports via anchors or fasteners. Model: ASC Engineered Solutions C150.
  8. Cable Toggle: Carbon steel, zinc-coated, with toggle designed for insertion into 1/2 inch hole through steel deck hat channel and provides anchor when pulled in tension. Model: ASC Engineered Solutions C160.
  9. Swivel Toggle Insert: Single assembly attached to wire rope cable, manufactured from plated carbon steel toggle, pins, and shackles; swivel insert engineered to be compatible with concrete insert.
  10. Wire Rope: High tensile steel wire rope, to ASTM A1023, Class A zinc coating; minimum 7 by 7 cross-sectional thread construction; having a tensile strength of 256,000 psi; No.3 wire size minimum.
  11. Adjustable Fastener: Mild steel (type UG2), bright zinc plated, one-channel body; encasing a series of Type 302 stainless-steel springs with serrated self-locking grade 40 chrome steel balls, adjustable by means of an integrated mechanism, capable of accommodating load of 500 lb. Model: Gripple No. 2, 3 or 4 UniGrip.

## 2.2 HORIZONTAL PIPING HANGERS AND SUPPORTS

- A. Manufacturers:
1. Armacell.
  2. ASC Engineered Solutions.
  3. Cooper B-Line, Inc.

4. Elite Components.
  5. ERICO/Michigan Hanger Co./Caddy
  6. Ferguson/FNW.
  7. Halfen-DEHA.
  8. Hilti.
  9. National Pipe Hanger Corporation.
  10. PHD Manufacturing.
  11. Piping Technology and Products, Inc.
  12. Power-Strut.
  13. Unistrut.
- B. Single Hangers:
1. Band Hanger: Carbon steel, adjustable band, adjustable swivel.
  2. Split Ring: Carbon steel, adjustable swivel, split ring type.
  3. Clevis Hanger: Carbon steel, adjustable, clevis type.
  4. Roll Support Hanger: Adjustable steel yoke, cast iron roll.
- C. Trapeze and Strut-mounted Supports:
1. Two-piece clamp: Designed for use with channel strut, held in place at channel shoulder when clamp attachment nut is tightened.
  2. Roll Support: Adjustable cast iron roll attached to metal channel strut framing system with brackets and nuts.
- D. Hangers and strut-mounted supports with pre-manufactured polymer inserts:
1. Manufacturers:
    - a. ASC Engineered Solutions.
    - b. Holdrite.
    - c. Klo-Shure.
  2. Strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts designed to receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation. Metal shields are not required with clevis hangers of this type.
- E. Spring Hangers:
1. Reference Section "Vibration Isolation for HVAC" for spring isolation hangers.
- F. Wall Supports:
1. Two-hole strap, galvanized steel or copper to suit pipe material. Provide rigid insulation between strap and pipe to maintain continuous insulation and vapor barrier where required.
  2. Welded steel bracket reinforced with angle or strut. Support pipe from bracket using horizontal pipe hanger or support appropriate for the pipe type.
- G. Floor Supports:
1. Pipe Saddle: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  2. Roller Support: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- H. Pre-Insulated Supports:
1. Manufacturers:
    - a. Aeroflex USA, Inc.
    - b. Armacell.
    - c. ASC Engineered Solutions
    - d. Buckaroos, Inc.
    - e. Cooper B-Line, Inc.
    - f. Pipe Shields, Inc.
  2. General Construction and Requirements:

- a. Flexible elastomeric insulation with integral high-density pipe support insert shall conform to ASTM C534, Type I.
  - b. Surface Burning Characteristics: Assembly shall have a flame spread index/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
  - c. Waterproof calcium silicate insulation shall conform to ASTM C795.
  - d. Rigid phenolic foam insulation shall conform to ASTM C1126, Type III.
  - e. Insulation inserts shall be surrounded by a 360 degree jacket or shield.
3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

### 2.3 SADDLES AND SHIELDS

- A. Pipe Covering Protection Saddles:
1. Manufacturers: Same as hanger and Supports.
  2. Meet MSS SP-58 Type 39A or B, 100-psi average compressive strength, with center rib for pipes 12 inches and larger. Saddles shall cover approximately one sixth of the circumference of the pipe and shall be 12 inches long.
- B. Insulation Protection Shield:
1. Sheet metal construction, meeting MSS SP-58 Type 40, of 18 gauge for 5-1/2 inches inside dimension and smaller, 16 gauge for 6-1/2 inches to 10-3/4 inches inside dimension, 14 gauge for 11-3/4 inches to 17 inches inside dimension, and 12 gauge for 18 inches to 28 inches inside dimension.
  2. Shield shall cover half of the circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.
  3. Lengths for pipes greater than 2 inches: Minimum 8 inch long section at each support.
  4. For pipes 2 inch and smaller without pre-insulated supports, provide insulation protection shields installed between hanger and pipe which meets the following minimum length requirements:

Pipe Size (NPS)	Insulation Thickness (inches)	Minimum Shield Length, (in)					
		5	6	7	8	9	10
		Hanger Spacing, (ft)					
≤ 1	0.5	5	6	8	-	-	-
	1	3	5	5	-	-	-
	1.5	3	5	5	-	-	-
	2	3	3	3	-	-	-
	3	3	3	3	-	-	-
≤ 2	0.5	8	8	11	11	12	14
	1	5	6	8	9	11	11
	1.5	5	6	8	8	9	9
	2	5	5	6	6	8	8
	3	5	5	6	6	6	8

- C. 360 Degree Insulation Protection Shield:
1. Shield shall cover all of the circumference of the pipe with two half circumference sections held together with bolts and nuts and shall be of length indicated by manufacturer for pipe size and thickness of insulation.
- D. Plastic Saddles and Shields:
1. Manufacturers:
    - a. Armacell.
    - b. Eaton.
    - c. Hydra-Zorb.
    - d. PHD Manufacturing.
    - e. Zsi Foster.

2. Polymer-based, snap-on or clip-on design, with non-adhesive surface and lip to allow lateral movement of piping without damaging insulation, field-paintable.

## 2.4 VERTICAL-PIPING SUPPORTS

- A. Manufacturers:
  1. ASC Engineered Solutions.
  2. Cooper B-Line, Inc.
  3. Halfen-DEHA.
  4. Hilti.
  5. ERICO/Michigan Hanger Co.
  6. National Pipe Hanger Corporation.
  7. PHD Manufacturing.
  8. Piping Technology and Products, Inc.
  9. Power-Strut.
  10. Unistrut.
- B. Components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.
  1. Components shall have galvanized coatings where installed for piping and equipment that will not have factory applied or field-applied finish.
  2. Pipe attachments shall be copper-plated or have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
  3. Components as listed below shall be made of 304 stainless steel where installed in corrosive environments and/or where indicated on the drawings.
- C. Riser Clamps with pre-manufactured polymer insert:
  1. Manufacturers:
    - a. Hydra-Zorb; Titan Riser Clamp.
    - b. National Pipe Hanger.
    - c. Pipe Hangers, Inc.
  2. Riser clamp with pre-manufactured polymer inserts designed to withstand vertical loading and receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation.

## 2.5 PIPE ALIGNMENT GUIDES

- A. Factory fabricated, constructed of cast semi-steel or heavy fabricated steel when applied to steel pipe and copper when applied to copper. Guide shall consist of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.
  1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
  2. Pipe Diameter 10 inches and Larger: Roller type.
  3. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.

## 2.6 PIPE ANCHORS

- A. Pre-Insulated Anchors: Galvanized steel or stainless steel assembly with high density insulation insert and no metal-to-metal contact.
- B. Anchor Clamps: Assembly with multi-piece clamp, constructed of compatible material with piping or with dielectric barrier.

**2.7 PRE-ENGINEERED ROOF EQUIPMENT SUPPORTS**

- A. Reference Section "Vibration Isolation for HVAC" for vibration isolated pre-engineered roof equipment supports.
- B. Manufacturers: Subject to compliance with requirements, provide roof equipment supports from the equipment manufacturer or from one of the following:
  - 1. AES Industries.
  - 2. Caldyn, California Dynamics Corp.
  - 3. Custom Curb, Inc.
  - 4. Kinetics Noise Control.
  - 5. Mason Industries, Inc.
  - 6. Pate Company.
  - 7. Thybar.
  - 8. Vibration Eliminator Co., Inc.
  - 9. Vibration Mounting and Controls (VMC Group).
  - 10. Vibro-Acoustics.
- C. Single Rail Equipment Supports:
  - 1. Construction:
    - a. Base plate with fully mitered raised cant and step to match roof insulation thickness.
    - b. Welded, minimum 18 gauge galvanized steel shell, internally reinforced to load bearing factors of equipment being supported.
    - c. Factory installed treated wood nailer.
    - d. 4 inch, minimum 18 gauge nailer jacket with counterflashing where equipment will not fully cover the equipment support.
- D. Roof Curbs:
  - 1. Construction:
    - a. Comply with NRCA standards.
    - b. Base plate with fully mitered raised cant and step to match roof insulation thickness.
    - c. Welded, minimum 18 gauge galvanized steel shell, internally reinforced to load bearing factors of equipment being supported.
    - d. Minimum 1-1/2 inch thick, 3 pound density rigid insulation internal to shell to maintain continuous roof insulation.
    - e. Factory installed treated wood nailer and drain nipple.
    - f. Sloped to match roof structure to enable level installation.

**2.8 ANCHORS AND FASTENERS**

- A. Manufacturers:
  - 1. Hilti, Inc.
  - 2. Illinois Tool Works, Inc.
  - 3. Phillips.
  - 4. Powers Fasteners, Inc.
  - 5. Rawl.
  - 6. Simpson Strong-Tie Company Inc.
- B. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
  - 1. Concrete: Use preset concrete inserts or expansion anchors.
  - 2. Solid or Grout-Filled Masonry: Use expansion anchors.
  - 3. Hollow Masonry: Use toggle bolts.
  - 4. Hollow Stud Walls: Use toggle bolts.
  - 5. Steel: Use beam clamps.
  - 6. Sheet Metal: Use sheet metal screws.



7. Wood: Use wood screws.
  8. Plastic and lead anchors are not permitted.
  9. Hammer-driven anchors and fasteners are permitted only as follows:
    - a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction.
    - b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction.
- C. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
1. Comply with MFMA-4.
  2. Channel Material: Use galvanized steel.
  3. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch minimum base metal thickness.
  4. Spot Inserts: Carbon steel with zinc plating or galvanized steel body and base plate, with protective sleeve for anchor rod insert, sized to accommodate anchor rod dimensions.
  5. Manufacturers:
    - a. Same as manufacturer of metal channel (strut) framing system.
    - b. DeWalt "Bang-It" concrete inserts.
- D. Post-Installed Concrete and Masonry Expansion Anchors:
1. Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
  2. Self-drilling, drilled flush or shell type. Size inserts to suit threaded rods.
- E. Beam Clamps: MSS SP-58 C-Type or adjustable, Types 19 through 23, 25 or 27 through 30 based on required load.
1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
  1. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- F. Vibration Isolation Anchors: Reference Section "Vibration Isolation for HVAC" for vibration isolation anchors.

## 2.9 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Malleable Iron: ASTM A47
- C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 INSTALLATION GENERAL

- A. Install products in accordance with manufacturer's instructions.
- B. Provide hangers and supports according to the Pipe Hanger and Support Schedule below.

- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- H. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- I. Provide vibration isolators at hangers and supports where specified in Section "Vibration Isolation for HVAC".

### 3.3 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58 unless indicated otherwise.
- B. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
- C. Space attachments within maximum piping span length specified in Division 23 piping sections.
- D. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- E. Install hangers, supports, clamps and attachments to support piping properly from building structure.
- F. Do not attach to ceilings, equipment, ductwork, conduit and other non-structural elements such as floor and roof decking.
- G. Hanger and clamps sizing:
  - 1. Cold Piping: Provide pipe hangers sized for the pipe outside diameter plus insulation thickness.
  - 2. Hot Piping: Provide pipe hangers sized for the pipe outside diameter plus insulation thickness.
  - 3. Vertical Piping: Provide clamps sized for the pipe outside diameter and extend clamp through insulation.
  - 4. Refer to Section "HVAC Insulation" for definition of hot and cold piping and required insulation thickness.
- H. Where several pipes can be installed in parallel and at the same elevation, Contractor has option to provide metal channel strut framing. Install supports with maximum spacing specified within Division 23 piping sections.
  - 1. Space strut framing at the required distance for the smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
  - 2. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
    - a. Uninsulated Copper Pipe: Install with plastic galvanic isolators
    - b. Insulated Tube or Pipe: Install with 360° insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Section "HVAC Insulation".
- I. Install building attachments within concrete or to structural steel.
  - 1. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping as specified in Division 23 piping sections.

2. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.
- J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Provide two nuts on threaded supports to securely fasten the support.
- K. Install appropriate types of hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
- L. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.
- N. Insulated Piping: Comply with the following installation requirements.
1. Riser Clamps: Attach riser clamp to piping with riser clamps projecting through insulation. Do not use riser clamps to support horizontal, insulated piping. Seal insulation for hot piping and protect vapor barrier for cold piping as specified in Division 23 Section "HVAC Insulation".
    - a. Contractor's Option: Provide riser clamps with pre-manufactured polymer insert.
  2. Pipe Covering Protection Saddles: Install pipe covering protection saddles where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
    - a. If insulation protection shields are used instead of protection saddles on hot piping where vapor barrier is not required, provide high density insulation insert sized for the insulation thickness used as specified in Division 23 Section "HVAC Insulation".
  3. Insulation Protection Shield: Install insulation protection shield with high density insulation insert, sized for the insulation thickness used as specified in Division 23 Section "HVAC Insulation". Do not use polymer-based shields for hot piping.
    - a. Exception for 2 inch and smaller horizontal piping with cellular glass, flexible elastomeric, or polyisocyanurate insulation: High density insulation insert is not required. Provide insulation protection shield over the insulation with length specified for pipe size and insulation thickness to prevent puncture or other damage.
  4. Contractor's Option: Provide pre-engineered thermal hanger inserts for piping insulated with flexible elastomeric insulation at pipe supports for piping 2-1/2 inches and larger.
  5. Contractor's Option: Provide strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts.
- O. Strut Framing Systems: Channel strut systems can be used at the Contractors option in lieu of individual hangers for horizontal pipes. Arrange for grouping of parallel runs of horizontal piping. Space channel strut systems at the required distance for the smallest pipe supported. Provide channel gauge and hanger rods per the manufacturer's recommendations for the piping supported. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
1. Uninsulated Copper Pipe: Install with plastic galvanic isolators
  2. Insulated Tube or Pipe: Install with 360 degree insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 23 Section "HVAC Insulation".
- P. Vertical Piping Risers:
1. Reference Section "Vibration Isolation for HVAC" for piping riser supports.
- Q. Wire Rope Hanging Systems:
1. Install in accordance with manufacturer's instructions.
  2. Supported load shall not exceed manufacturer's recommended load rating.
  3. Applications for Pipe Supports:
    - a. 3 inch and smaller.

- b. Wire rope hanging system is not allowed for steam or steam condensate piping.
4. Do not support pipe by wrapping the rope around the pipe.
5. Provide appropriate hanger or support compatible with the wire rope hanging system adjustable fastener as specified in the Pipe Hanger and Support Schedule.
6. Install cast-in-place concrete inserts in elevated concrete slabs.
7. Install bream clamps for attachment to structural beams as required.

### 3.4 INSTALLATION OF PIPE ALIGNMENT GUIDES

- A. Install pipe alignment guides on piping that adjoins expansion joints, as required by expansion joint manufacturer, and elsewhere as indicated on plans and specification sections to eliminate binding and torsional stress on piping systems. Install guides per ASME B31.9 unless noted otherwise. Install pipe insulation at guide to not interfere with movement of pipe within the guide.
- B. Install guide to accommodate 1/2 the thermal movement at the adjacent expansion joint.
- C. Anchor to building substrate.

### 3.5 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS Standards D1.1.
- C. Spacing: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

### 3.6 INSTALLATION OF ROOF EQUIPMENT SUPPORTS

- A. Attach roof equipment support to the roof structure according to the manufacturer's installation instructions.
- B. Provide multiple single rail equipment supports to uniformly support the equipment.
- C. Provide rigid backing material (e.g., insulation, wood, etc.) to maintain cant slope.
- D. Install supports to maintain continuous insulation on roof.
- E. Provide vibration isolators between roof equipment support and equipment according to Division 23 Section "Vibration Isolation for HVAC."
- F. If vibration isolation is not required or units are internally isolated, attach equipment directly to pre-engineered roof equipment support using one of the following:
  1. Single Rail Equipment Supports: Secure each equipment support leg to the rail with a minimum of 4 points of connection per leg.
  2. Roof Curbs:
    - a. Secure each corner of the equipment to the curb nailer using a minimum of 4 lag screws, located along the length of the equipment.
    - b. Secure equipment to the curb using hold-down brackets. Provide minimum 6 inch long, 14 gauge galvanized steel brackets sized to wrap around top of curb and under equipment base rail with sufficient horizontal offset to cover overlap gap between the equipment rail and curb. Secure bracket to equipment and curb nailer using a minimum of 8 points of connection per bracket. Provide one bracket at each corner along the length of the unit.
  3. Hold-Down Brackets: Coordinate with the pre-engineered roof equipment support manufacturer to determine the quantity and size of hold-down brackets and fasteners, with installation instructions, for each equipment to meet the following criteria:

- a. Building Design Risk Category: III.
- b. Design Wind Speed: 169 mph.
- c. Submit design and installation requirements as a Deferred Submittal.

### 3.7 EQUIPMENT SUPPORT AND ATTACHMENT

- A. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
- B. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls.
- C. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
- D. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- E. Preset Concrete Inserts and Expansion Anchors: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
  1. Where concrete slabs form finished ceiling, locate anchors flush with slab surface.
- F. Secure fasteners according to manufacturer's recommended torque settings.
- G. Remove temporary supports.
- H. Fabricate structural steel supports to suspend equipment from structure above or support equipment from floor.
- I. Grouting: Place grout under supports for piping and equipment.

### 3.8 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours welded surfaces to match adjacent contours.

### 3.9 FIELD QUALITY CONTROL

- A. Examine support and attachment components for damage and defects.
- B. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop

painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces. Comply with Division 09 Section "Painting."

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- E. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.
- F. Correct deficiencies and replace damaged or defective support and attachment components.

### 3.10 PIPE HANGER AND SUPPORT SCHEDULE

- A. Additional hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Provide the following acceptable hangers and supports for each type of piping system. Hangers and supports may be single type or strut-mounted:
- C. Single Hangers:
1. All pipe sizes 1-1/2 inch and less:
    - a. Band hanger.
    - b. Swivel split ring.
    - c. Clevis hanger.
  2. Cold and Hot pipe sizes 2 inches and greater where pipes are in stationary position: Clevis hanger.
  3. Cold and Hot pipe sizes 2 inches and greater for pipes in the following locations: Roll support hanger.
    - a. Axial movement due to thermal expansion or contraction generates swing angles in excess of 4 degrees.
    - b. Between anchor locations shown on the drawings.
- D. Trapezes and Strut-mounted Supports:
1. Pipes in stationary position: Two-piece clamp, strut clamp or U-bolts.
  2. Cold and Hot pipe sizes 2 inches and greater in the following locations: Roll support.
    - a. Axial movement due to thermal expansion or contraction generates swing angles in excess of 4 degrees.
    - b. Between anchor locations shown on the drawings.
- E. Wall Supports:
1. Pipe sizes 3 inches and less:
    - a. Two-hole strap mounted to wall.
    - b. Welded steel bracket with reinforced angle or strut.
  2. Pipe sizes 4 inch and greater:
    - a. U-bolt.
    - b. Welded steel bracket with reinforced angle or strut.
- F. Floor Supports:
1. Pipes in stationary position: Pipe saddle.
  2. Cold and Hot pipe sizes 2 inches and greater in the following locations: Roll support.
    - a. Axial movement due to thermal expansion or contraction is greater than one inch.
    - b. Between anchor locations shown on the drawings.

END OF SECTION

**SECTION 23 05 50 - VIBRATION ISOLATION FOR HVAC****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Vibration isolation requirements.
- B. Vibration-isolated equipment support bases.
- C. Vibration isolators.

**1.2 COORDINATION**

- A. Contractor's Responsibility:
  - 1. Verify the completeness of the isolation installation and the overall suitability of the equipment to meet the intent of this specification. Any additional equipment needed to meet the intent of this specification, even if not specifically mentioned herein or in the Contract Documents, shall be supplied by the Contractor without claim for additional payment.
  - 2. Performance or waiving of inspection, testing or surveillance for any portion of the Work shall not relieve the Contractor of the responsibility to conform strictly with the Contract Documents. The Contractor shall not construe performance or waiving of inspection, testing or surveillance by the Owner or Architects to relieve the Contractor from total responsibility to perform in strict accordance with the Contract Documents.
  - 3. Coordinate selection and arrangement of vibration isolation components with the actual equipment to be installed.
  - 4. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 5. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 6. Sequencing:
    - a. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.
- B. Manufacturer's Responsibility:
  - 1. Determine vibration isolation types for all equipment and systems in accordance with the local governing code.
  - 2. Calculate the static deflection requirements for all equipment and systems to provide uniform deflection based on distributed operating weight of actual installed equipment.
  - 3. Select the vibration isolation systems to provide static deflection indicated on the Vibration Isolation Schedule and as specified below. Determine the mounting sizes and layout.
  - 4. Guarantee specified isolation system deflection.
  - 5. Select and size vibration isolators to not exceed the recommended loading of the isolators.
  - 6. Provide installation instructions, drawings and field supervision to ensure proper installation and performance.
  - 7. Verify that all equipment to be isolated has sufficient support structure to distribute equipment loads onto isolators.

**1.3 SUBMITTALS**

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.

1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification method for spring element load capacities. Include clearly outlined procedures for installing and adjusting the isolators.
- B. Shop Drawings:
  1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators on each piece of isolated equipment. Indicate equipment weights and static deflections.
  2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable. Indicate equipment mounting provisions.
  3. Piping isolators shown and identified on piping layout drawings.
  4. Concrete foundations, supports, and required reinforcing and forms. These appurtenances shall be provided by another trade. This trade shall furnish the shop drawings, including the following:
    - a. Concrete reinforcing steel details and templates for all foundations and supports.
    - b. Required hanger bolts.
    - c. All other appurtenances necessary for proper installation of equipment.
- C. Vibration Isolation System Schedule: Include the following for each isolation element:
  1. Manufacturer, isolator type, model number, size.
  2. Height when uncompressed and static deflection.
  3. Spring constant.
  4. Spring outside diameter, free operating, and solid heights.
  5. Design of supplementary bases.
  6. Details of attachment to load-bearing structure or supplementary framing.
- D. Post-Installation Inspection Report:
  1. Vibration isolation vendor notice of inspection of all vibration isolators.
  2. Vibration isolation vendor notice of approval that all vibration isolators have been properly installed and conform to the specification.
  3. Itemized list of deficiencies.
  4. Vibration Isolation System Schedule.
  5. For each isolator containing steel springs, record the following:
    - a. Size.
    - b. Uncompressed height.
    - c. Design static deflection.
    - d. Measured static deflection.

#### **1.4 QUALITY ASSURANCE**

- A. All vibration isolation equipment shall be furnished by one manufacturer unless specifically approved otherwise in writing by the Engineer.
- B. All vibration isolation equipment and materials shall be new and manufactured specifically for the purpose intended.
- C. Maintain at the project site a copy of each reference document that prescribes execution requirements.
- D. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

#### **1.5 DELIVERY STORAGE AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.



**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. BRD Noise and Vibration Control.
- B. Caldyn, California Dynamics Corp.
- C. Kinetics Noise Control.
- D. Mason Industries, Inc.
- E. Thybar Corporation.
- F. Vibration Eliminator Co., Inc.
- G. Vibration Mounting and Controls.
- H. Vibro-Acoustics.

**2.2 VIBRATION ISOLATION REQUIREMENTS**

- A. Construct vibration isolators out of resilient materials resistant to oil, ozone, and oxidant.
- B. Select vibration isolators to provide the static deflection as specified in Part 2 "Products" unless otherwise specified for the application listed in Part 3 "Execution."
- C. Where a pipe run connects multiple equipment, select the pipe isolators for the entire run to suit the connected equipment of greatest static deflection.
- D. Vibration isolators shall have either known undeflected heights or calibration markings so that the amount of deflection can be verified after adjustment to determine that the load is within the proper range of the device and that the correct degree of vibration isolation is provided according to the design.
- E. Vibration isolators, base frames, and inertia bases shall provide uniform deflection and stability under all operating loads.
- F. Isolators for fans shall be sized so that thrust restraints (which would act against turning moment caused by static pressure) are not required.
- G. Lateral restraining isolators shall have the same static deflection as the vertical isolators for the equipment being isolated.
- H. The theoretical vertical natural frequency for each support point based upon load per isolator and isolator stiffness shall not differ from the design objectives for the equipment as a whole by more than plus/minus 10 percent.
- I. All elastomeric mountings shall have a Shore hardness of 30 to 60 plus/minus 5 after minimum aging of 20 days or corresponding over-aging, or as specified herein.
- J. Elastomeric isolators that will be exposed to temperatures below 32 degrees F shall be fabricated of natural rubber instead of neoprene.
- K. Equipment mounted on vibration isolated bases shall have minimum operating clearance of 1 inch between the base and floor or support beneath unless noted otherwise.
- L. Vibration Isolator Assemblies with Steel Springs:
  - 1. Housed or caged spring isolators are not acceptable.
  - 2. Assemblies shall use bare springs, color coded or otherwise identify springs to indicate load capacity.
  - 3. Spring diameter shall not be less than 0.8 of the loaded operating height of the spring.
  - 4. The ratio of the horizontal to vertical spring constant shall be between 1 and 2.

5. Springs shall be sized to be non-resonant with equipment forcing frequencies or support structure natural frequencies.
  6. Assembly shall be designed and installed so that the ends of the spring remain parallel during and after the spring installation.
  7. Springs shall operate in the linear portion of their load versus deflection curve over a deflection range of not less than 50 percent above the design deflection.
- M. Vibration isolators exposed to weather and other corrosive environments shall be protected with factory corrosion resistance.
1. Exterior applications:
    - a. Springs: Cadmium-plated and neoprene coated.
    - b. Nuts and bolts: Cadmium plated.
    - c. Other metal mounting parts: Hot-dip galvanized.
  2. Interior applications: Painted.

### 2.3 VIBRATION ISOLATED EQUIPMENT SUPPORT BASES

- A. Pre-Engineered Roof Equipment Support (Type RES):
1. Reference Section "Hangers and Supports for HVAC Piping and Equipment" for specification of non-vibration isolated, pre-engineered roof equipment supports.
- B. Structural Rails (Type SR):
1. Assembly: Structural steel channels furnished with double-deflection neoprene mountings or spring isolators.
  2. Base: All metal mounting parts shall be covered with neoprene to avoid corrosion and metal-to-metal contact.
  3. Selection: Channel length and isolator type with deflection as required for proper isolation of equipment.
  4. Type SR: Mason Industries Type RND or approved equal.
- C. Vibration Isolation Roof Curb (Type CMB):
1. Description: Engineered, structural steel frame mounted directly to the structure with an upper floating section on adjustable steel springs. The upper frame shall provide continuous support for the equipment.
  2. Steel springs shall rest on minimum 1/4 inch thick elastomeric pads and have a minimum static deflection as specified in Part 3.
  3. All-directional elastomeric snubber bushings shall be minimum 1/4 inch thick.
  4. Weatherproofing: Continuous galvanized flexible counterflashing nailed over the lower curb's waterproofing and joined at the corners by elastomeric bellows.
  5. Access Ports: Provided for all spring locations with removable waterproof covers to allow for adjustment or replacement of springs.
  6. Lower curbs shall have provision for 2 inches insulation.
  7. Type CMB: Mason Industries Type RSC or approved equal.

### 2.4 VIBRATION ISOLATORS

- A. Ribbed Neoprene "Waffle" Pads (Type WP):
1. Assembly: Single ribbed or crossed double ribbed elastomer in-shear pads, in one or more layers separated and bonded to a minimum 1/4 inch thick galvanized steel shim plate as required to provide selected deflection.
  2. Thickness: Each layer 5/16 inch thick.
  3. Selection: Maximum durometer of 50 and designed for 15 percent strain, static deflection of 0.05 inches.
  4. Type WP: Mason Industries Type W, Type WSW, or approved equal.
- B. Neoprene and Cotton Duck Pads (Type DP):
1. Assembly: Neoprene and cotton duck construction, 12 Plys per 1/2 inch thickness.

2. Selection: Thickness or multiple pads in series as required to limit maximum loading to 500 psi and static deflection of 0.1 inches.
  3. Type DP: Mason Industries Type HL, or approved equal.
- C. Double Deflecting Neoprene Mounts (Type DDNM):
1. Assembly: Laterally stable, double deflecting, neoprene encapsulated mount with bolt holes for attachment to supporting structure.
  2. Selection: Maximum durometer of 50 and designed for 15 percent strain, static deflection of 0.4 inches unless specified otherwise.
  3. Type DDNM: Mason Industries Type ND or approved equal.
- D. Restrained Neoprene Mounts (Type RNM)
1. Assembly: Restrained neoprene mounting element encapsulated in a metal housing to prevent bulging of the neoprene element with bolt holes for attachment to supporting structure. Assembly shall be designed to provide isolation in tension, shear or compression.
  2. Selection: Maximum durometer of 50 and designed for 15 percent strain, static deflection of 0.25 inches.
  3. Type RNM: Mason Industries Type RBA or approved equal.
- E. Steel Spring Neoprene Mounts (Type SPNM):
1. Assembly: Single or multiple free-standing and laterally stable steel springs without a housing.
    - a. Light capacity base: Molded elastomeric neoprene load plate.
    - b. Heavy capacity base: Springs welded to the load plate assembly furnished with integral elastomeric pad.
    - c. Leveling Device: Rigidly connected to equipment or frame.
  2. Selection:
    - a. Minimum static deflection for equipment mounted on grade slabs shall be 1 inch unless specified otherwise.
    - b. Minimum static deflection for equipment mounted above grade (suspended) slabs shall be 2 inches unless specified otherwise.
  3. Type SPNM: Mason Industries Type SLFH or approved equal.
- F. Constrained Steel Spring Neoprene Mounts (Type CSNM):
1. Assembly: Single or multiple free-standing and laterally stable steel springs assembled into a factory-fabricated housing with integral leveling device and stops to limit vertical movement of the isolated equipment during a temporary weight reduction. Include rigid blocking to support equipment during rigging to maintain identical installed and operating heights of the isolator. Housing shall maintain a minimum clearance of 1 inch around restraining bolts and the spring so as not to interfere with the spring operation.
    - a. Leveling Device: Rigidly connected to equipment or frame. Limit stops shall provide minimum 1/4 inch clearance between housing and isolator base plate under normal operation.
    - b. Equipment Wind Loading Applications: Provide tapped hole in top and bottom plates for bolting to equipment and the roof or supporting structure with a neoprene mounting sleeve.
  2. Base: Minimum 1/4 inch thick neoprene pad under housing.
  3. Selection: Minimum static deflection of 2 inches unless specified otherwise.
  4. Type CSNM: Mason Industries Type SLR or approved equal.
- G. Neoprene Bushing (Type NR):
1. Assembly: Neoprene restraint, rubber-in-shear bushings for lightweight, suspended equipment supported from structure with all-thread rod and angle iron or Unistrut.
  2. Selection: Maximum durometer of 50 and designed for 15 percent strain, static deflection of 0.15 inches.
  3. Type NR: Mason Industries Type HMIB or approved equal.
- H. Double Deflection Neoprene Hangers ((Type DDNH)

1. Assembly: Steel hanger box containing a laterally stable, double deflecting, neoprene isolator. Neoprene isolator shall prevent contact between the lower hanger rod and hanger box and short-circuiting the isolating function.
    - a. Housing: Bottom opening sized to allow hanger rod to swing through a 30 degree arc.
  2. Selection: Maximum durometer of 50 and designed for 15 percent strain, static deflection of 0.4 inches.
  3. Type DDNH: Mason Industries Type HD or approved equal.
- I. Spring and Neoprene Hanger (Type SPNH)
1. Assembly: Steel hanger box containing a laterally stable, double deflecting, neoprene isolator in series with a steel spring.
    - a. Housing: Include a neoprene bushing to prevent contact between the lower hanger rod and hanger box and short-circuiting the isolating function. Bottom opening sized to allow hanger rod to swing through a 30 degree arc.
  2. Selection:
    - a. Neoprene isolator: Maximum durometer of 50 and designed for 15 percent strain, static deflection of 0.4 inches unless specified otherwise.
    - b. Spring isolator: Minimum static deflection of 2 inches unless specified otherwise.
  3. Type SPNH: Mason Industries Type 30N or approved equal.
- J. Neoprene Mounting Sleeves, Grommets, and Bushings: Designed to prevent steel-to-steel contact within vibration isolators.
- K. Flexible Connectors:
1. Pipe: Refer to Section "Hydronic Piping Specialties."
  2. Duct: Refer to Section "Air Duct Accessories."
- L. Pipe Riser Anchor (Type PRA)
1. Assembly: Telescoping arrangement of two sizes of steel tubing separated by minimum 1/2 inch thick, 60 durometer neoprene. Anchor shall include tapped hole on the top plate for bolt attachment to riser clamp. Anchor shall allow for all-directional movement.
  2. Selection: Static deflection of 0.1 inches, maximum allowable load on the isolation material shall not exceed 500 psi.
  3. Type PRA: Mason Industries Type ADAH or approved equal.
- M. Pipe Riser Guide (Type PRG):
1. Assembly: Telescoping arrangement of two sizes of steel tubing separated by minimum 1/2 inch thick, 60 durometer neoprene with set screw to prevent lateral movement. Guide shall include tapped hole on the top plate for bolt attachment to riser clamp.
  2. Type PRG: Mason Industries Type VSGH or approved equal.
- N. Riser Suspension Anchor (Type PRSA):
1. Assembly: Steel hanger box containing laterally stable steel spring with integral deflection scale, adjustment plate, and nut. Housing shall include tapped hole at the top for hanger rod attachment.
  2. Selection: Minimum static deflection of 4 inches.
  3. Type PRSA: Mason Industries Type HES or approved equal.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that mounting surfaces are ready to receive vibration isolation and associated attachments.

#### **3.2 INSTALLATION - GENERAL**

- A. Install in accordance with manufacturer's instructions.

- B. External spring isolators are not required if unit is provided with internal spring isolation. If external spring isolators are provided, internal spring isolation shall not be approved.
- C. Mount or suspend all equipment, piping, ductwork, etc. from approved foundations and supports as specified herein or as shown on the drawings.
- D. Secure fasteners according to manufacturer's recommended torque settings.
- E. Support piping, ductwork, conduit, and mechanical equipment from the building structure. Do not support from other equipment, piping, or ductwork.
- F. Install isolators to prevent short-circuiting of the isolation.
- G. All wiring connections to mechanical equipment on isolators shall have a minimum 18 inch long flexible conduit in a "U" shaped loop. Coordinate with Division 26.
- H. Flexible Connectors: Install flexible connectors sized to match equipment connections and to provide sufficient slack for vibration isolation as required.
- I. Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping. Block-up equipment with temporary shims to final operating height. When the system is assembled full load is applied, adjust the isolators shall be adjusted to allow shim removal.
- J. Refer to Division 23 Section "Common Work Results for HVAC" for noise critical spaces.

### **3.3 INSTALLATION OF VIBRATION ISOLATED EQUIPMENT SUPPORT BASES**

- A. All floor-mounted equipment shall be erected on housekeeping pads. Refer to Section "Common Work Results for HVAC" for concrete housekeeping pad requirements.
- B. Maintain minimum 4 inches clearance between isolated equipment and the walls, ceiling, floors, columns, and any other equipment not installed on vibration isolators.
- C. Set steel bases for one inch clearance between housekeeping pad and base.
- D. Set concrete inertia bases for 2 inches clearance between housekeeping pad and base.
- E. Adjust equipment to be level.
- F. Verify no material is left to short-circuit the isolator.
- G. For equipment support bases installed on the roof, coordinate with the pre-engineered roof equipment support manufacturer to determine the quantity and size of hold-down brackets, isolators, and fasteners, with installation instructions, for each equipment to meet the following criteria:
  - 1. Building Design Risk Category: III.
  - 2. Design Wind Speed: 169 mph.
- H. Type CMB:
  - 1. Attach roof equipment support to the roof structure according to the manufacturer's installation instructions.
  - 2. Provide flexible duct connector using a foam rubber gasket to seal against the unit bottom.
  - 3. Provide rigid backing material (e.g., insulation, wood, etc.) to maintain cant slope on roof equipment support bases.
  - 4. Install roof equipment support bases to maintain continuous insulation on roof.

### **3.4 INSTALLATION OF VIBRATION ISOLATORS**

- A. Neoprene Mounting Sleeves, Grommets, and Bushings: Install on vibration isolators to prevent any metal to metal contact.
- B. Spring Isolators:

1. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
  2. Install springs so that the ends of springs remain parallel and all springs are installed with adjustment bolts.
  3. Locate isolation hangers at the top of hanger rods.
  4. Type SPNM: Unless otherwise specified, isolators need not be bolted to the floor for indoor installations.
  5. Type SPNH and DDNH: Install the hanger box to allow it to rotate a full 360 degrees without encountering any obstruction.
- C. Isolating Pipe Anchors:
1. Weld anchor base to support steel or bolt base plate to structure. Weld or bolt pipe clamp or bracket to anchor.

### 3.5 EQUIPMENT ISOLATION

- A. Air Handling Units:
1. Units that are furnished with internal structural frames and external lugs (both of suitable strength and rigidity), or without any severe overhangs, do not require an additional structural frame installed beneath the unit.
  2. Support condensate drain pipes from the isolated air handling unit frame.
  3. Slab-on-Grade: Housekeeping pad base, Type SPNM isolation with 1 inch static deflection.
  4. Suspended: Type SPNH isolation with 2 inch static deflection.
  5. Roof-mounted:
    - a. Provide steel dunnage base for units without internal isolation, Type CSNM isolation with 2 inch static deflection.
    - b. Provide steel dunnage base for units with internal isolation, Type DDNM isolation.
- B. VAV Terminal Units:
1. Fan-Powered: Flexible duct connectors with Type SPNH isolation with 1 inch static deflection.
  2. All other Types: Flexible duct connectors.
- C. Centrifugal or Scroll Chillers:
1. Slab-on-Grade: Housekeeping pad base, Type WP isolation continuous along support.
- D. Cooling Towers:
1. Slab-on-Grade: Structural steel rails, Type WP isolation continuous along support.
- E. Boilers:
1. All Applications: Housekeeping pad base, Type WP isolation continuous along support.
- F. Inline Pumps:
1. Pump supported in-line with piping: Provide vibration isolators on the piping per the article "Pipe Isolation" below.
  2. Pump supported independent of piping:
    - a. Provide flexible connectors on each side of pump. The vertical load shall be carried by the supports, not by the flexible couplings.
    - b. Floor Mounted, Slab-on-Grade: Provide housekeeping pad with Type WP or Type DP, type as required to support weight of pump and components, isolation continuous along support.
    - c. Floor Mounted, Suspended Slab:
      - 1) 5 hp and smaller: Housekeeping pad with Type WP isolation continuous under support.
      - 2) Greater than 5 hp: Housekeeping pad under Type CIB base, Type SPNM isolation with 0.75 inch static deflection.
    - d. Suspended: Type SPNH isolation with 2 inch static deflection.

- G. Fans
  - 1. Suspended:
    - a. Fans 1 hp and less: Type NR isolation with 0.15 inch static deflection.
    - b. Fans greater than 1 hp: Type SPNH isolation with 2 inch static deflection.
  - 2. Roof-mounted:
    - a. Curb mounting: Type RES curb base, with closed cell sponge gasket for sealing, continuous along support sealed to curb top rail.
    - b. Rail mounting:
      - 1) Fans 10 hp and less: Type RES rail base, Type DDNM with 0.75 inch static deflection.
      - 2) Fans greater than 10 hp: Type RES rail base, Type SPNM with 2 inch static deflection.
- H. Unit Heaters: Type SPNH isolation with 2 inch static deflection.
- I. All other equipment not specifically identified in this specification that contains rotating or vibrating elements and any associated electrical apparatus installed by this division that contains transformers or inductors shall be installed on Type DDNM or RNM neoprene isolators as appropriate.

### 3.6 PIPING ISOLATION

- A. Provide isolation supports on the following HVAC pipe:
  - 1. Piping within 50 feet of the following connected rotating equipment. Provide Type SPNH or SPNM isolators. The first three isolators both upstream and downstream of equipment shall have a static deflection equal to that of the equipment isolators, up to a maximum of 2 inches. The static deflection of the remaining pipe isolators shall be 0.75 inch.
    - a. Chillers.
    - b. Pumps with motors greater than 5 hp.
    - c. Base mounted air handling units with fan motors greater than 5 hp and no internal isolation.
  - 2. Piping within 20 feet of the following suspended equipment: Provide Type SPNH isolators. The first isolator both upstream and downstream of equipment on springs shall have a static deflection equal to that of the equipment isolators, up to a maximum of 2 inches. The static deflection of the remaining pipe isolators shall be 0.75 inch.
    - a. Pipes connected without flexible connectors to suspended equipment that is installed with spring vibration isolators.
    - b. Pipes connected without flexible connectors to suspended in-line pumps.
  - 3. Piping installed below or adjacent to noise sensitive areas:
    - a. Refer to Section "Common Work Results for HVAC" for definition of noise sensitive areas.
    - b. Isolate all piping larger than 2 inch from the structure with spring and rubber type SPNH or SPNM isolators with 0.75 inch deflection.
    - c. Isolate all 2 inch and smaller HVAC piping from the structure with sponge neoprene, felt, or glass/mineral fiber sleeves between the pipe and pipe clamp or with Type WP pads between the clamp and the structure. The sleeve shall be not less than 1/8-inch in thickness when compressed.
- B. Provide flexible connectors for piping system connections on equipment side of shutoff valves for the following:
  - 1. Pumps except suspended in-line pumps supported by the piping.
  - 2. Mechanical equipment supported or suspended by spring isolators.
  - 3. Where indicated on Drawings.
- C. Provide resilient diagonal mountings or other approved devices as required to limit piping motion due to equipment startup or shut down to a maximum of 1/8 inch.

- D. Where supplementary steel is required to support pipes, size the supplementary steel so that maximum deflection between supports does not exceed 0.08 inches. Isolate the supplementary steel from building structure using the same isolator required for the pipe. Rigidly suspend or support the pipe from the supplementary steel.
- E. Provide pre-compressed hanger rod isolators for all pipes greater than 12 inch diameter and all supplementary steel supports used for the large pipe. Factory set the pre-compression at 75 percent of rated deflection.
- F. Where isolated pipe 8 inch and larger is supported from exposed steel beams, use welded channel beam attachments located directly under the web of the beam. For piping 6 inch and smaller, beam clamps may be used in lieu of welding, subject to approval of beam clamp selection.
- G. Vertical Piping Riser Supports:
  - 1. Do not exceed pipe stresses allowed by ASME B31.9.
  - 2. Provide multiple supports along riser so that each isolator support is loaded for 50 psi maximum. Provide tapped hole in top of support for rigid attachment of pipe riser clamp to support.
  - 3. Riser Supports: Pipe clamp on top of Type DP or Type WP.
  - 4. Risers Subject to Thermal Expansion:
    - a. Support vertical pipe risers subjected to thermal expansion and/or contraction with spring isolators, anchors, and guides designed to ensure loading within design limits at support points. Perform design calculations for sizing the riser supports incorporating the initial load, initial deflection, change in deflection, final load and change in load at support locations. Design calculations must include anchor loads when installed, cold filled and at operating temperature and pipe stress at end connections and branch locations. Design system for an initial spring deflection of at least 4 times the thermal movement. Design must be stamped and signed by a licensed professional engineer.
    - b. Spring Isolators: Type SPNH, DDNH, or PRSA.
    - c. Anchors: Type PRA.
    - d. Guides: Type PRG.
    - e. Reference Section "Expansion Fittings and Loops for HVAC Piping" for expansion joints.

### 3.7 DUCT ISOLATION

- A. Connect ducts to equipment, fans, fan casings, and fan plenums with flexible connectors.
- B. Support grease exhaust ducts with Type SPNH and/or SPNM isolators as appropriate. Install neoprene riser guides if lateral restraint is required in shafts.

### 3.8 FIELD QUALITY CONTROL

- A. Arrange for inspection of all isolation and noise control equipment by the vibration isolation vendor and submit post-installation inspection report.
- B. The installation of all vibration isolation systems shall be under the supervision of the manufacturer's representative.
- C. Guarantee: If, in the actual installation, any equipment fails to meet the vibration control requirements specified herein, that equipment shall be corrected or replaced without claim for additional payment, inclusive of all labor and material costs. Such corrective measures shall be done within a time schedule specified by the Owner.

END OF SECTION



**SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Adhesive-backed duct markers.
- D. Stencils.
- E. Pipe markers.
- F. Ceiling tacks.
- G. Engraved plastic-laminate signs.

**1.2 SUBMITTALS**

- A. Custom Signage: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Valve Tag Schedule: Submit 8-1/2 x 11 inch typewritten valve schedule. Furnish one extra copy for each maintenance manual. Include the following information in the schedule:
  - 1. Valve tag number.
  - 2. Piping system and system abbreviation as shown on tag.
  - 3. Location of valve (room or space).
  - 4. Variations for identification (if any).
  - 5. Function. Specially mark valves which are intended for emergency shut-off and similar special uses in margin of schedule.
  - 6. Valve manufacturer's name and model number.
- C. Product Data: Submit manufacturer's technical product data for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures and installation for each product required.

**1.3 SPARE PARTS**

- A. Furnish minimum of 5 percent extra stock of each mechanical identification material required for each system that uses the identification material.
- B. Furnish not less than 3 additional numbered valve tags for each piping system.
- C. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock along with stenciling paints and applicators.

**PART 2 - PRODUCTS AND MATERIALS****2.1 ACCEPTABLE MANUFACTURERS**

- A. Advanced Graphic Engraving, LLC.
- B. Brady Corporation.
- C. Brimar Industries, Inc.

- D. Craftmark.
- E. Industrial Safety Supply Co., Inc.
- F. Kolbi Pipe Marker Co.
- G. MIFAB, Inc.
- H. Seton Identification Products, a Tricor Direct Company..

## 2.2 IDENTIFICATION APPLICATIONS AND REQUIREMENTS

- A. General:
  - 1. Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than a single type is specified for application, selection is the installer's option, but provide single selection for each product category.
  - 2. Lettering: Coordinate names, abbreviations, and other designations used in mechanical identification work with the corresponding designations shown on the drawings, scheduled, and specified. If not otherwise indicated, provide numbering, lettering, and wording as recommended by the manufacturer or as required for proper identification, operation, and maintenance of mechanical systems and equipment.
  - 3. Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (e.g., Boiler No. 3, Air Supply No. 1H, etc.).
- B. Air Handling Units: Nameplates, stencils, or engraved plastic laminate signs.
- C. Air Terminal Units: Tags, stencils, or engraved plastic laminate signs.
- D. Automatic Controls: Tags, use the same naming convention coordinated with the building automation system.
- E. Control Panels: Nameplates.
- F. Dampers: Ceiling tacks where located above lay-in ceiling. Do not use ceiling tacks in a gyp ceiling.
- G. Ductwork: Adhesive-backed duct markers. Stencils are only acceptable for concealed ductwork, exterior ductwork, or in mechanical rooms.
- H. Fans: Nameplates, stencils, or engraved plastic laminate signs.
- I. Heat Transfer Equipment: Nameplates, stencils, or engraved plastic laminate signs.
- J. Humidifiers: Nameplates or engraved plastic laminate signs.
- K. Instrumentation: Tags.
- L. Major Control Components including Variable Frequency Drives: Nameplates or engraved plastic laminate signs.
- M. Piping: Pipe Markers.
- N. Pumps: Nameplates or engraved plastic laminate signs.
- O. Relays: Tags.
- P. Small-sized Equipment: Tags.
- Q. Tanks: Nameplates or engraved plastic laminate signs.
- R. Thermostats: Nameplates.
- S. Valves: Tags. Ceiling tacks are acceptable where located above a lay-in ceiling. Do not use ceiling tacks in a gyp ceiling.

- T. Water Treatment Devices: Nameplates or engraved plastic laminate signs.
- U. General Signs: Engraved plastic laminate signs.

### 2.3 NAMEPLATES

- A. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
  - 1. Name and mark number.
  - 2. Equipment service.
  - 3. Design capacity.
  - 4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.
- B. Size: 2-1/2 inch x 4 inch for control panels and components, 4-1/2 inch x 6 inch for equipment.
- C. Letter Color: White.
- D. Letter Height: 1/4 inch.
- E. Background Color:
  - 1. Cooling equipment: Green.
  - 2. Heating equipment: Yellow.
  - 3. Combination cooling and heating equipment: Yellow/Green.
  - 4. Energy reclamation equipment: Brown.
  - 5. Hazardous equipment: Colors and designs recommended by ASME.
  - 6. Equipment and components that do not meet any of the above criteria: Blue.
- F. Plastic: Conform to ASTM D709.

### 2.4 TAGS

- A. Plastic Laminate Tags: Laminated three-layer plastic, minimum 3/32 inch thick, with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter and 5/32 inch hole for fastener.
- B. Solid Plastic Tags: Solid plastic, minimum 3/32 inch thick, with printed black letters on white color. Tag size minimum 1-1/2 inch diameter and 5/32 inch hole for fastener.
- C. Metal Tags: Provide 19-gauge polished brass with stamped letters. Tag size minimum 1-1/2 inch diameter with smooth edges and 5/32 inch hole for fastener. Fill tag engraving with black enamel paint.
- D. Accident Prevention Tags: Pre-printed or partially pre-printed, of plasticized card stock with matte finish suitable for writing, minimum 3-1/4 inch x 5-5/8 inch size, with brass grommet in hole for fastener. Order with appropriate pre-printed wording (e.g., DANGER, CAUTION, DO NOT OPERATE, etc.).
- E. Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks of the size required for proper attachment of tags to valves, manufactured specifically for that purpose.
- F. Valve Tag Chart: Typewritten letter size list in anodized aluminum or finished hardwood frame, covered with SSB-grade sheet glass. Provide frame and mounting screws for removable mounting.
- G. Letter Height:
  - 1. System Abbreviation: Minimum 1/4 inch.
  - 2. Valve Number: Minimum 1/2 inch.

### 2.5 ADHESIVE-BACKED DUCT MARKERS

- A. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch; printed with UV and chemical resistant inks.

- B. Style: Individual label.
- C. Nomenclature: Include air handling unit identification number, duct size, service, and arrows indicating direction of flow.
- D. Specialty Exhaust: Identify the specialty using the system terminology (e.g., Grease, Dishwasher, Dryer, Fume Hood, etc.).
- E. Color: Yellow background with black lettering or blue background with white lettering.
  - 1. Hazardous Exhaust: Use colors and designs recommended by ASME A13.1.

## 2.6 STENCILS

- A. Stencils: With clean cut symbols and letters of following size, complying with ASME A13.1:
  - 1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
  - 2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
  - 3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
  - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
  - 5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
  - 6. Ductwork and Equipment: 2-1/2 inch high letters.
  - 7. Access Doors: 3/4 inch high letters.
  - 8. Operational Instructions: 3/4 inch high letters.
  - 9. Provide arrows indicating direction of flow.
- B. Stencil Paint: Oil based, alkyd enamel, either brushing grade or pressurized spray-can form and grade, black color, except for piping. For piping systems use colors conforming to ASME A13.1.

## 2.7 PIPE MARKERS

- A. Semi-rigid Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings, minimum 3 mil thick.
  - 1. Width: 1-1/2 inch for pipes less than 6 inches (including insulation), 2-1/2 inch for pipes 6 inches and larger (including insulation).
- C. Pipe Marker with Insulation: 1 inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F or greater. Insulation shall extend 2 inches beyond each end of plastic pipe marker.
- D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
  - 1. Detection: Provide multi-ply tape consisting of solid aluminum foil core between two layers of plastic ribbon tape.
- E. Nomenclature: Manufacturer's standard pre-printed nomenclature which best describes piping system. Differentiate between supply and return. In the case of a variance, provide nomenclature as selected by the Engineer.
- F. Arrows: Provide pipe markers with integral arrows indicating direction of flow or as a separate unit of plastic.
- G. Color:

1. Conform to ASME A13.1.
2. Heating, Cooling, and Boiler Feedwater: Green with white letters.
3. Toxic and Corrosive Fluids: Orange with black letters.
4. Compressed Air: Blue with white letters.

H. Letter Height: Minimum 1/2 inch for pipes up to 3 inch, minimum 1 inch for larger pipes.

## 2.8 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.
- B. Color:
  1. HVAC Equipment: Yellow.
  2. Fire Dampers and Smoke Dampers: Red.
  3. Heating/Cooling Valves: Blue.

## 2.9 ENGRAVED PLASTIC-LAMINATE SIGNS

- A. General: Engraving stock melamine plastic laminate, engraved with manufacturer's standard letter style, black with white core letter color except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
- B. Thickness: 1/16 inch thick for units up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger units.
- C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
- D. Nomenclature: When used to identify equipment, match terminology on schedules, including the following:
  1. Name and mark number.
  2. Equipment service.
  3. Design capacity.
- E. Access Panel Markers: Laminated three-layer plastic, minimum 1/16 inch thick and 1/8 inch hole for fastener, with abbreviations and numbers corresponding to concealed valve.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Division 09 for stencil painting.

### 3.2 GENERAL INSTALLATION

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- B. Install products in accordance with manufacturer's instructions.
- C. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- D. Install tags on piping 3/4 inch diameter and smaller.
- E. Install in clear view and align with axis of piping.

- F. Apply stencil painting in accordance with Division 09.
- G. Identify service, flow direction, and pressure.

### 3.3 PIPING IDENTIFICATION

- A. General: Install identification on the most obviously visible portion of the pipe from the point of access.
- B. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- C. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe during back-filling/top-soiling of each underground piping system. Where multiple pipes are buried in common trench and do not exceed overall width of 16 inches, install single pipe marker. For tile fields and similar artificial field installations, mark only edge pipe lines of field.
- D. Pipes less than 6 inches diameter (including insulation): Provide full-band pipe markers with 360 degree coverage.
- E. Pipes 6 inches diameter and larger (including insulation): Provide either full-band or strip-type pipe markers.
- F. Location: Install piping identification where piping is exposed to view, concealed by a removable ceiling system, located in accessible maintenance spaces (shafts, tunnels, plenums, etc.) and exterior non-concealed locations as follows:
  - 1. Within 5 feet of each valve, tee, and control device.
  - 2. Within 5 feet of each branch, excluding branches less than 25 feet in length to fixtures or terminal heating and cooling units.
  - 3. Within 5 feet of each side of a penetration of a wall, floor, ceiling, structure, or enclosure.
  - 4. At access doors, manholes and similar access points which permit view of concealed piping.
  - 5. Within 5 feet of equipment outlets and other points of origination and termination.
  - 6. Spaced intermediately at a maximum spacing of 50 feet along each riser and run. Reduce spacing to 25 feet in congested areas where there are more than two piping systems or pieces of equipment.

### 3.4 VALVE IDENTIFICATION

- A. Provide a tag on each valve, cock, and control device. Exclude check valves, valves within factory-fabricated equipment, HVAC terminal devices, and similar rough-in connections of end-use fixtures and units.
- B. Mount valve tag chart and schedule frame in mechanical room, or where indicated on plans. If not indicated, mount where directed by Engineer. Where more than one mechanical room is included on the project, mount framed copies of valve tag chart and schedule in each mechanical room.

### 3.5 DUCTWORK IDENTIFICATION

- A. Install identification on the most obviously visible portion of the duct from the point of access.
- B. Location: Install ductwork identification where ductwork is exposed to view, concealed by a removable ceiling system, located in accessible maintenance spaces (shafts, tunnels, plenums, etc), and exterior non-concealed locations as follows:
  - 1. Within 5 feet of each control damper or balancing damper, excluding balancing dampers installed in duct take-offs to individual grilles, registers, or diffusers that are less than 25 feet in lengths and installed in the same space as the air device.

2. Within 5 feet of each branch duct, excluding branch ducts that are less than 25 feet in length and located in the same space as the main duct.
3. Within 5 feet of each side of a penetration of a wall, floor, ceiling, structure, or enclosure.
4. Spaced intermittently at a maximum spacing of 50 feet along each duct run. Reduce spacing to 25 feet in congested areas when there are more than two types of duct systems or pieces of equipment.
5. Within 5 feet of equipment outlets and other points of origin or termination.
6. Install marker on the most obviously visible portion of the duct from point of access.

### **3.6 ACCESS DOOR IDENTIFICATION**

- A. Provide identification on each access door, indicating purpose of access, maintenance and operating instructions, and appropriate safety and procedural information.
- B. Where access doors are concealed above a removeable ceiling system or similar concealment, tags may be used in lieu of specified identification.

### **3.7 CEILING TACK INSTALLATION**

- A. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

### **3.8 EQUIPMENT IDENTIFICATION**

- A. Install nameplates and engraved plastic laminate signs for identification of equipment. Provide additional signs and lettering as follows:
  1. To distinguish between multiple units in close proximity.
  2. To inform operator of operational requirements.
  3. To indicate safety and emergency precautions.
  4. To warn of hazards and improper operations.
- B. Adjust lettering size based on viewing distance from normal location of identification:
  1. Less than 2 feet: Minimum 1/4 inch.
  2. Up to 6 feet: Minimum 1/2 inch.
  3. Greater than 6 feet: Proportionally increase letter size based on recommendations above.
  4. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.
  5. Stencils may be used in lieu of nameplates when lettering greater than 1 inch is needed for proper identification because of distance from normal location of required identification.
- C. Where equipment to be identified is concealed above acoustical ceilings or similar removeable concealment, equipment tags may be installed in the concealed space to reduce the amount of text in exposed sign.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 23 05 93 - TESTING ADJUSTING AND BALANCING FOR HVAC****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. General testing, adjustment, and balancing requirements.
- B. Testing, adjustment, and balancing of air systems.
- C. Testing, adjustment, and balancing of hydronic systems.
- D. Testing, adjustment, and balancing of domestic water systems.
- E. Testing, adjustment, and balancing of specialty systems:
  - 1. Smoke control systems.
- F. Sound and vibration measurement of equipment operating conditions.
- G. This section excludes:
  - 1. Testing boilers and pressure vessels for compliance with safety codes;
  - 2. Specifications for materials for patching mechanical systems;
  - 3. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.
  - 4. Requirements and procedures for piping and ductwork systems leakage tests.

**1.2 DEFINITIONS**

- A. TAB: Testing, adjusting, and balancing.
- B. Test: To determine quantitative performance of equipment.
- C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).
- D. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.
- E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.
- F. Report forms: Data sheets arranged for collecting test data in logical order for submission and review. Data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.
- G. Terminal: The point where the controlled fluid enters or leaves the distribution system. Examples include inlets and outlets on water terminals, inlets and outlets from air terminal units, and inlets and outlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
- H. Main: Duct or pipe containing the major or entire fluid flow of the system.
- I. Submain: Duct or pipe containing part of the system capacity and serving two or more branch mains.
- J. Branch main: Duct or pipe serving two or more terminals.
- K. Branch: Duct or pipe serving a single terminal.

**1.3 SUBMITTALS**

- A. Qualifications:

1. Submit qualifications of TAB agency.
  2. Submit qualifications of TAB supervisor.
  3. Submit qualifications of the smoke control system inspector.
- B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
- C. Sample Forms: Submit sample forms if they are other than the standard forms available from the certification association followed for the project.
- D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- E. Progress Reports.
- F. Certified TAB Reports:
1. General:
    - a. Submit within two weeks after completion of testing, adjusting, and balancing.
    - b. Revise TAB plan to reflect actual procedures and submit as part of final report.
    - c. Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
  2. Draft Report: Submit draft copies of report for review prior to final acceptance of Project. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
  3. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports. The final report shall be certified proof of the following:
    - a. The systems have been tested, adjusted, and balanced in accordance with the referenced standards.
    - b. The report reflects an accurate representation of how the systems have been installed.
    - c. The report reflects a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures.
    - d. The report is an accurate record of all final quantities measured to establish normal operating values of the systems.
  4. Report Format: Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, and cover identification at front and side. Include set of reduced size drawings indicating air outlets, equipment, and thermostat locations identified to correspond with report forms. Divide the report into the following divisions:
    - a. General Information and Summary
      - 1) Include project name, location, altitude, and date.
      - 2) Identify TAB agency, contractor, owner, architect, and engineer.
      - 3) Include addresses, contact names, and telephone numbers.
      - 4) Include certification sheet containing the seal, name, address, telephone number, and signature of the certified TAB Supervisor.
      - 5) Include actual instrument list, with manufacturer name, serial number, and date of calibration.
    - b. Air Systems
    - c. Hydronic Systems
    - d. Temperature Control Systems
    - e. Special Systems
    - f. Sound and Vibration Systems
  5. Report Forms: Standard forms prepared by the TAB certification standard being followed for each respective item and system to be tested, adjusted, and balanced. If not specified, follow ASHRAE 111.

6. Units of Measure: Report data in I-P (inch-pound) units only.
- G. Smoke Control System Test Report: A complete report of the testing and verification of the smoke control system shall be prepared by the special inspector or special inspection agency and submitted for approval. A copy of the final, approved report shall be submitted to the local fire code official and Owner.
- H. Project Record Documents: Provide drawings that record actual locations of flow measuring stations and balancing devices.

#### 1.4 QUALITY ASSURANCE

- A. Comply with ASHRAE Standard 111, Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
- B. Comply with ASHRAE Handbook, HVAC Applications Volume, Chapter "Testing, Adjusting, and Balancing", most current edition.
- C. TAB Agency Qualifications:
  1. Act as the single source of responsibility for TAB of the HVAC systems.
  2. Staff the project at all times by qualified personnel.
  3. Have a minimum of 5 years documented experience on projects with TAB requirements similar to those required for the project.
  4. Certified by one of the following Certification Associations:
    - a. NEBB: National Environmental Balancing Bureau, Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- D. TAB Supervisor and Technician Qualifications:
  1. Certified by the same organization as TAB agency.
  2. TAB Supervisor shall be a professional engineer licensed in the state in which the project is located.
- E. Smoke Control System Inspector Qualifications: A special inspector or agency with expertise in fire protection engineering, mechanical engineering and has a certification from an acceptable Certification Association.

## PART 2 - PRODUCTS AND MATERIALS – NOT USED

## PART 3 - EXECUTION

### 3.1 GENERAL REQUIREMENTS

- A. Begin work after systems to be tested, adjusted, or balanced are fully operational, duct systems are sealed, piping systems have been tested for leaks, and equipment is operational. Complete work prior to Substantial Completion of the project.
- B. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
- C. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5 deg. F wet bulb temperature of maximum summer design condition, and within 10 deg. F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.
- D. Coordinate with Division 22 drawings for testing, adjusting, and balancing scope of work.
- E. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

- F. Submit progress reports at least once a week to the General Contractor to communicate status of work so that the TAB work is completed in a timely manner.
- G. Notice of Tests: Provide seven days advance notice for each test. Include scheduled test dates and times.
- H. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- I. Coordinate schedule for testing of smoke control systems with the local fire code official for on-site observance of testing procedures.
- J. All required instrumentation shall be calibrated to tolerances specified in the referenced standards within a period of six months prior to starting the project.

### 3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
  - 1. Systems are started and operating in a safe and normal condition.
  - 2. Temperature control systems are installed complete and operable.
  - 3. Proper thermal overload protection is in place for electrical equipment.
  - 4. Motors and bearings are lubricated.
  - 5. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - 6. Duct systems are clean of debris.
  - 7. Fans are rotating correctly and belts have tension.
  - 8. Fire, smoke, fire/smoke, and volume dampers are in place and open.
  - 9. Air coil fins are cleaned and combed.
  - 10. Volume dampers are installed at locations needed for balancing the air systems.
  - 11. Access doors are closed and duct end caps are in place.
  - 12. Air outlets are installed and connected.
  - 13. Visually inspect duct systems to ensure they are sealed and leakage is minimized.
  - 14. Hydronic systems are flushed, filled, and vented.
  - 15. Hydronic systems are tested for leaks.
  - 16. Test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves are properly installed and that their location is accessible.
  - 17. Pumps are rotating correctly.
  - 18. Proper strainer baskets are clean and in place.
  - 19. Service and balance valves are open.
  - 20. Expansion tanks are not air bound and have appropriate charge.
  - 21. Air vents are operating freely.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

### 3.3 PREPARATION

- A. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a coordination meeting with all installers whose work will be tested, adjusted, or balanced.
- B. Furnish all instruments required for testing, adjusting, and balancing operations.
  - 1. Verify all instruments have been calibrated.
  - 2. Furnish instruments as recommended by the manufacturer for the TAB application.
  - 3. Furnish instruments that are best suited to the function being measured.

4. Furnish instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.
- C. Furnish additional balancing devices as required for TAB to the appropriate contractor for installation.
- D. Obtain copies of approved shop drawings of air handling equipment, terminal outlets, and temperature control diagrams.
- E. Obtain manufacturer's fan and terminal device outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.
- F. Determine best locations in main and branch ductwork for most accurate duct traverses.
- G. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

### 3.4 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Balance main ducts and equipment to within plus or minus 5 percent of design airflow.
- B. Air Outlets and Inlets: Balance branch ducts and terminal devices to within plus or minus 10 percent of design airflow.
- C. Hydronic Systems: Balance to within plus or minus 5 percent of design flow.

### 3.5 RECORDING AND ADJUSTING

- A. Record data regarding design conditions from contract documents and installed conditions from shop drawings including equipment identification number, model number, location, area served, manufacturer, model number, serial number, motor nameplate horsepower and rpm, fan rpm, capacity and electrical voltage, amps and phases.
- B. For all systems measure and record the ambient conditions at the time of testing and balancing. Include the following:
  1. Dry bulb temperature.
  2. Relative humidity.
  3. Cloud cover.
  4. Wind speed.
  5. Time.
- C. Field Logs: Maintain written logs including:
  1. Running log of events and issues.
  2. Discrepancies, deficient or uncompleted work by others.
  3. Contract interpretation requests.
  4. Lists of completed tests.
- D. Ensure recorded data represents actual measured or observed conditions.
- E. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- F. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- G. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- H. Cut insulation around ductwork and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

- I. Patch and seal insulation, vapor barrier, ductwork, and housings, using materials identical to those removed.
- J. Seal ducts and piping and test and repair leaks.
- K. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- L. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- M. Check and adjust systems approximately six months after final acceptance and submit report.
- N. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive values are obtained.
- O. Take all readings at eye level of the indicated value to prevent parallax.
- P. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.
- Q. Take measurements in the system where best suited for the task.
- R. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

### **3.6 AIR SYSTEM TESTING AD USTMENT AND BALANCING PROCEDURE**

- A. Check filters for cleanliness.
- B. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.
- C. Verify volume dampers are installed at locations needed for balancing the air systems.
- D. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.
- E. Determine best locations in main and branch ductwork for most accurate duct traverses.
- F. Place outlet dampers in the full open position.
- G. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.
- H. Lubricate all motors and bearings.
- I. Check fan belt tension.
- J. Check fan rotation.
- K. Energize fan motors and adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude. Replace fan and motor pulleys as required to achieve design conditions.
- L. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- M. Measure air quantities at air inlets and outlets.
- N. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

- O. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Affect volume control by duct internal devices such as dampers and splitters.
- P. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- Q. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- R. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- S. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- T. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- U. Where modulating dampers are provided, take measurements and balance at design conditions. Balance variable volume systems at design air flow rate and at minimum air flow rate.
- V. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship to maintain building pressure setpoint.
- W. For variable air volume boxes, set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- X. On fan powered VAV boxes, adjust air flow switches for proper operation.
- Y. Procedure for establishing minimum and absolute minimum outdoor air damper position on air handling units:
  - 1. Open the minimum outdoor air damper and return air damper fully. Close the economizer air damper.
  - 2. Operate supply fan at design speed and measure the outdoor airflow.
  - 3. If the outdoor airflow is above the scheduled minimum ventilation airflow, adjust the damper linkage on the minimum outdoor air damper so that outdoor airflow equals the scheduled minimum ventilation airflow with damper fully stroked.
  - 4. If outdoor airflow is below the scheduled minimum ventilation airflow, adjust the damper linkage on the return air damper so that outdoor airflow equals the schedule minimum ventilation airflow with the damper fully stroked.
  - 5. Convey the measured setpoint and/or damper position to the BAS installer and note on air balance report.
  - 6. Repeat this procedure to determine damper position for absolute minimum ventilation.

### **3.7 HYDRONIC SYSTEM TESTING ADJUSTMENT AND BALANCING PROCEDURE**

- A. Open valves to full open position. Close coil bypass valves.
- B. Remove and clean all strainers.
- C. Check pump rotation.
- D. Clean and set automatic fill valves for required system pressure.
- E. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
- F. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
- G. Set temperature controls so all coils are calling for full flow.
- H. Check operation of automatic bypass valves.

- I. Check and set operating temperatures of chillers to design requirements.
- J. Lubricate all motors and bearings.
- K. Adjust water systems to provide required or design quantities.
- L. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on correlated flow from temperature and pressure gauges across the heat transfer elements in the system.
- M. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- N. Affect system balance with automatic control valves fully open to heat transfer elements.
- O. Affect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- P. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.
- Q. Balance cooling tower water distribution systems to ensure even water flow to each tower cell.
- R. Test cooling tower systems for capacity, recording pump flow and head, fan airflow, ambient air wet and dry bulb temperatures at tower inlet and outlet and tower inlet and outlet water temperatures.
- S. Record the necessary information for optimizing pump operation as defined on the controls drawings. Give this information to the controls contractor for building automation system programming.

### **3.8 DOMESTIC WATER SYSTEM TESTING ADJUSTMENT AND BALANCING PROCEDURE**

- A. Before balancing the system perform these steps:
  - 1. Open valves to full open position.
  - 2. Examine plumbing system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices and balancing valves and fittings are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
  - 3. Remove and clean all strainers.
  - 4. Check pump rotation.
  - 5. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
  - 6. Lubricate all motors and bearings.

### **3.9 SMOKE CONTROL SYSTEM TESTING ADJUSTMENT AND BALANCING PROCEDURE**

- A. Perform leakage testing of the smoke control ductwork in accordance with Section "Metal Ducts".
- B. Measure and record airflows for each smoke control condition in the supply and exhaust ducts and at each inlet and outlet.
- C. Verify fan operation for correct rotation and measure airflow, pressures, voltage, amperage, rpm and belt tension.
- D. Measure and verify pressure differences across smoke barriers including stairways and elevator shafts for each smoke control condition.



- E. Verify that the smoke control system operates according to the control sequences for each specified condition including verification of override from the fire-fighter's control panel and simulation of standby power conditions.

### **3.10 TESTING FOR SOUND AND VIBRATION**

- A. Test and adjust mechanical systems for sound and vibration in accordance with the detailed instructions of the referenced standards:
  - 1. ASHRAE: ASHRAE Handbook, HVAC Applications Volume, Chapter "Sound and Vibration Control", most current edition.
  - 2. NEBB: "Procedural Standards for the Measurement and Assessment of Sound and Vibration."
- B. Other than sound data, failure of an item includes a deviation of more than 10 percent from setpoint. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report.
  - 1. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
- C. Prepare and submit report of recommendations for correcting any sound or vibration levels that are outside of manufacturer's tolerances, ASHRAE standards and/or values specified in the contract documents.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 23 07 00 - HVAC INSULATION****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Piping Insulation.
- B. External Ductwork Insulation.
- C. Equipment Insulation.

**1.2 RELATED REQUIREMENTS**

- A. Division 23 Section "Hangers & Supports for HVAC Piping & Equipment," for insulation shields, pipe saddles, and high-density insulation inserts.
- B. Division 23 Section "Buried Hydronic Piping," for insulation of piping installed below grade.
- C. Division 23 Section "Metal Ducts" for duct liner insulation.

**1.3 DEFINITIONS**

- A. Cold Pipe: Piping that carries fluid with a minimum operating temperature less than 60 degrees F.
- B. Hot Pipe: Piping that carries fluid with a minimum operating temperature greater than 105 degrees F.
- C. Cold Duct: Ductwork that carries airflow with a minimum operating temperature less than 65 degrees F temperature.
- D. Hot Duct: Ductwork that carries airflow with a minimum operating temperature greater than 75 degrees F temperature.
- E. Neutral Ductwork: Ductwork that carries airflow with temperatures between the defined cold and hot temperatures.
- F. Cold Equipment: Equipment that carries fluids with a minimum operating temperature less than 60 degrees F.
- G. Hot Equipment: Equipment that carries fluids with a minimum operating temperature greater than 105 degrees F.
- H. Exposed: Insulation that is visible from the occupied space.
- I. Exposed to Weather: Insulation that is exposed to potential damage caused by weather, including sunlight, moisture, wind, and solar radiation.
- J. Exterior: Locations outside of or within the building envelope (walls, roof, floors, etc) as defined by the architectural drawings and specifications.
- K. Unconditioned Spaces: An enclosed space within a building that is not provided with mechanical heating or cooling.

**1.4 SUBMITTALS**

- A. Product Data: Submit technical product data, thermal characteristics, and materials for each type of mechanical insulation.

- B. Insulation Schedule: Include product name, conductivity k-value, thickness, and furnished accessories for each service.
- C. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.
- D. Manufacturer's Instructions: Include installation instructions for storage, handling, protection, examination, preparation, and installation of the product.

### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualification: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.
- B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.
  - 1. Exception: Exterior mechanical insulation may have flame spread index of 75 and smoke developed index of 150.
  - 2. Exception: Industrial mechanical insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.
  - 3. Exception: Polyisocyanurate insulation that is not installed in a return air plenum may have a flame spread index of 25 and smoke developed index of 450.

### 1.6 DELIVERY STORAGE AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage; store in original wrapping.

### 1.7 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

## PART 2 - PRODUCTS

### 2.1 PIPING INSULATION MATERIALS

- A. Cellular Glass:
  - 1. Manufacturers:
    - a. Owens Corning.
  - 2. Insulation: ASTM C552, Type II, Grade 6, rigid closed glass cells pre-formed for the application.
    - a. K-value: ASTM C518 or C177, maximum 0.34 at 75 degrees F.
    - b. Minimum Service Temperature: Minus 450 degrees F.
    - c. Maximum Service Temperature: 800 degrees F.
    - d. Density: Minimum 6.12 pounds per cubic feet.
- B. Polyisocyanurate:
  - 1. Manufacturers:

- a. Dyplast Products.
  - b. Johns Manville.
  - c. Approved equal.
  - 2. Insulation: ASTM C591, Grade 2, Type IV for ASTM E84 25/50 compliance, Type I for ASTM E84 25/450 compliance; rigid molded, pre-formed for the application.
    - a. K-value: ASTM C518 or C177, maximum 0.2 at 75 degrees F.
    - b. Minimum Service Temperature: Minus 297 degrees F
    - c. Maximum Service Temperature: 300 degrees F.
    - d. Density: Maximum 6 pounds per cubic feet.
- C. Flexible Elastomeric:
- 1. Manufacturers:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. K-Flex USA.
  - 2. Insulation: ASTM C534, Grade I, flexible elastomeric cellular rubber insulation, pre-formed for the application.
    - a. K-value: ASTM C518 or C177, maximum 0.28 at 75 degrees F.
    - b. Minimum Service Temperature: Minus 297 degrees F
    - c. Maximum Service Temperature: 220 degrees F for Grade I, 300 degrees F for Grade II.
  - 3. Factory Applied Jacket:
    - a. Polymeric Coating: Multi-ply, polymeric blend coating, 16 mils thick, designed to prevent damage to underlying insulation from sunlight, installation, and physical abuse, with water vapor permeance of 0.03 perms. Reference Piping Jacket Schedule in Part 3 of this specification for application of this jacket.
- D. Field-Applied Jacket:
- 1. Canvas: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
  - 2. Semi-rigid PVC: One-piece, pre-molded PVC cover conforming to ASTM D1784, including factory-furnished, pre-cut insulation blanket inserts for fittings.
    - a. Outdoor Applications: Provide minimum 30 mils thickness and UV protection.
    - b. Manufacturers:
      - 1) Johns Manville Zeston PVC Jacketing and 2000 Series Fitting Covers
      - 2) Proto Corp LoSmoke PVC Jacketing and Pro Fitting Covers.
      - 3) Or approved equal.
  - 3. Rigid Aluminum Shell: One-piece, pre-formed cover conforming to ASTM C1729 with weather-proof construction. Shell shall have the following minimum thickness based on the outer insulation diameter:

Outer Insulation Diameter (in)	Minimum Aluminum Jacket Thickness, (in)		
	Non-Rigid Insulation	Rigid Insulation	Finish
≤ 8	0.016	0.016	Stucco
12	0.020	0.016	Stucco
≤ 24	0.024	0.016	Stucco
≤ 36	0.032	0.020	See Note 1
36	0.040	0.024	See Note 1

Note 1: Use corrugated finish for non-rigid insulation. Use stucco finish for rigid insulation.

- a. Banding:
  - 1) For piping less than or equal to 8 inches, provide 0.020 inch thick, 3/4 inch wide aluminum bands.
  - 2) For piping larger than 8 inches, provide 0.020 inch thick, 3/4 inch wide stainless steel bands.
- 4. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW, or approved equal.
  - a. Water Vapor Transmission: 0.0 perms per ASTM E96.

- b. Puncture Resistance: Minimum 65 pounds per ASTM D1000.
- 5. Rubberized Asphalt Vapor Barrier Cladding: UV-resistant aluminum outer layer, multi-ply cross-laminated polyethylene film, and rubberized asphalt formulated for use on faced insulated duct and piping applications. Provide Polyguard Products, Inc. Alumaguard 60 mils thick cladding, Alumaguard Low Temp (LT) 35 mils thick cladding, or approved equal.
  - a. Water Vapor Transmission: 0.0 perms per ASTM E96.
  - b. Puncture Resistance: Minimum 15 pounds per ASTM D1000.
- E. Pipe Insulation Accessories: Provide staples, bands, wires, cement, and other appurtenances as recommended by insulation manufacturer for applications indicated.
- F. Adhesives, Sealers, Mastics, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.
  - 1. Lagging Adhesive: Comply with MIL-A-3316C, Class 1, Grade A. Provide Foster 30-36, Childers CP-50AHV2, or equal.
  - 2. Weather Barrier Breather Mastic: Permeance shall be 1.0 perms or less at 62 mils dry per ASTM E96, Procedure B. Provide Foster 46-50, Childers CP-10/11 or equal.
  - 3. Solvent-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 35 mils dry per ASTM F 1249.
  - 4. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance in accordance with ASTM C755 for insulation application. Provide Foster 30-80, Childers CP-38, or equal.

Table: Recommended Maximum Permeance of Water Vapor Retarders (Note 1)

Insulation Application	Insulation Permeability, Less than 4.0 perm-in. (Note 2)	Insulation Permeability, 4.0 or greater perm-in. (Note 2)
	Vapor Retarder perms	Vapor Retarder perms
Pipe and vessels (33 F to ambient)	0.05	0.05
Pipe and vessels (-40 F to 32 F)	0.02	0.02
Ducts (40 F to ambient)	1.0	0.03

## Notes:

- 1. Water vapor permeance of the vapor retarder in perms when tested in accordance with Test Methods E96.
- 5. Water vapor permeability of the insulation material when tested in accordance with Test Methods E96.
- G. Insulation Diameters: Comply with ASTM C585 for inner and outer diameters of rigid thermal insulation.
- H. Pipe, Valve and Fitting Covers: Comply with ASTM C450 for fabrication of fitting covers for pipe, valves and fittings.
- I. High Density Insulation Billets:
  - 1. Calcium Silicate: ASTM C533 and C795.
  - 2. Flexible elastomeric: ASTM C534, Type 1.
  - 3. Polystyrene: ASTM C578, Type XIII.
  - 4. Phenolic: ASTM C1126, Type III, Grade 1.

**2.2 EXTERNAL DUCTWORK INSULATION MATERIALS**

- A. Flexible Mineral Fiber (rock, slag, or glass):
  - 1. Manufacturers:
    - a. CertainTeed Corp.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Owens Corning.

2. Insulation: ASTM C553, Type I or II, flexible mineral fiber blanket.
    - a. K-value: ASTM C518 or C177, maximum 0.31 at 75 degrees F.
    - b. Minimum Service Temperature: Minus 20 degrees F
    - c. Maximum Service Temperature: 450 degrees.
    - d. Density:
      - 1) 1.5 pounds per cubic foot.
  3. Factory Applied Vapor Barrier Jacket: ASTM C1136, Type II.
    - a. Foil Scrim Kraft (FSK): Kraft paper with glass fiber yarn and bonded to aluminized film, water vapor permeance of 0.02 perms and 2 inch stapling tab.
    - b. Polypropylene Scrim Kraft (PSK): Kraft paper with glass fiber yarn and bonded to metalized polypropylene, water vapor permeance of 0.02 perms and 2 inch stapling tab.
- B. Rigid Mineral Fiber (rock, slag, or glass):
1. Manufacturers:
    - a. Johns Manville.
    - b. Knauf Insulation.
    - c. Owens Corning.
  2. Insulation: ASTM C612, Type IA or IB, rigid mineral fiber board.
    - a. K-value: ASTM C518 or C177, maximum 0.25 at 75 degrees F.
    - b. Minimum Service Temperature: 0 degrees F
    - c. Maximum Service Temperature: 450 degrees.
    - d. Density:
      - 1) 3.0 pounds per cubic foot.
  3. Factory Applied Vapor Barrier Jacket: ASTM C1136, Type II.
    - a. All-Service Jacket (ASJ): Paper/Foil/Scrim, water vapor permeance of 0.02 perms.
    - b. Foil Scrim Kraft (FSK): Kraft paper with glass fiber yarn and bonded to aluminized film, water vapor permeance of 0.02 perms.
    - c. Polypropylene Scrim Polyester (PSP): Polyester paper with glass fiber yarn and bonded to polypropylene, water vapor permeance of 0.02 perms.
    - d. Color: White.
- C. Cellular Glass:
1. Manufacturers:
    - a. Owens Corning.
  2. Insulation: ASTM C552, Type I, Grade 6, rigid closed glass cells, block form.
    - a. K-value: ASTM C518 or C177, maximum 0.31 at 75 degrees F.
    - b. Minimum Service Temperature: Minus 450 degrees F.
    - c. Maximum Service Temperature: 800 degrees F.
    - d. Density: Minimum 6 pounds per cubic feet.
- D. Polyisocyanurate:
1. Manufacturers:
    - a. Dyplast Products.
    - b. Johns Manville.
    - c. Approved equal.
  2. Insulation: ASTM C591, Grade 2, Type IV for ASTM E84 25/50 compliance, Type I for ASTM E84 25/450 compliance; rigid board.
    - a. K-value: ASTM C518 or C177, maximum 0.2 at 75 degrees F.
    - b. Minimum Service Temperature: Minus 297 degrees F
    - c. Maximum Service Temperature: 300 degrees F.
    - d. Density: Maximum 6 pounds per cubic feet.
- E. Flexible Elastomeric:
1. Manufacturers:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. K-Flex USA.

2. Insulation: ASTM C534, Grade 1, flexible elastomeric cellular rubber insulation, sheet form.
    - a. K-value: ASTM C518 or C177, maximum 0.28 at 75 degrees F.
    - b. Minimum Service Temperature: Minus 40 degrees F
    - c. Maximum Service Temperature: 180 degrees F.
  3. Factory Applied Jacket:
    - a. Flexible Metal Cladding: Metallic factory-laminated cladding, 17.5 mils thick, designed to prevent damage to underlying insulation from sunlight, installation, and physical abuse, with water vapor permeance of 0.00 perms. Provide ArmaTuff or equal. Reference Duct Jacket Schedule in Part 3 of this specification for application of this jacket.
- F. Field-Applied Jacket:
1. Aluminum: ASTM B209, 3003 alloy, H-14 temper, with 3-mil thick polyfilm moisture barrier to interior surface.
    - a. Thickness: 0.032 inch sheet.
    - b. Finish: Smooth or Stucco. Reference Part 3 for jacket applications.
    - c. Joining: Longitudinal slip joints and 2 inch laps.
    - d. Fittings: 0.032 inch thick die shaped fitting covers with factory attached protective liner.
    - e. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel.
  2. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW, or approved equal.
    - a. Water Vapor Transmission: 0.0 perms per ASTM E96.
    - b. Puncture Resistance: Minimum 65 pounds per ASTM D1000.
  3. Rubberized Asphalt Vapor Barrier Cladding: UV-resistant aluminum outer layer, multi-ply cross-laminated polyethylene film, and rubberized asphalt formulated for use on faced insulation. Provide Polyguard Products, Inc. Alumaguard 60 mils thick cladding, Alumaguard Low Temp (LT) 35 mils thick cladding, or approved equal.
- G. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, pins with insulation retaining washers, anchors, corner angles and other appurtenances as recommended by insulation manufacturer for applications indicated.
- H. Adhesives, Sealers, Mastics, and Protective Finishes: Provide cements, adhesives, coatings, sealers, mastics, protective finishes, and similar compounds as recommended by insulation manufacturer for applications indicated.
1. Mineral Fiber Lagging Adhesive: Comply with ASTM C916, Type 2 or MIL-A-3316C, Class 2, Grade A. Provide Foster 85-60, Childers CP-127, or equal water-based adhesive.
  2. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.
  3. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 47 mils dry per ASTM E96. Provide Fosters 30-80, Childers CP-38, Design Polymerics 3040, or equal.
  4. Solvent-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 35 mils dry per ASTM F 1249.
  5. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

### 2.3 EQUIPMENT INSULATION MATERIALS

- A. Flexible Mineral Fiber (rock, slag, or glass):
1. Manufacturers:
    - a. CertainTeed Corp.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Owens Corning.



2. Insulation: ASTM C553, Type I and II or ASTM C547 Type II, flexible mineral fiber blanket.
    - a. K-value: ASTM C518 or C177, maximum 0.31 at 75 degrees F.
    - b. Minimum Service Temperature: Minus 20 degrees F
    - c. Maximum Service Temperature: 450 degrees F for ASTM C553 Types I and II, 1200 degrees F for ASTM C547 Type II.
    - d. Density: Minimum 1.5 pounds per cubic foot.
  3. Factory Applied Vapor Barrier Jacket: ASTM C1136, Type II.
    - a. Foil Scrim Kraft (FSK): Kraft paper with glass fiber yarn and bonded to aluminized film, water vapor permeance of 0.02 perms and 2 inch lap.
    - b. Color: White.
- B. Flexible Removeable and Reusable Blanket Insulation:
1. Manufacturers:
    - a. Auburn Manufacturing.
    - b. Approved equal.
  2. Insulation: ASTM C553, Type V, flexible, noncombustible.
    - a. Comply with ASTM C1695.
    - b. K-value: ASTM C518 or C177, maximum 0.37 at 100 degrees F.
    - c. Minimum Service Temperature: 32 degrees F
    - d. Maximum Service Temperature: 500 degrees.
- C. Rigid Mineral Fiber (rock, slag, or glass):
1. Manufacturers:
    - a. Johns Manville.
    - b. Knauf Insulation.
    - c. Owens Corning.
  2. Insulation: ASTM C612, Type IA or IB, rigid mineral fiber board.
    - a. K-value: ASTM C518 or C177, maximum 0.25 at 75 degrees F.
    - b. Minimum Service Temperature: 0 degrees F
    - c. Maximum Service Temperature: 450 degrees.
    - d. Density: Minimum 3.0 pounds per cubic foot.
  3. Factory Applied Vapor Barrier Jacket: ASTM C1136, Type II.
    - a. All-Service Jacket (ASJ): Paper/Foil/Scrim, water vapor permeance of 0.02 perms.
    - b. Foil Scrim Kraft (FSK): Kraft paper with glass fiber yarn and bonded to aluminized film, water vapor permeance of 0.02 perms.
    - c. Color: White.
- D. Cellular Glass:
1. Manufacturers:
    - a. Owens Corning.
  2. Insulation: ASTM C552, Type I, Grade 6, rigid closed glass cells, block form.
    - a. K-value: ASTM C518 or C177, maximum 0.31 at 75 degrees F.
    - b. Minimum Service Temperature: Minus 450 degrees F.
    - c. Maximum Service Temperature: 800 degrees F.
    - d. Density: Minimum 6.12 pounds per cubic feet.
- E. Flexible Elastomeric:
1. Manufacturers:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. K-Flex USA.
  2. Insulation: ASTM C534, Grade I or II, flexible elastomeric cellular rubber insulation, sheet form.
    - a. K-value: ASTM C518 or C177, maximum 0.28 at 75 degrees F.
    - b. Minimum Service Temperature: Minus 40 degrees F
    - c. Maximum Service Temperature: 220 degrees F for Grade I, 300 degrees F for Grade II.

- F. Field-Applied Jacket:
1. Canvas: UL listed, minimum 8 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
  2. Aluminum: ASTM B209, 3003 alloy, H-14 temper, with 3-mil thick polyfilm moisture barrier to interior surface.
    - a. Thickness: 0.032 inch sheet.
    - b. Finish: Smooth.
    - c. Joining: Longitudinal slip joints and 2 inch laps.
    - d. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel.
  3. Stainless Steel: ASTM A666, Type 304 stainless steel.
    - a. Thickness: 0.010 inch sheet.
    - b. Finish: Smooth.
    - c. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.
  4. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW, or approved equal.
    - a. Water Vapor Transmission: 0.0 perms per ASTM E96.
    - b. Puncture Resistance: Minimum 65 pounds per ASTM D1000.
  5. Rubberized Asphalt Vapor Barrier Cladding: UV-resistant aluminum outer layer, multi-ply cross-laminated polyethylene film, and rubberized asphalt formulated for use on faced insulation. Provide Polyguard Products, Inc. Alumaguard 60 mils thick cladding, Alumaguard Low Temp (LT) 35 mils thick cladding, or approved equal.
- G. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors, stud pins, and other appurtenances as recommended by insulation manufacturer for applications indicated.
- H. Adhesives, Sealers, Mastics, and Protective Finishes: Provide cements, adhesives, coating, sealers, mastics, and protective finishes as recommended by insulation manufacturer for applications indicated.
1. Mineral Fiber Lagging Adhesive: Comply with ASTM C916, Type 2 or MIL-A-3316C, Class 2, Grade A. Provide Foster 85-60, Childers CP-127, or equal water-based adhesive.
  2. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 47 mils dry per ASTM E96. Provide Foster 30-80, Childers CP-38, Design Polymeric 3040, or equal.
  3. Lagging Adhesive: Comply with MIL-A-3316C, Class 1, Grade A. Provide Foster 30-36. Childers CP-50AHV2 or equal.
  4. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Test piping and ductwork for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

#### **3.2 PROTECTION AND REPLACEMENT**

- A. Provide all required protection for insulation (installed and uninstalled) throughout the duration of construction to avoid exposure to plaster, dust, dirt, paint, moisture, deterioration, and physical damage.

- B. Repair existing mechanical insulation that is damaged during this construction period. Use insulation of same type and thickness as existing insulation. Install new jacket lapping and sealed over existing.
- C. Replace damaged insulation which cannot be repaired satisfactorily at no additional expense to the Owner, including insulation with vapor barrier damage and insulation that has been exposed to moisture during shipping, storage, or installation. Drying the insulation is not acceptable. Dry surfaces prior to installation of new insulation that replaces the damaged or wet insulation.

### 3.3 INSTALLATION GENERAL

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.

### 3.4 PIPING SYSTEM INSULATION INSTALLATION

- A. Maintain continuous thermal and vapor-retarder integrity throughout entire installation and protect it from puncture and other damage.
- B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- D. Exposed Piping: Locate insulation and cover seams in least visible locations.
- E. Cold Pipe Insulation:
  - 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
  - 2. Provide vapor barrier jacket according to the Piping Jacket Schedule.
  - 3. Provide high density insulation material under supports or pre-insulated supports. Protect insulation with shields to prevent puncture or other damage. Refer to Section "Hangers & Supports for HVAC Piping & Equipment" for pre-insulated supports and insulation shields. and for exception where high density insulation inserts are not required.
  - 4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
  - 5. Secure all-service jacket with self-sealing longitudinal laps.
  - 6. Butt pipe insulation tightly at insulation joints. Apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture ingress.
- F. Hot Pipe Insulation:
  - 1. Insulate entire system, including fittings, valves, unions flanges, strainers, flexible connections, pump bodies, and expansion joints.
  - 2. Provide jackets without vapor barrier according to the Piping Jacket Schedule. Jackets with vapor barrier are allowed.
  - 3. Provide high density insulation material or pre-insulated supports where supports are installed outside of the insulation. Protect insulation with shields to prevent puncture or other damage. Refer to Section "Hangers & Supports for HVAC Piping & Equipment" for pre-insulated supports and insulation shields and for exception where high density insulation inserts are not required.
  - 4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
  - 5. Secure all-service jacket with self-sealing longitudinal laps.
  - 6. Butt pipe insulation tightly at insulation joints and wrap insulation around supports. Apply 3 inch wide vapor barrier tape or band over joint.

- G. Insulation of Fittings, Valves, Strainers, Flanges, and Unions:
1. Insulate fittings, joints, and valves with molded insulation of like material, vapor barrier coating, and thickness as adjacent pipe. Provide pre-formed insulation pieces, segmented insulation, or sectional pipe insulation for the application. Provide the same insulation jacket as adjoining pipe.
  2. Sectional pipe insulation: Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Hold sectional cuts in place with tie wire or bands. Wire and bands shall be compatible with insulation and jacket.
  3. Segmented pipe insulation: Cover segmented insulated surfaces with a layer of finishing cement and finish with a coating or mastic. Reinforce the mastic with fabric-reinforcing mesh. Trowel the coating or mastic to a smooth and well-shaped contour.
  4. Butt each insulation piece tightly against adjoining piece of insulation. Bond pieces together according to Cold Pipe or Hot Pipe installation instructions.
  5. Insulate valves up to and including the bonnets, valve stuffing-box studs, bolts, and nuts with a removeable insulation cover. Sectional valve insulation covers shall divide the section along the vertical center line of the valve body.
  6. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover.
  7. Insulate flanges and unions with a removeable insulation cover. Sectional pipe insulation covers shall divide the section along the center line of pipe.
  8. When removeable covers are made from sectional block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, around the insulated device with tie wire. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  9. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation. PVC fitting covers with end caps are also acceptable. Tape PVC covers to adjoining insulation facing using PVC tape.
  10. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- H. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- I. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated. Maintain vapor barrier through the penetration.
- J. Exterior Piping and Piping Exposed to Weather:
1. General: Provide piping jacket around insulation as scheduled in the Piping Jacket Schedule. Jacket material shall be approved by the jacket manufacturer for use with the specific insulation material that it covers. Locate longitudinal seams of outer shell (aluminum, flexible elastomeric, or cladding as applicable) at bottom of pipe. Provide insulation shields so that the piping supports cannot puncture, cut or break the jacket.
  2. Rigid aluminum shell: Space attachment bands 12 inches on center and directly centered over end joints.

### 3.5 PIPING SYSTEM INSULATION SCHEDULE

- A. Reference Pipe Insulation Thickness Schedule at the end of this specification for thickness requirements based on insulation conductivity.
- B. Do not apply insulation to piping that operates outside of the minimum and maximum service temperature range.

- C. Omit insulation on the following:
1. Hot piping within radiation enclosures or unit cabinets.
  2. Cold piping within unit cabinets provided piping is located over drain pan.
  3. Heating piping between coil and shutoff valves provided piping is located within heated space and not more than three feet from coil.
  4. Condensate piping between steam trap and union.
  5. Steam relief vent piping.
  6. Chiller emergency refrigerant vent piping.
  7. Flexible connections and expansion joints in pipes with fluids above ambient temperatures.
- D. Exterior Piping: Insulate all exterior HVAC piping with one of the following:
1. Cellular glass.
  2. Flexible elastomeric, use high temperature formula for systems with operating temperatures above 220 F. (not acceptable for steam, steam condensate or hot water piping systems with temperatures above 300 F).
- E. Cold Piping (40 degrees F (4.4 degrees C) to 60 degrees F):
1. Service:
    - a. Chilled water supply and return piping.
    - b. Domestic make-up water piping between the backflow preventer and HVAC system connection.
    - c. Air conditioner condensate drain piping.
    - d. Condenser water supply and return piping when used for free cooling.
    - e. Water-source heat pump supply and return water piping.
  2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
    - a. Cellular glass.
    - b. Polyisocyanurate.
    - c. Flexible elastomeric.
    - d. Phenolic.
- F. Warm Temperature Piping (105 degrees to 140 degrees F (40 to 94 degrees C)):
1. Service:
    - a. Heating hot water supply and return piping.
    - b. Refrigerant liquid lines between the condensing unit and expansion valve.
  2. Insulate each piping system specified above with one of the following types of insulation.
    - a. Cellular glass.
    - b. Polyisocyanurate.
    - c. Flexible elastomeric.
    - d. Phenolic.
- G. Hot Non-Steam Piping (141 to 200 degrees F (61 to 94 degrees C)):
1. Service:
    - a. Heating hot water supply and return piping.
    - b. Heated fuel piping.
  2. Acceptable Insulation:
    - a. Cellular glass.
    - b. Calcium silicate.
    - c. Polyisocyanurate.
    - d. Flexible elastomeric .
    - e. Phenolic.

### 3.6 PIPE INSULATION THICKNESS SCHEDULE

- A. IECC – 2015 Requirements, Pipe Insulation

#### Minimum Pipe Insulation Thickness

Insulation Conductivity	Nominal Pipe or Tube Size (in.)
-------------------------	---------------------------------

Fluid Operating Temp. Range (°F) And Usage	Conductivity, Btu·in./(hr·ft <sup>2</sup> ·°F)	Mean Rating Temp., °F.	Insulation Thickness, in.				
			1	1 to 1-1/2	1-1/2 to 4	4 to 8	≥8
350°F	0.32–0.34	250	4.5	5.0	5.0	5.0	5.0
251°F–350°F	0.29–0.32	200	3.0	4.0	4.5	4.5	4.5
201°F–250°F	0.27–0.30	150	2.5	2.5	2.5	3.0	3.0
141°F–200°F	0.25–0.29	125	1.5	1.5	2.0	2.0	2.0
105°F–140°F	0.21–0.28	100	1.0	1.0	1.5	1.5	1.5
40°F–60°F	0.21–0.27	75	0.5	0.5	1.0	1.0	1.0
40°F	0.20–0.26	50	0.5	1.0	1.0	1.0	1.5

## Notes:

- a. For piping smaller than 1-1/2 inch and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted (before thickness adjustment required in footnote b) but not to a thickness less than 1 inch.
- b. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:  $T = r \left[ \frac{1}{t/r} \left( \frac{K}{k} \right) - 1 \right]$  where
  - 1) T minimum insulation thickness (in.),
  - 2) r actual outside radius of pipe (in.),
  - 3) t insulation thickness listed in this table for applicable fluid temperature and pipe size,
  - 4) K conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu·in./hr·ft<sup>2</sup>·°F); and
  - 5) k the upper value of the conductivity range listed in this table for the applicable fluid temperature.
- c. Insulation thicknesses are based on energy efficiency considerations only. Add insulation where noted on the drawings.
- d. For piping that shall be installed below grade, reference Division 23 section "Underground Hydronic and Steam Piping."
- e. The table is based on steel pipe. Non-metallic pipes schedule 80 thickness or less shall use the table values. For other non-metallic pipes having thermal resistance greater than that of steel pipe, reduced thicknesses are permitted if documentation is provided showing that the pipe with the proposed insulation has no more heat transfer per foot than a steel pipe of the same size with the insulation thickness shown on the table.

**3.7 PIPING JACKET SCHEDULE**

- A. Exposed piping within mechanical rooms (below 10 feet):
  1. Semi-rigid PVC.
  2. Rigid aluminum shell.
- B. Exposed piping within mechanical rooms (above 10 feet):
  1. Semi-rigid PVC.
  2. Rigid aluminum shell.
- C. Exposed piping:
  1. All-service jacket.
  2. Semi-rigid PVC.
- D. Piping within return air plenums:
  1. All-service jacket.
- E. Exterior piping and piping exposed to weather:
  1. Rigid aluminum shell.

**3.8 DUCTWORK INSULATION SYSTEM INSTALLATION**

- A. Maintain continuous thermal and vapor-barrier integrity throughout entire installation and protect it from puncture and other damage.
- B. Install insulation on duct systems subsequent to painting, testing, and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces.
- D. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- E. Install insulation without sag on underside of duct. Where rectangular ducts are 24 inches in width or greater, secure external insulation to the bottom of the duct with mechanical fasteners, spaced on 18 inches on center (maximum). Fasteners shall include 2-inch square self-sticking galvanized carbon-steel base plates with minimum 0.106-inch diameter zinc-coated, low carbon steel, fully annealed shank spindle, length to suit depth of insulation. Secure insulation to spindles with self-locking washers incorporating a spring steel insert to ensure permanent cap retention. Lift duct off trapeze hangers and insert spacers to avoid insulation compression.
- F. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- G. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.
- H. Lined Ductwork: At interface of lined and wrapped ductwork, overlap lined ductwork by 2 feet (minimum) with wrapped insulation.
- I. Cold Ducts:
  - 1. Insulate entire system, including fittings, joints, flanges, expansion joints, and air duct accessories.
  - 2. Provide vapor barrier jacket according to the Ductwork Jacket Schedule.
  - 3. Seal joints with vapor barrier mastic.
  - 4. Continue insulation, including vapor barrier, through walls, sleeves, hangers, and other duct penetrations.
  - 5. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
  - 6. Where cold ducts are installed in mechanical rooms or non-conditioned spaces (excludes return air plenums), prevent condensation from forming on the duct supports by providing one or more of the following:
    - a. Install thermal break such as rigid board insulation between the support and duct.
    - b. Wrap support that is in contact with the duct with external duct wrap insulation to prevent condensation. Wrap shall extend a minimum of 12 inches from point of contact of the support with the duct. Tape joints to provide a thermal and vapor barrier. Coat all taped joints, punctures and seams with 4 inch wide coating of vapor barrier mastic.
    - c. If a support device similar to Unistrut is used, foam fill or stuff tube.
- J. Hot and Neutral Ducts:
  - 1. Insulate entire system, including fittings, joints, flanges, expansion joints, and air duct accessories.
  - 2. Provide jackets with or without vapor barrier according to the Ductwork Jacket Schedule.
  - 3. Secure joints with staples, tape, or wires.
  - 4. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- K. Exterior Ductwork and Ductwork Exposed to Weather:

1. Slope ductwork to ensure that water cannot pond anywhere on the duct. Do not vary the insulation thickness to achieve drainage.
2. Jackets shall be approved by the jacket manufacturer for use with the specific insulation material it covers.
3. Locate longitudinal seams of jacket at bottom of duct. Install jacket in strict conformance with cladding manufacturer's instructions.
4. Seal joints with vapor barrier mastic and reinforcing mesh as recommended by manufacturer or protective jacket as specified.
5. Install aluminum jacket with three metal jacket bands per section.
6. Multilayer Laminate Vapor Barrier Cladding: Install cladding only when ambient temperature is above 50 degrees F. Provide low-temp products for installation in low ambient temperatures down to 10 degrees F.
7. Rubberized Asphalt Vapor Barrier Cladding: Install cladding for use in ambient temperatures as low as minus 10 degrees F.
8. Cover seams in flexible metal cladding with ArmaTuff seal tape or equal.

### 3.9 DUCTWORK SYSTEM INSULATION SCHEDULE

- A. Omit insulation on the following:
  1. Fibrous glass ductwork (ductboard).
  2. Lined ductwork that is interior to the building unless otherwise indicated on the drawings.
  3. Ductwork with sound absorbing linings unless otherwise indicated on the drawings.
- B. Prohibited insulation:
  1. Polyisocyanurate installed within a return air plenum.
- C. Outdoor Air:
  1. Service:
    - a. Interior untreated outdoor air intake ducts.
    - b. Combustion air intake ducts.
  2. Acceptable Insulation:
    - a. Flexible mineral fiber.
    - b. Rigid mineral fiber.
    - c. Cellular glass.
    - d. Polyisocyanurate.
    - e. Flexible elastomeric.
- D. Supply Air:
  1. Service:
    - a. Supply ducts from air handling equipment.
    - b. Insulate neck and bells of supply diffusers.
  2. Acceptable Insulation:
    - a. Flexible mineral fiber.
    - b. Rigid mineral fiber.
    - c. Cellular glass.
    - d. Polyisocyanurate.
    - e. Flexible elastomeric.
- E. Return Air:
  1. Service:
    - a. Interior ductwork within 10 feet of exterior roof or wall penetrations.
    - b. Interior ductwork routed through or from unconditioned spaces and plenums.
  2. Acceptable Insulation:
    - a. Flexible mineral fiber.
    - b. Rigid mineral fiber.
    - c. Cellular glass.
    - d. Polyisocyanurate.
    - e. Flexible elastomeric.



- F. Exhaust Air.
1. Service:
    - a. Interior ductwork within 10 feet of exterior roof or wall penetrations.
    - b. Interior ductwork routed through conditioned spaces (excludes ductwork routed in shafts) that is exhausting from unconditioned spaces (such as loading docks, garages, etc.).
    - c. Interior ductwork downstream of heat recovery device (wheel, plate, heat pipe, etc.) to exterior discharge outlet.
    - d. Exterior ductwork upstream of heat recovery device (wheel, plate, heat pipe, etc.).
    - e. Range and kitchen hood non-grease exhaust ductwork.
    - f. Dishwasher exhaust ducts within 10 feet of discharge to the outdoors.
  2. Acceptable Insulation:
    - a. Flexible mineral fiber.
    - b. Rigid mineral fiber.
    - c. Cellular glass.
    - d. Polyisocyanurate.
    - e. Flexible elastomeric.
- G. Range and hood grease exhaust ductwork: Refer to Section "Air Duct Accessories" for requirements of fire-rated wrap insulation for grease exhaust duct.
- H. Relief Air.
1. Service:
    - a. Interior ductwork within 10 feet of exterior roof or wall penetrations.
    - b. Downstream of heat recovery device (wheel, plate, heat pipe, etc.) to exterior discharge outlet.
  2. Acceptable Insulation:
    - a. Flexible mineral fiber.
    - b. Rigid mineral fiber.
    - c. Cellular glass.
    - d. Polyisocyanurate.
    - e. Flexible elastomeric.
- I. HVAC plenums and unit housings not pre-insulated at factory or lined.
1. Acceptable Insulation:
    - a. Flexible mineral fiber.
    - b. Rigid mineral fiber.
    - c. Cellular glass.
    - d. Polyisocyanurate.
    - e. Flexible elastomeric.
- J. Exterior Ductwork:
1. Service:
    - a. Supply ductwork.
    - b. Return ductwork.
    - c. Exhaust ductwork.
    - d. Pre-conditioned outside air downstream of conditioning unit.
    - e. Plenums and unit housings not pre-insulated at factory or lined.
  2. Acceptable Insulation:
    - a. Cellular glass.
    - b. Polyisocyanurate.
    - c. Flexible elastomeric.
    - d. Omit insulation on phenolic foam ductwork and fittings. Refer to Division 23 Section "Nonmetal Ducts."

**3.10 DUCT SYSTEM INSULATION THICKNESS SCHEDULE**

- A. Flexible Mineral Fiber:
  - 1. Interior Ductwork:
    - a. 0
    - b. 1.5 pounds per cubic foot density:
      - 1) 2 inch thick, minimum R-6.0.
  - 2. Meet R-value installed at maximum 25% compression, application limited to concealed locations.
- B. Rigid Mineral Fiber:
  - 1. Interior Ductwork:
    - a. 3 pounds per cubic foot density:
      - 1) 1-1/2 inch thick, minimum R-6.0.
  - 2. Ductwork installed in machine, fan, and mechanical equipment rooms:
    - a. 2 inch thick, minimum R-8.0.
  - 3. Exterior Ductwork or Ductwork Exposed to Weather, or Ductwork:
    - a. 2 inch thick, minimum R-8.0.
  - 4. Ductwork in an Unconditioned Space:
    - a. 1-1/2 inch thick, minimum R-6.0.
- C. Cellular Glass:
  - 1. Interior Ductwork:
    - a. 2 inch thick, minimum R-6.0.
  - 2. Exterior Ductwork or Ductwork Exposed to Weather, or Ductwork:
    - a. 2-1/2 inch thick, minimum R-8.0.
  - 3. Ductwork in an Unconditioned Space:
    - a. 2 inch thick, minimum R-6.0.
- D. Polyisocyanurate:
  - 1. Interior Ductwork:
    - a. 1 inch thick, minimum R-6.0.
  - 2. Exterior Ductwork or Ductwork Exposed to Weather:
    - a. 1-1/2 inch thick, minimum R-8.0.
  - 3. Ductwork in an Unconditioned Space:
    - a. 1 inch thick, minimum R-6.0.
- E. Flexible Elastomeric:
  - 1. Interior Ductwork:
    - a. 1-1/2 inch thick, minimum R-6.0.
  - 2. Exterior Ductwork or Ductwork Exposed to Weather:
    - a. 2 inch thick, minimum R-8.0.
  - 3. Ductwork in an Unconditioned Space:
    - a. 1-1/2 inch thick, minimum R-6.0.

**3.11 DUCTWORK JACKET SCHEDULE**

- A. Omit jacket on internally lined ductwork.
- B. Exposed ductwork within mechanical rooms (below 10 feet):
  - 1. Foil Scrim Kraft (FSK).
  - 2. Polypropylene Scrim Kraft (PSK).
  - 3. All-Service Jacket (ASJ).
  - 4. Polypropylene Scrim Polyester (PSP).
  - 5. Flexible Metal Cladding (flexible elastomeric only).
  - 6. Aluminum with smooth finish.
- C. Exposed ductwork within mechanical rooms (above 10 feet):
  - 1. Foil Scrim Kraft (FSK).

2. Polypropylene Scrim Kraft (PSK).
  3. All-Service Jacket (ASJ).
  4. Polypropylene Scrim Polyester (PSP).
  5. Flexible Metal Cladding (flexible elastomeric only).
- D. Exposed ductwork:
1. Foil Scrim Kraft (FSK).
  2. Polypropylene Scrim Kraft (PSK).
  3. All-Service Jacket (ASJ).
  4. Polypropylene Scrim Polyester (PSP).
  5. Flexible Metal Cladding (flexible elastomeric only).
  6. Aluminum with smooth finish.
- E. Ductwork within return air plenums:
1. Foil Scrim Kraft (FSK).
  2. Polypropylene Scrim Kraft (PSK).
  3. All-Service Jacket (ASJ).
  4. Polypropylene Scrim Polyester (PSP).
  5. Flexible Metal Cladding (flexible elastomeric only).
- F. Ductwork in an unconditioned space:
1. Foil Scrim Kraft (FSK).
  2. Polypropylene Scrim Kraft (PSK).
  3. All-Service Jacket (ASJ).
  4. Polypropylene Scrim Polyester (PSP).
  5. Flexible Metal Cladding (flexible elastomeric only).
- G. Exterior ductwork and ductwork exposed to weather:
1. Flexible Metal Cladding (flexible elastomeric only).
  2. Aluminum with stucco finish.
  3. Multilayer Laminate Vapor Barrier Cladding.
  4. Rubberized Asphalt Vapor Barrier Cladding.
  5. Heavy duty multilayer composite (polyolefin insulation only).

### **3.12 EQUIPMENT INSULATION INSTALLATION**

- A. Install insulation subsequent to painting, testing, and acceptance of tests.
- B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.
- C. Protect insulation to prevent puncture and other damage.
- D. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- E. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.
- F. Do not apply insulation to equipment, breechings, or stacks while hot.
- G. Do not insulate flanges and unions of equipment carrying fluids less than 105 degrees F.
- H. Provide neatly beveled edge at interruptions of insulation.
- I. Fasten insulation to equipment with studs, pins, clips, adhesives, wires, or bands.
- J. Stagger insulation joints for both single and double layer application, where feasible. Apply each layer of insulation separately. Tape all joints using glass cloth or a suitable, matching acrylic adhesive tape; minimum 3 inches wide.

- K. Coat insulated surfaces of calcium silicate with layer of insulating cement, troweled in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- L. Cover insulated surfaces with jacketing, factory or field applied, neatly fitted and firmly secured. Lap seams at least 2 inches. Apply over vapor barrier where applicable. Tape all joints using glass cloth or a suitable, matching acrylic adhesive tape; minimum 3 inches wide.
- M. Cold Equipment:
  - 1. Insulate entire system, including flanges and unions. Maintain continuous vapor-barrier integrity throughout entire installation and protect it from puncture and other damage.
  - 2. Provide vapor barrier jacket, factory or field applied over mineral fiber insulation. Finish with glass cloth or vapor barrier adhesive.
  - 3. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
- N. Hot Equipment:
  - 1. Insulate entire system, including flanges and unions.
  - 2. Provide jacket, with or without vapor barrier, factory or field applied over mineral fiber insulation. Finish with glass cloth or vapor barrier adhesive.
- O. Exterior Equipment and Equipment Exposed to Weather:
  - 1. Jackets shall be approved by the jacket manufacturer for use with the specific insulation material it covers.
  - 2. Seal joints with vapor barrier mastic and reinforcing mesh as recommended by manufacturer or protective jacket as specified.
  - 3. Install aluminum or stainless steel jacket with three metal jacket bands per section.
  - 4. Multilayer Laminate Vapor Barrier Cladding: Install cladding only when ambient temperature is above 50 degrees F. Provide low-temp products for installation in low ambient temperatures down to 10 degrees F.
  - 5. Rubberized Asphalt Vapor Barrier Cladding: Install cladding for use in ambient temperatures as low as minus 10 degrees F.

### 3.13 EQUIPMENT INSULATION SCHEDULE

- A. Omit Insulation on the following:
  - 1. Boiler manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplates.
  - 2. Factory pre-insulated equipment.
- B. Do not apply insulation to equipment that operates outside of the minimum and maximum service temperature range.
- C. Provide flexible removable and reusable blanket insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.
- D. Cold Equipment:
  - 1. Service:
    - a. Refrigeration equipment, including chillers, tanks and pumps.
    - b. Cold surfaces not factory insulated.
    - c. Drip pans under chilled equipment.
    - d. Chilled water buffer tank.
    - e. Chilled water expansion tanks, air separators and piping accessories.
    - f. Chilled water pumps.
  - 2. Acceptable Insulation:
    - a. Flexible Mineral Fiber:
      - 1) 1-1/2 inch thick for cold surfaces above 35 degrees F.
      - 2) 2 inch thick for surfaces 35 degrees F and lower.
    - b. Rigid Mineral Fiber:

- 1) 1-1/2 inch thick for cold surfaces above 35 degrees F.
      - 2) 2 inch thick for surfaces 35 degrees F and lower.
    - c. Cellular Glass:
      - 1) 1-1/2 inch thick for surfaces above 35 degrees F.
      - 2) 2 inches thick for surfaces 35 degrees F and lower.
    - d. Flexible Elastomeric:
      - 1) 1-1/2 inch thick for surfaces above 35 degrees F.
      - 2) 2 inch thick for surfaces 35 degrees F and lower.
- E. Hot Equipment:
  1. Service:
    - a. Boilers.
    - b. Hot water buffer tanks.
    - c. Hot water expansion tanks, air separators, and piping accessories.
    - d. Hot water pumps.
  2. Acceptable Insulation:
    - a. Flexible Mineral Fiber:
      - 1) 3 inch thick for steam boilers and steam-jacketed heat exchangers.
      - 2) 2 inch thick for all other applications.
    - b. Rigid Mineral Fiber:
      - 1) 3 inch thick for steam boilers and steam-jacketed heat exchangers.
      - 2) 2 inch thick for all other applications.
    - c. Calcium Silicate
      - 1) 4-1/2 inches thick for low-pressure boilers and steam-jacketed heat exchangers.
      - 2) 3 inch thick for all other applications.
- F. Coils
  1. Application Requirements: Insulate the following coils that are installed in cold ducts:
    - a. Hydronic coils.
    - b. Refrigerant coils.
    - c. Steam coils.
    - d. Duct mounted electric heaters (do not insulate the control panel of the heater).
  2. Acceptable Insulation:
    - a. For ducts with exterior wrap, apply the same insulation as installed on the duct.
    - b. For ducts with interior duct liner, apply one of the following:
      - 1) Flexible Mineral Fiber: 1-1/2" thick, minimum R4.2.
      - 2) Rigid Mineral Fiber: 1" thick, minimum R-4.2.
      - 3) Cellular Glass: 1-1/2" thick, minimum R-4.2.
      - 4) Flexible Elastomeric: 1" thick, minimum R-4.2.
- G. Breechings, Chimneys, and Stacks:
  1. Service:
    - a. Breechings between heating equipment outlet and stack or chimney connection, except for double wall or factory insulated breechings.
    - b. Stack from bottom to top except for factory insulated stacks.
  2. Acceptable Insulation:
    - a. Flexible Mineral Fiber: 2 inch thick.
    - b. Calcium Silicate: 2 inch thick.
- H. Generator Exhaust:
  1. Service:
    - a. Emergency generator exhaust piping from generator outlet to discharge.
  2. Acceptable Insulation: Insulate each generator exhaust with one of the following types and thicknesses of insulation.
    - a. Flexible Mineral Fiber (ASTM C547 Type II only): 2 inch thick.
    - b. Calcium Silicate: 2 inch thick.

**3.14 EQUIPMENT JACKET SCHEDULE**

- A. Omit jacketing on equipment pre-insulated and jacketed from the factory.
- B. Interior Equipment (all except flexible elastomeric insulation):
  - 1. Canvas.
  - 2. Aluminum.
  - 3. Stainless steel.
- C. Equipment in unconditioned spaces (all except flexible elastomeric insulation):
  - 1. Canvas.
  - 2. Aluminum.
  - 3. Stainless steel.
- D. Exterior Equipment or Equipment Exposed to Weather:
  - 1. Aluminum.
  - 2. Stainless Steel.
  - 3. Multilayer Laminate Vapor Barrier Cladding.
  - 4. Rubberized Asphalt Vapor Barrier Cladding.
- E. Exterior Generator Exhaust or Generator Exhaust Exposed to Weather:
  - 1. Aluminum.
  - 2. Stainless Steel.

END OF SECTION

**SECTION 23 08 00 - COMMISSIONING OF HVAC SYSTEMS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Commissioning process requirements for HVAC systems, assemblies, and equipment.

**1.2 SUMMARY**

- B. Commissioning Authority
  - 1. Retain the services of a third-party registered design professional or approved agency that is regularly engaged in conducting commissioning to perform the duties of the Commissioning Authority including development of the commissioning plan, supporting documentation, and reports.
- A. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned shall be responsible for the commissioning activities relating to that system or equipment item.
- B. The Commissioning Authority (CxA) shall direct and coordinate all commissioning activities and provide Prefunctional Checklists and Functional Test Procedures for Contractor's use.
- C. The entire HVAC system and its appurtenances shall be commissioned, including controls, ductwork, piping, noise and vibration control devices, specialty systems (e.g., smoke control systems), and other systems identified elsewhere in the Contract Documents.
- D. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

**1.3 RELATED REQUIREMENTS**

- A. Division 01 Commissioning requirements that apply to all types of work.

**1.4 REFERENCE STANDARDS**

- A. ASHRAE Guideline 0 – The Commissioning Process, most current edition.
- B. ASHRAE Guideline 1.1 - The HVAC Commissioning Process; most current edition.

**1.5 DEFINITIONS**

- C. Refer to Division 01 "General Commissioning Requirements" for additional abbreviations and definitions.
- A. BAS: Building Automation System.
- B. Commissioning Authority (CxA): An entity who coordinates the commissioning team to implement the Commissioning Process.
- C. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process.
- D. Commissioning Process: A quality-focused process for enhancing the delivery of a project. The process focuses on verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the OPR. Commissioning is intended to achieve the following objectives:

1. Verify that applicable systems and equipment are designed and installed according to the manufacturer's recommendations and to industry accepted minimum standards.
  2. Verify that applicable systems and equipment receive adequate operational checkout by installing contractors.
  3. Verify and document proper performance of equipment and systems.
  4. Verify that O&M documentation provided to the Owner is complete.
  5. Verify that the Owner's operating personnel are adequately trained.
- E. Commissioning Report: A report that includes the following:
1. Results of final functional performance tests. Organize equipment and components specified by other Divisions in separate sections for independent review.
  2. List of functional performance testing procedures used during commissioning, including measurable criteria for test acceptance.
  3. Itemization of resolved deficiencies found during preliminary commissioning.
  4. List of deferred tests that cannot be performed at the time of final commissioning report preparation because of climatic conditions.
- F. Functional Performance Test (FPT): A test that verifies the equipment or item being tested performs in the manner intended.
- G. Operations and Maintenance Manual (O&M): A system-focused composite document that includes the operation manual, maintenance manual, and additional information of use to the Owner during the occupancy and operation of the building.
- H. Pre-Functional Checklist (PFC): A checklist that verifies all components and accessories related to a system that will be subjected to an FPT are present and functional.
- I. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- J. TAB: Testing, Adjusting, and Balancing.

## 1.6 SUBMITTALS

- A. Updated Submittals: Keep the Commissioning Authority informed of all changes to the HVAC system documentation made during installation, and startup; revise and resubmit when substantial changes are made.
- D. Submit a commissioning plan that includes the following:
1. General project information and commissioning goals.
  2. Commissioning team information.
  3. Narrative description of commissioning process activities, schedules, responsibilities, and personnel required during commissioning.
  4. List of equipment and systems to be tested with description of tests to be performed. Include an explanation of the original design intent.
  5. List of functions to be tested, including calibration and economizer controls.
  6. List of conditions under which the tests shall be performed.
  7. List of measurable criteria for performance.
- B. Draft Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:
1. System name.
  2. List of devices.
  3. Step-by-step procedures for testing each controller after installation, including:
    - a. Process of verifying proper hardware and wiring installation.
    - b. Process of downloading programs to local controllers and verifying that they are addressed correctly.



- c. Process of performing operational checks of each controlled component.
    - d. Plan and process for calibrating valve and damper actuators and all sensors.
    - e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
  4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has "passed" and is operating within the contract parameters.
  5. Description of the instrumentation being used for testing.
  6. Indicate the tests required on each system that should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.
- C. Submit startup reports pre-functional tests, and trend logs for review by the Commissioning Authority.
- E. Submit a copy of the preliminary commissioning report. Preliminary commissioning report shall include the following:
1. Results of preliminary functional performance tests. Organize equipment and components specified by other Divisions in separate sections for independent review.
  2. List of functional performance testing procedures used during commissioning, including measurable criteria for test acceptance.
  3. Completed Commissioning Compliance Checklist.
  4. Itemization of deficiencies found during testing that have not been corrected at the time of preliminary commissioning report preparation.
  5. List of deferred tests that cannot be performed at the time of preliminary commissioning report preparation because of climatic conditions.
  6. List of climatic conditions required for the performance of the deferred tests.
- F. Submit a final commissioning report that includes the following:
1. Results of final functional performance tests. Organize equipment and components specified by other Divisions in separate sections for independent review.
  2. List of functional performance testing procedures used during commissioning, including measurable criteria for test acceptance.
  3. Itemization of resolved deficiencies found during preliminary commissioning.
  4. Submit report to the Engineer and Owner within 90 days of the date of receipt of the certificate of occupancy.
- D. Project Record Documents:
1. Submit as-built drawings indicating changes that occurred during the construction phase.
  2. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
  3. Show actual locations of all sensors on project record drawings.
- G. O&M Manual: The O&M manual shall expand upon the more traditional operating and maintenance documentation to include information gathered during the commissioning process. Include the following for each system:
1. Manufacturer information.
  2. Equipment specifications and recommendations.
  3. Programming procedures and data points.
  4. Narratives.
  5. Other means of illustrating to the Owner how the building, equipment, and systems are intended to be installed, maintained, and operated.
  6. Label that includes required regular maintenance actions for equipment and systems.
    - a. Include in the label the title or publication number for the O&M manual for the model and type of product.
  7. Site information, including facility description, history, and current requirements.
  8. Site contact information.

9. Description of major systems.
10. As-built control schematics for each commissioned system.
11. As-built control sequences for each commissioned system, including final setpoints and list of all control points.
12. Final parameters of all peripheral equipment (e.g., final parameters resident in a VFD).
13. Recommended operating procedures for each piece of primary equipment.
14. Instructions for integrated building systems.
15. Instructions for basic troubleshooting.
16. Recommended schedule of maintenance requirements and frequency, troubleshooting guidelines, and emergency procedures.
17. Site equipment inventory and maintenance notes.
18. Site events log.
19. Copy of all special inspection verifications required by the enforcing agency or standards.

## **PART 2 - PRODUCTS**

### **2.1 TEST EQUIPMENT**

- A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing. Unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. If not otherwise specified, provide test equipment certified and calibrated within the past year of use. Meet the following minimum accuracy requirements:
  1. Temperature sensors and thermometers: Accuracy of plus/minus 0.5 degrees F and resolution of plus/minus 0.1 degrees F.
  2. Pressure sensors: Accuracy of plus/minus 2.0 percent of value within the range of values being measured (not full range of sensor).
- C. Equipment-Specific Tools: Where special testing equipment, tools, and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work. Such equipment, tools, and instruments shall become the property of Owner.

## **PART 3 - EXECUTION**

### **3.1 COMMISSIONING PROCESS OVERVIEW**

- A. The following narrative provides a brief overview of the typical commissioning tasks performed during the design, construction, acceptance, and post-occupancy phases and the general order in which they occur. Coordinate with the CxA to comply with the commissioning requirements of the project.
  1. Owner furnishes documentation to support the OPR and BOD to the design team and CxA.
  2. The design team prepares construction documents to meet the OPR and BOD.
  3. The CxA develops the commissioning plan.
  4. Plans are permitted and construction-related submittals for all commissioned equipment are provided to the CxA during the normal submittal process.
  5. The CxA develops specific equipment PFCs and furnishes them to the contractor.
  6. The CxA conducts a kick-off meeting early during construction and presents the commissioning process for the project.
  7. The Contractor coordinates project construction and prepares the project for inspecting, acceptance testing, and PFCs.
  8. The Contractor coordinates with the CxA to execute and document the PFCs. The CxA reports on the PFC process including an issues report.
  9. PFCs are completed before start-up, testing and balancing, and functional testing.

10. The Contractor and responsible subcontractors shall document equipment start-up and initial checkout with assistance from manufacturer's technicians. The CxA may request copies of the manufacturer's or contractor's field start-up reports.
11. The CxA develops specific FPT plans for review by the Engineer, Contract Administrator and responsible subcontractors.
12. The Contractor coordinates TAB for the project.
13. Testing, adjusting and balancing of completed HVAC systems is completed and verified by the CxA.
14. The Contractor and responsible subcontractors complete the installation and checkout of all building control systems.
15. The CxA coordinates and executes the FPTs with the assistance of responsible subcontractors. The CxA reports on the testing process including all observed deficiencies.
16. The CxA develops a preliminary commissioning report.
17. Testing of other commissioned systems not requiring formal functional testing is completed.
18. The CxA reviews close-out documentation and schedules deferred testing.
19. The Contractor and CxA coordinate to compile the O&M manual.
20. The CxA verifies training as required by the Contract Documents is completed.
21. The CxA develops a final commissioning report.
20. Recommended energy efficiency measures.

### 3.2 PREPARATION

- A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.
- B. Furnish additional information requested by the Commissioning Authority.
- C. Prepare a preliminary schedule for use by the Commissioning Authority. Develop the following schedules and update the schedule as appropriate during the course of construction:
  1. Leakage testing of duct systems.
  2. Pressure testing of piping systems.
  3. Flushing and cleaning piping systems.
  4. Equipment startup.
  5. Testing, adjusting, and balancing systems.
- D. Notify the Commissioning Authority when scheduled tests shall occur. When commissioning activities not yet performed or not yet scheduled will delay construction, notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.
- E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
  1. Include cost of sheaves and belts that may be required for testing, adjusting, and balancing.
- F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.
- G. Provide temperature and pressure taps in accordance with the contract documents.
  1. Provide a pressure/temperature plug at each water sensor that is an input point to the control system.

### 3.3 INSPECTING AND TESTING - GENERAL

- A. Refer to the latest adopted edition of the applicable energy code for more information.

**3.4 PREFUNCTIONAL CHECKOUT**

- A. Submit startup plans, startup reports, and PFCs for each item of equipment or other assembly to be commissioned.
- B. PFCs shall demonstrate the commissioned equipment is properly installed and ready for startup and initial operation.
- C. Perform the PFCs directed by the CxA for each item of equipment or other assembly to be commissioned.
- D. Document items from the PFCs and startup that were not completed successfully.
- E. Complete and submit all PFC forms and provide notice that the equipment is ready for testing, adjusting, and balancing.
- F. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

**3.5 TESTING AND BALANCING COORDINATION**

- A. Coordinate commissioning schedule with TAB schedule.
- B. Notify the CxA at least 7 days in advance of testing and balancing work. Provide access for the CxA to witness test TAB work.
- C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
- D. All required Prefunctional Checklists, calibrations, startup, and component Functional Tests of the system shall be completed and approved by the CxA prior to starting TAB.
- E. Coordinate with the BAS and TAB Contractor to make available technicians, instrumentation, and tools to assist the CxA in verification of data points associated with TAB of HVAC systems.

**3.6 FUNCTIONAL PERFORMANCE TESTING**

- A. The CxA shall furnish FPT procedures to the subcontractors and equipment manufacturers for review for feasibility, safety, equipment, and warranty protection.
- B. Perform the FPTs directed by the CxA for each item of equipment or other assembly to be commissioned, including equipment, controls, and economizers. FPTs shall demonstrate the following:
  - 1. The operation, function, and maintenance serviceability for each commissioned equipment, component, and system is confirmed according to the approved plans and specifications.
  - 2. The sequence of operations, including modes, backup modes (if applicable), alarms, and mode of operation upon a loss of power and restoration of power for each control device, equipment, component, and system. Reference section Control System Functional Testing below for more information.
  - 3. Control devices, components, equipment, and systems are calibrated, adjusted, and operate in accordance with the approved plans and specifications.
  - 4. Air economizers operated in accordance with manufacturer's specifications and specified sequence of operation.
  - 5. Terminal units: For multiples of like equipment (VAV terminal units, unit heaters, etc.), commission a minimum of 50 percent of total number of units.
- C. Coordinate with the responsible sub-contractors to provide trained technicians to perform commissioning tests and/or coordinate with equipment manufacturers to make available authorized technicians for the same purpose.

- D. Test equipment under design conditions when possible. Impose simulated design conditions using an artificial load when it is not practical to test under design conditions. Provide additional equipment to impose simulated loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
  - 1. The CxA may direct that set points be altered when simulating conditions is not practical.
  - 2. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- E. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- F. If the Commissioning Plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.
- G. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

### **3.7 DEFERRED AND SEASONAL TESTING**

- A. If any PFC or FPT cannot be completed due to an unforeseen condition not within control of the Contract Administrator, defer execution of the PFC or FPT based on the recommendation of the CxA and approval of the Owner. Complete the affected testing as soon as practical.
- B. During the warranty period, complete tests purposely delayed until weather conditions are closer to the system's design conditions. The CxA shall coordinate this activity. Any final adjustments to the O&M manuals and/or as-built drawings due to the testing shall be made by the CA.

### **3.8 OPERATION AND MAINTENANCE MANUALS**

- A. See Division 01 and Section "General Mechanical Requirements for HVAC" for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

### **3.9 DEMONSTRATION AND TRAINING**

- A. See Division 01 for additional requirements.
- B. Complete all related commissioning requirements prior to final inspections.
- C. Demonstrate operation and maintenance of HVAC system to Owner' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
- D. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
- E. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned.
- F. Provide the services of manufacturer representatives to assist instructors where necessary.

- G. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
- H. Document systems operations training in the commissioning report.

END OF SECTION

**SECTION 23 09 13 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Control panels.
- B. Fire-Fighter Smoke Control Panel.
- C. Control valves.
- D. Control dampers.
- E. Operators.
- F. Flow measuring apparatus.
- G. Input/Output sensors and transmitters.
- H. Output control devices.
- I. Power Supplies.
- J. Thermostats.

**1.2 DEFINITIONS**

- A. BAS: Building Automation System.
- B. Control Wiring: Includes conduit, wire and wiring devices to install complete control systems including motor control circuits, interlocks, thermostats, EP and IP switches and like devices. Includes all wiring from Intelligent Devices and Controllers to all sensors and points defined in the input/output summary shown on the drawings or specified herein and required to execute the sequence of operations.
- C. Cv: Design Valve Flow Coefficient.
- D. DDC: Direct Digital Control.
- E. EPDM: Ethylene Propylene Diene Monomer.
- F. High voltage: 50 volts or higher.
- G. Low voltage: Below 50 volts.
- H. PTFE: Polytetrafluoroethylene.
- I. TEFZEL: A modified ETFE (ethylene tetrafluoroethylene) fluoroplastic.

**1.3 CONTRACTOR RESPONSIBILITIES**

- A. Reference Division 23 Section "Electrical Coordination for Mechanical Equipment" for contractor responsibilities.
- B. BAS Contractor:
  - 1. Installation of the BAS shall be by the BAS Contractor or their subcontractors.
  - 2. Low voltage control wiring.
  - 3. Coordinate high voltage control wiring to instrumentation and control devices with Division 26. Where high voltage power is required for instrumentation and control devices that is in addition to what is shown on the drawings, the BAS contractor shall cover the cost of providing this wiring.

4. All interlock wiring regardless of voltage (e.g., exhaust fan interlocked to supply fan).
  5. Coordinate with Division 26 that motor starters are provided with auxiliary contacts as required for interlocks.
  6. Coordinate power wiring to BAS controllers and instrumentation and control devices with Division 26.
  7. Coordinate installation of back-box rough-in for wall-mounted control devices sensors, etc. with Division 26. Coordinate with mechanical contractor all locations, quantities, and sizes required for installation by Division 26.
  8. Perform startup and demonstration services as specified in Section "Direct Digital Control for HVAC".
  9. Smoke Control Systems: Coordinate all control panels and devices used as part of the smoke control systems are provided with an uninterruptible power system (UPS) to allow for continuous operation of all smoke control equipment during loss of normal power until stand by power is achieved. Coordinate the type and size required for the UPS with Division 26.
- C. Sheet Metal Contractor:
1. Installation of automatic control dampers, smoke control dampers, and necessary blank off plates.
  2. Access doors where and as required.
- D. Mechanical Contractor:
1. Installation of immersion wells.
  2. Installation of flow switches.
  3. Installation of automatic control valves.
  4. Installation of pressure tappings and associated shut-off cocks.
  5. Coordinate conduit and wall box rough-in, power wiring and magnetic starter requirements for controls and mechanical equipment with Division 26.

#### 1.4 SUBMITTALS

- A. Refer to Division 01 for submittal procedures.
- B. Product Data: Provide description and engineering data for each control system component. Include dimensions, capacities, size, performance characteristics, electrical characteristics, and finishes of materials.
- C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
- D. Schedule for control valves and actuators, including the following:
1. Tag.
  2. Quantity.
  3. Model number.
  4. Equipment served.
  5. Flow at project design conditions.
  6. Selected valve flow coefficient (Cv). For butterfly valves, submit the corresponding valve position at which the Cv is calculated.
  7. Pressure differential drop across valve at project design flow conditions and selected Cv.
  8. Maximum close-off pressure.
  9. Valve Configuration (2-way/3-way).
  10. Valve Normal Position and Fail Position (e.g., NO/FO; normally open/fail open).
  11. Valve Size.
  12. Line Size.
  13. Valve Type.
  14. Actuator Signal Type (Open/Close, Modulating 0-10 Vdc, 2-10 Vdc, 4-20 mA, etc.)



15. Torque required to close valve at pump shutoff head.
  16. Selected actuator maximum torque output.
- E. Manufacturer's Instructions: Provide for all manufactured components.
  - F. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
  - G. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
  - H. Warranty: Submit manufacturer warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
  - I. Fire Fighter Control Panel Graphics: Submit the mechanical smoke control system graphic display with color chart.
  - J. Fire Fighter Control Panel Verification Test Exceptions: Submit documentation to the Owner and Engineer, signed by the authority having jurisdiction, for all devices, equipment, and components approved to be exempt from the weekly verification test sequence required by the building code.

### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Control valves shall be manufactured in plants located in the United States or certified to meet the specified ASTM, ANSI and MSS standards.
- D. Measurement devices and sensors shall be calibrated using NIST traceable standards.

### **1.6 WARRANTY**

- A. Correct defective Work within a one year period after Substantial Completion.
- B. Provide extended warranty for control devices and equipment as specified herein.

## **PART 2 - PRODUCTS**

### **2.1 CONTROL PANELS**

- A. Construction:
  1. Panel shall be UL 508A listed.
  2. NEMA 250, general purpose utility enclosures with enameled finished face panel.
  3. NEMA 4X utility enclosure for outdoor or wash-down applications.
  4. Provide common keying for all panels.

### **2.2 FIRE-FIGHTER SMOKE CONTROL PANEL**

- A. General:
  1. Comply with local building code.
  2. Include manual control and override of automatic control of mechanical smoke control systems.
  3. Include a graphic display with switches for control and indicator lights for monitoring status and override of automatic control of smoke control equipment as specified herein and described on the drawings.

4. UL864 – UUKL listed as a Firefighters Smoke Control Station.
- B. Construction:
1. Unitized cabinet, primed and painted with a baked enamel, textured finish. Provide a security door with viewing window.
  2. Include an aluminum substrate for mounting of graphics, indicating lights, switches, control devices and test stations.
  3. Front panel shall have a polyester film overlay protected by a non-glare textured coating which is non-yellowing, durable and scratch resistant. The overlay shall be bonded to the front panel with an adhesive that does not delaminate and provides 100 percent bonding.
  4. Graphics: The front panel overlay shall be a multi-color graphic display showing the mechanical smoke control system as shown on the drawings. Smoke control fans within the building shall be shown on the fire-fighter's control panel. Display a clear indication of the direction of airflow and the relationship of components.
  5. Switches: Rotary or flip type for ON-OFF-AUTO, OPEN-AUTO-CLOSE, ON-OFF or OPEN-CLOSE operation as required per code for the operated equipment. Include a keyed switch for panel enable and a momentary test button for sample testing of all indicating lights.
  6. Indicating Lights: High intensity LED or pilot-lamp type lights of colors as required by code. Indicate the following:
    - a. Normal, Off, On, or Fault status of equipment.
    - b. Positive confirmation of actuation, testing, manual override, and the presence of power downstream of all disconnects.
    - c. Panel power.
    - d. Panel communication fault.
  7. Audible Signal: Provide audible signal to indicate failure of smoke control equipment.
- C. Operating Features:
1. Full monitoring and manual control capability over smoke control systems or equipment.
  2. Capability to override any operation in progress or other control signal associated with the smoke control equipment except electrical overload or personnel safety devices.
  3. Act as highest priority over the smoke control systems or equipment.
  4. Indicate actual status of systems and equipment used for smoke control.
  5. Ability to activate an audible signal if the operational proof sensor failed to provide positive feedback that the equipment operated as commanded.
  6. Alarm a failure of smoke control systems or equipment.
  7. Provisions for verification of system operation.
  8. Conduct a pre-programmed weekly test sequence to report abnormal conditions audibly, visually, and by printed report. The pre-programmed weekly test shall operate all devices, equipment, and components used for smoke control.

## 2.3 CONTROL VALVES

- A. General:
1. Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated. Each valve shall be equipped with proper packing to ensure there will be no leakage at the valve stem.
  2. Pressure Ratings:
    - a. Valve body and packing rated to withstand the system static head plus the maximum pump head and the maximum temperature of the control medium (i.e. chilled water, steam, hot water, etc.).
      - 1) Minimum pressure class 150 psig.
    - b. Two-way modulating valves and their operators shall have close-off pressure ratings exceeding the dead-head condition of the pump in the system it serves.
    - c. Two-way modulating valves with equal percentage flow characteristics and their operators shall be rated to safely operate within a differential pressure range between 2 and 50 psi across the valve without cavitating.
  3. Sizing:

- a. Hydronic Systems:
  - 1) Two-Position: Line size or sized using a maximum pressure differential of 1 psi. Size butterfly valves using the 90 degree flow coefficient (Cv).
  - 2) Modulating: Select valves with an appropriate flow coefficient (Cv) to achieve a minimum design valve authority of 0.5 relative to the total pressure drop of the piping branch the valve controls. Calculate Cv based on the larger of the following:
    - a) 5-psig pressure drop at the design flow rate specified in the Schedules.
    - b) Twice the equipment design pressure drop as specified in the Schedules unless otherwise noted:
      - i) Minimum Flow Primary Bypass Valve: Refer to the drawings for the required flow rate and pressure drop.
    - c) Valve shall not be less than 1/2 Inch in size.
    - d) Size butterfly valves using the 60 degree of full open flow coefficient (Cv).
- 4. Flow Characteristics:
  - a. Hydronic Service:
    - 1) Two-way valves: Equal percentage characteristic.
    - 2) Three-way valves: Linear characteristic.
    - 3) Chiller isolation valves: Linear characteristic.
  - b. Steam Service: Linear flow characteristics.
- 5. End Connections:
  - a. Reference the Control Valve Schedule in Part 3 for allowable end connections by pipe material.
  - b. Carbon steel and stainless steel valves shall comply with ASME B16.34.
  - c. Comply with ASME B16.10 for face-to-face and end-to-end dimensions.
  - d. Threads:
    - 1) Comply with ASME B1.20.1.
    - 2) Comply with ASME B16.4 for cast iron.
    - 3) Comply with ASME B16.15 for cast copper alloys, including bronze and brass.
  - e. Flanges:
    - 1) Comply with ASME B16.5 for steel.
    - 2) Comply with ASME B16.1 for cast iron
    - 3) Comply with ASME B16.24 for cast copper alloys, including bronze and brass.
  - f. Grooved Fittings:
    - 1) Water services to 230 deg F and 250 psig.
- B. Globe Pattern:
  - 1. Size: Reference the Control Valve Schedule in Part 3 for allowable valve size and end connection by application.
  - 2. Construction:
    - a. Up to 2 inches: Class 150, ASTM B62 bronze body, bronze trim, rising stem, renewable composition disc, screwed ends with backseating capacity repackable under pressure.
      - 1) Bronze body and bonnet shall conform to ASTM B62 up to pressure class 150. Conform to ASTM B61 for pressure class 200 and higher.
    - b. Over 2 Inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.
      - 1) Iron body and bonnet shall conform to ASTM A126, class B.
    - c. Bonnet:
      - 1) Bronze body, Class 125: Threaded type.
      - 2) Bronze body, Class 150 or higher: Union type.
      - 3) Iron body: Bolted type.
    - d. Disc Material:
      - 1) PTFE.
      - 2) Stainless steel.

- e. Stem: Outside screw and yoke. Include extension for insulation.
  - f. Two-piece brass packing gland assembly, non-asbestos composition packing.
  - 3. Rangeability: Minimum 50:1.
  - 4. Leakage:
    - a. Up to 1-1/4 Inch: Minimum ANSI Class III per ANSI/FCI 70-2.
    - b. 1-1/2 Inch and Larger: Minimum ANSI Class IV per ANSI/FCI 70-2.
  - 5. Design and Testing:
    - a. MSS SP-80 for bronze.
    - b. MSS SP-85 for cast iron.
- C. Ball Pattern:
- 1. Size: Reference the Control Valve Schedule in Part 3 for allowable valve size by application.
  - 2. Construction:
    - a. Body:
      - 1) Bronze conforming to ASTM B61, B62, and B584.
      - 2) Forged brass with or without nickel plating conforming to ASTM B283.
      - 3) Cast carbon conforming to ASTM A216.
      - 4) Cast iron according to ASTM A126.
      - 5) Stainless steel conforming to ASTM A351.
    - b. Up to 2 inches: Two-piece construction
    - c. 2-1/2 inch to 3 inch: Three-piece construction.
    - d. Stainless steel, blowout proof stem. Include extension for insulation.
    - e. Replaceable PTFE seats and EPDM O-ring or PTFE packing seals.
  - 3. Ball: Full port with characterized insert comprised of the following material:
    - a. Stainless steel.
    - b. Chrome-plated.
    - c. Nickel-plated.
  - 4. Rangeability: Minimum 50:1.
  - 5. Leakage: Minimum ANSI Class IV per ANSI/FCI 70-2.
  - 6. Design and Testing:
    - a. MSS SP-72 for flanged ends.
    - b. MSS SP-110 for threaded and grooved ends.
- D. Butterfly Pattern:
- 1. Size: Reference the Control Valve Schedule in Part 3 for allowable valve size by application.
  - 2. Construction:
    - a. Body: Lug ends suitable for connecting to ASME B16.5 flanges, or grooved ends.
      - 1) Cast iron according to ASTM A126.
      - 2) Ductile iron according to ASTM A536.
      - 3) Cast steel according to ASTM A216.
    - b. Disc:
      - 1) Aluminum bronze.
      - 2) Stainless steel.
      - 3) One-piece nylon coated ductile iron disc. Nylon coated discs are not allowed for open loop condenser water systems.
    - c. Stem: 416 Stainless steel. Include extension for insulation.
    - d. Replaceable PTFE or EPDM seats and seals.
  - 3. Rangeability: Minimum 20:1.
  - 4. Leakage: Minimum ANSI Class IV, per ANSI/FCI 70-2.
  - 5. Design and Testing: MSS SP-67 for Class 150 and MSS SP-68 for pressure classes above 150.
- E. Manufacturers:
- 1. Belimo.
  - 2. Bray.

3. Danfoss.
  4. Fisher Controls.
  5. Griswold Controls.
  6. Honeywell.
  7. Johnson Controls, Inc.
  8. Kele.
  9. Schneider Electric.
  10. Siemens.
  11. Victaulic (Tour & Andersson).
- F. At the contractor's discretion, control valves and balancing valves may be combined into a single device. Submit pricing deduct as an alternate to the base bid.
1. Manufacturers:
    - a. Victaulic, TBV-TC/TCM Series.
- G. Pressure Independent Control Valves (PICV):
1. Sizing:
    - a. Size valve and cartridge based on design flow rate through the circuit it serves. Choose the smallest valve rated by the manufacturer capable of delivering the design flow rate unless otherwise noted.
  2. Construction:
    - a. Factory fabricated, Integrated valve body that incorporates an adjustable flow coefficient (Cv) chamber and separate pressure regulating chamber to maintain a constant differential pressure across the valve.
    - b. Field-adjustable: Capable of modifying the valve flow characteristics without removing the valve from the piping system.
    - c. Valve shall have a minimum of two integral ports factory installed capable of being used to measure pressure or temperature. If valve does not have these ports, contractor shall provide test ports on each side of valve for field verification.
    - d. 2 Inch and Smaller:
      - 1) Forged brass body conforming to ASTM B283.
    - e. 2-1/2 Inch and Larger:
      - 1) Ductile iron body conforming to ASTM A536.
      - 2) Cast carbon body conforming to ASTM A216.
      - 3) Stainless steel body conforming to ASTM A351.
    - f. Flow Regulator: Stainless steel.
    - g. Stem: Brass or stainless steel, blowout proof. Include extension for insulation.
    - h. Replaceable PTFE seats and EPDM O-ring or PTFE packing seals.
    - i. Characterizing Disc:
      - 1) Ball Type: Full port with characterized insert comprised of the following material:
        - a) Stainless steel.
        - b) Chrome-plated.
        - c) Nickel-plated.
      - 2) Plug Type: Brass, TEFZEL, or stainless steel characterizing disc.
  3. Electronic Actuator:
    - a. Direct mounted, self-calibrating type designed for minimum 60,000 full-stroke cycles at rated force.
    - b. Supplied from the same manufacturer as the valve.
    - c. Include visible position indicator.
    - d. Overload Protection: Electronic overload or digital rotation-sensation circuitry.
    - e. Fail-Safe Operation: Mechanical, spring-return mechanism or Capacitance return.
    - f. Power Requirements: 24 VAC/DC motor; accepting a 0-10 Vdc or 4-20 mA signal.
  4. PICVs shall be individually flow tested and factory verified with calibrated instruments to deviate not more than  $\pm$  5 percent through the selected operating pressure range. A calibrated performance tag shall be provided with each valve that verifies the flow in 10 degree rotation increments up to full rated flow.

5. Accuracy: PI control valve shall accurately control the flow from 0 to 100 percent rated flow within an operating pressure differential range of 5 to 50 psi across the valve.
6. Leakage: Minimum ANSI Class IV per ANSI/FCI 70-2. Valve shall be equipped with proper packing to ensure there will be no leakage at the valve stem.
7. Design and Testing:
  - a. MSS SP-72 for flanged ends.
  - b. MSS SP-110 for threaded and grooved ends.
8. PI control valves shall be provided with electronic actuator driven by a 24VAC/DC motor from a 0-10Vdc or 4-20 mA signal.
9. Extended Warranty: Minimum of 5 years from date of shipment.
10. Manufacturers:
  - a. Belimo.
  - b. Bray.
  - c. Danfoss.
  - d. Flow Control Industries.
  - e. Griswold Controls.
  - f. Honeywell.
  - g. Johnson Controls.
  - h. Oventrop.
  - i. Victaulic (Tour & Andersson).

## 2.4 CONTROL DAMPERS

- A. Dampers shall be factory fabricated and sized as shown on drawings and as specified.
- B. Individual damper sections shall not be larger than 48 inches x 60 inches. Provide a minimum of one damper actuator per section.
- C. Performance: Test in accordance with AMCA 500-D.
  1. Pressure Drop: Unless otherwise scheduled or indicated on the Drawings, size control dampers as follows:
    - a. Modulating Dampers: Provide dampers with linear flow characteristics. Size modulating dampers based on the smaller of the following.
      - 1) Maximum velocity of 1,500 feet per minute.
      - 2) Maximum Full-open air pressure drop of 0.1 inches W.C.
    - b. Two Position Dampers: Dampers shall be full duct size and selected to minimize pressure drop.
  2. Leakage:
    - a. Motorized dampers for outdoor, exhaust and relief air and for shaft and stairway vents shall be Class I leakage and shall not exceed 4.0 CFM/square foot in full closed position at 1 inch W.G. pressure differential across damper.
    - b. Motorized dampers for other applications shall be Class II leakage.
  3. All control dampers used for smoke control shall conform to UL555S. Dampers that are installed in fire rated assemblies requiring fire rating shall also conform to UL555.
    - a. Fire/smoke dampers shall have fire resistance of 1-1/2 or 3 hours in accordance with UL 555 as required for the rated assembly that damper is installed.
      - 1) Fire/smoke damper shall have elevated temperature rating of 250 F to remain open during smoke control operation.
    - b. Fire/smoke and smoke dampers shall be rated for Leakage Class I in accordance with UL555S and shall be rated for dual direction airflow.
- D. Frames: Galvanized steel, extruded aluminum, or stainless steel, welded or riveted with corner reinforcement.
  1. Use minimum 16 gauge for rectangular dampers.
  2. Use minimum 20 gauge for round dampers.
  3. For aluminum frames, use 1/8 inch thick material.
  4. All damper frames shall have a flange for duct mounting.

5. Reference Part 3 Execution for application of the material type.
- E. Blades: Galvanized steel, extruded aluminum, or stainless steel, maximum blade size 6 inches wide, 48 inches long, attached to minimum 1/2 inch shafts with set screws.
  1. Use minimum 16 gauge for rectangular dampers.
  2. Use minimum 16 gauge for round dampers.
  3. For aluminum blades, use 1/8 inch thick material.
  4. The blades shall be suitable for the air velocities to be encountered in the system.
  5. Dampers longer than the maximum blade length shall be fabricated in sections.
  6. Reference Part 3 Execution for application of the material type.
- F. Blade Seals: Synthetic elastomeric inflatable or Neoprene, mechanically attached, field replaceable.
  1. Installed along the top and bottom of the frame and on all mating surfaces.
- G. Jamb Seals: Spring stainless steel.
  1. Installed inside the frame sides.
- H. Shaft Bearings: One of the following as recommended by manufacturer for the application:
  1. Oil impregnated sintered bronze.
  2. Graphite impregnated nylon sleeve with thrust washers at bearings.
  3. Lubricant free, stainless steel, single row, ground, flanged, radial, antifriction type with extended inner race.
  4. Molded synthetic bearings.
- I. Linkage Bearings: One of the following as recommended by manufacturer for the application:
  1. Oil impregnated sintered bronze
  2. Graphite impregnated nylon.
- J. Maximum Pressure Differential: 6 inches wg.
- K. Temperature Limits: -40 to 200 degrees F.
- L. Smoke Control Damper Accessories
  1. Fire/Smoke Damper
    - a. Fire Stat: Provide UL classified dual temperature device that allows the damper to be re-opened after initial closure from high heat. Fire stat shall lock the damper closed when duct temperature exceeds temperature of 250 350 F. Fire stat shall allow the damper to remain operable from the control panel for smoke management purposes while air temperature is below the elevated temperature range specified herein.
    - b. Blade Position Indicator Switches: Provide two position indicator switches linked directly to the damper blade to enable remote indication of damper position.
    - c. Factory Sleeve: Provide minimum 20 gauge thick sleeve of length as required for the installation.
  2. Smoke Damper:
    - a. Blade Position Indicator Switches: Provide two position indicator switches linked directly to the damper blade to enable remote indication of damper position.
    - b. Factory Sleeve: Provide minimum 20 gauge thick sleeve of length as required for the installation.
- M. Manufacturers:
  1. Greenheck.
  2. CESCO.
  3. Pottorff.
  4. Nailor.
  5. Ruskin.
- N. Reference the Damper Schedule in Part 3 for basis of design damper model and material for the application.

## 2.5 OPERATORS

### A. General:

1. Voltage: Voltage selection shall be as required to achieve the required torque for the application.
  - a. Reference Part 3 for Damper Operator Voltage Schedule.
2. Type: Motor operated, with or without gears. Motor type shall be continuous duty.
3. Construction:
  - a. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
  - b. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
  - c. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.
4. Field Adjustment:
  - a. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
  - b. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.
5. Two-Position Actuators: Single direction, spring return or reversing type. End-switches shall be integral to the actuator to determine actuator status.
6. Modulating Actuators:
  - a. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
  - b. Control Input Signal:
    - 1) Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position and other input drives actuator to close position. No signal of either input remains in last position.
    - 2) Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10-Vdc or 2- to 10-Vdc and 4- to 20-mA signals.
    - 3) Pulse Width Modulation (PWM): Actuator drives to a specified position according to pulse duration (length) of signal from a dry contact closure, triac sink, or source controller.
  - c. Programmable Multi-Function:
    - 1) Control Input, Position Feedback, and Running Time: Factory or field programmable.
    - 2) Diagnostic: Feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
    - 3) Service Data: Include, at a minimum, number of hours powered and number of hours in motion.
7. Position Feedback:
  - a. Where indicated on the controls drawings, equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
  - b. Where indicated on the controls drawings, equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
  - c. Actuator shall contain position indicator and graduated scale indicating open and closed travel limits.
8. Integral Overload Protection:
  - a. Provide against overload throughout the entire operating range in both directions.
  - b. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.
9. Attachment:



- a. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to device without the need for connecting linkages.
  - b. Attach actuator to device drive shaft in a way that ensures maximum transfer of power and torque without slippage.
10. Temperature and Humidity:
    - a. Temperature: Suitable for operating temperature range encountered by application.
    - b. Humidity: Suitable for humidity range encountered by application, non-condensing.
  11. Enclosure:
    - a. Suitable for ambient conditions encountered by application.
    - b. NEMA 4 for indoor wash-down or wet locations.
    - c. NEMA 4X, Belimo ZS-300, or equivalent; for outdoor applications.
    - d. Provide actuator enclosure with heater and control where required by application.
  12. Stroke Time:
    - a. Coordinate with stroke time indicated on the control drawings.
    - b. Unless otherwise noted, select operating speed to be compatible with equipment and system operation.
- B. Damper Operators:
1. Controls contractor shall size damper operator.
  2. Sizing: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
    - a. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
    - b. Provide one operator for maximum 20 sq ft damper section or maximum 7 in-lb/sq ft damper area.
  3. Fail Positions:
    - a. Spring return to normal position as indicated on freeze, fire, temperature, or loss of power protection. Normal positions are indicated on the control drawings.
      - 1) Return air damper, normally open.
      - 2) Outside air damper, normally closed.
      - 3) Exhaust/Relief air damper, normally closed.
    - b. Operator shall fail in place for all other applications not listed under spring return.
- C. Valve Operators
1. Sizing: Select operator with sufficient torque capacity to operate the valve under all conditions and to guarantee tight shut-off of as specified against system pressure encountered.
    - a. Operators for Hydronic Control Valves: Capable of closing valve against system pump dead head.
  2. Fail Positions:
    - a. Spring return to normal position as indicated on freeze, fire, temperature, or loss of power protection.
      - 1) Pre-heat coil, normally open.
      - 2) Other devices needing fail safe operation to account for freeze protection, power failure, overheating or moisture damage, reference control drawing points list for normal position.
    - b. Operator shall fail in place for all other applications not listed under spring return.
- D. Manufacturers:
1. Damper Operators:
    - a. Belimo.
    - b. Honeywell.
    - c. Johnson Controls.
    - d. Schneider Electric (Invensys).
    - e. Siemens.
  2. Valve Operators:

- a. Belimo.
- b. Bray.
- c. Danfoss.
- d. Fisher Controls.
- e. Honeywell.
- f. Johnson Controls.
- g. Schneider Electric (Invensys).
- h. Siemens.

## 2.6 FLOW MEASURING APPARATUS

### A. Airflow Measuring Stations

1. Sensor quantity and spacing shall comply with the Equal-Area or Log-Tchebycheff method as defined in the ASHRAE Handbook of Fundamentals.
2. Element Construction: Non-corrosive material such as stainless steel, aluminum, or cadmium-plated.
3. Stations and insertion elements utilizing thermal dispersion technology shall utilize hermetically sealed thermistors for each sensor and shall be factory calibrated to NIST traceable standards.
4. Stations and insertion elements using velocity pressure shall be tested and certified in accordance with AMCA 611.
5. Air Inlet Measuring Stations:
  - a. Intended for location within an air inlet to equipment, such as a hood or louver.
  - b. Elements:
    - 1) Element constructed of 316 stainless steel, factory mounted in a circular puck constructed of 14 gauge galvanized steel. Housing shall meet NEMA 1.
    - 2) Element shall not induce a measurable pressure drop, adversely affect fan performance or amplify the sound level within the fan system by its presence in the airstream.
    - 3) Element shall not be affected by the presence of moisture, dirt, or debris in the airstream and shall be unaffected by gusting wind.
    - 4) Density corrected for ambient temperature variances and atmospheric pressure due to altitude.
  - c. Range: Minimum 100 to 2,400 fpm.
  - d. Accuracy: Plus/minus 5.0 percent of reading within the calibrated airflow range.
  - e. Options: Provide with remote monitoring panel for local display.
  - f. Manufacturers:
    - 1) Air Monitor Corporation.
    - 2) Approved equal.
6. Fan Inlet Air Flow Measuring Stations:
  - a. Located in the fan cone inlet with a minimum of two sensing elements.
  - b. Traverse Type Elements:
    - 1) The elements shall not induce a measurable pressure drop, adversely affect fan performance or amplify the sound level within the fan system by its presence in the airstream.
  - c. Surface Mount Probes:
    - 1) Thermal Dispersion Type: Two surface mounted thermal dispersion probes mounted on opposite ends of the fan cone shall monitor the airflow.
    - 2) Velocity Pressure Type: The piezometer ring probes shall monitor the pressure difference between the largest and smallest diameters of the inlet cone venturi. High and low pressure sensors shall be connected to flow tubes extending to a termination plate mounted on the fan housing.
  - d. Range: Minimum 100 to 10,000 fpm.
  - e. Accuracy: Plus/minus 3.0 percent of the measured airflow range.
  - f. Manufacturers:
    - 1) Air Monitor Corporation.

- 2) Ebtron.
  - 3) Greenheck
  - 4) Johnson Controls.
  - 5) Paragon Controls.
  - 6) Ruskin.
  - 7) Sensoco.
7. Duct Air Flow Measuring Stations
- a. Located in a configuration and size equal to that of the duct it is installed.
  - b. The airflow traverse probe shall not induce a measurable pressure drop, nor amplify the sound level within the duct by its presence in the airstream.
  - c. Flow Straightener: Provide flow straightener as required by manufacturer of construction as needed to meet the application.
  - d. Range: Minimum 400 to 4,000 fpm.
  - e. Accuracy: Plus/minus 2.0 percent of the measured airflow.
  - f. Manufacturers:
    - 1) Air Monitor Corporation.
    - 2) Ebtron.
    - 3) Johnson Controls.
    - 4) Paragon Controls.
    - 5) Ruskin.
    - 6) Sensoco.
8. Signal Processor:
- a. Microprocessor-based, field programmable, capable of local display of the measured airflow rate.
  - b. Factory calibrated to NIST traceable standards.
  - c. Accuracy: 0.1 percent of full scale, including linearity, hysteresis, dead band, and repeatability.
  - d. Output: 0 to 10 Vdc or 4-20 mA scaled output signal for remote monitoring.
- B. Water Flow Meter: Provide Water Flow Meter as specified in Division 23 Section, "Meters and Gauges for HVAC Piping."
- C. BTU Meter: Provide BTU Meter as specified in Division 23 Section, "Meters and Gauges for HVAC Piping."

## 2.7 INPUT OUTPUT SENSORS AND TRANSMITTERS

- A. General:
- 1. Performance Requirements:
    - a. Device must be compatible with project DDC controllers.
    - b. Elements used shall be general-purpose type.
    - c. Provide transmitters or transducers with sensors as required, with range suitable for the system encountered.
      - 1) Transmitters and transducers shall have offset and span adjustments.
      - 2) Shock and vibration shall not harm the transmitter or transducer.
      - 3) Transmitters and transducers shall have a zeroing capability of readjusting the transmitter zero.
    - d. Accuracy requirements shall include the combined effects of linearity, hysteresis, repeatability, and the transmitter.
  - 2. Output: Linear, proportional type over shielded cable pair, 4 - 20 mA or 0 – 10 Vdc signal.
  - 3. Input Power: Low voltage, nominal 24 Vdc.
- B. Temperature Sensors:
- 1. General: Temperature sensing elements shall have characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy. Sensor shall be UL 873 listed for temperature equipment.
  - 2. Performance Requirements:

- a. Thermistor:
    - 1) Accuracy (All): Plus/minus 0.36 degrees F minimum.
    - 2) Temperature Differential Accuracy: Plus/minus 0.15 degrees F minimum.
    - 3) Resolution: Plus/minus 0.2 degrees F minimum.
    - 4) Heat Dissipation Constant: 2.7 mW per degree C.
    - 5) Drift: 0.04 degree F after 10 years within temperature range.
  - b. RTD:
    - 1) Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
    - 2) Accuracy (All): Plus/minus 1 degree F minimum, unless otherwise noted below.
      - a) Room Sensor Accuracy: Plus/minus 0.5 degrees F minimum.
      - b) Chilled Water Accuracy: Plus/minus 0.5 degrees F minimum.
      - c) Temperature Differential Accuracy: Plus/minus 0.15 degrees F minimum.
    - 3) Resolution: Plus/minus 0.2 degree F.
    - 4) Drift: 0.04 degrees F after 10 years within temperature range.
  - c. Sensing Range:
    - 1) Provide limited range sensors if required to sense the range expected for a respective point.
  - d. Wire Resistance:
    - 1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F or use temperature transmitter when offset is greater than 1.0 degree F due to wire resistance.
    - 2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.
  3. Outside Air Sensors: Watertight inlet fitting shielded from direct rays of the sun.
  4. Room Temperature Sensors:
    - a. Construct for surface or wall box, or enclosure with insulated backing suitable for exterior wall mounting.
    - b. Provide the following features:
      - 1) Non-adjustable, blank front panel.
      - 2) Setpoint reset slide switch, dial wheel, or push-button interface with an adjustable temperature range.
      - 3) Locking cover where noted on the drawings.
      - 4) Integral digital display with the following:
        - a) Indication of space temperature.
        - b) Setpoint adjustment to accommodate room setpoint.
  5. Temperature Averaging Elements:
    - a. Use on duct sensors for ductwork 10 sq ft or larger.
    - b. Use averaging elements where prone to stratification with sensor length range between 16-22 ft.
    - c. Provide for all mixed air and heating coil discharge sensors regardless of duct size.
  6. Insertion Elements:
    - a. Use in ducts not affected by temperature stratification or smaller than 10 sq ft.
    - b. Provide dry type, insertion elements for liquids, installed in immersion wells, with minimum insertion length of 2.5 inches for pipe sizes greater than 4 inches.
    - c. Immersion Well Housing: 1/2 inch NPT brass or stainless steel. Stainless steel required for piping 6 inch and larger.
- C. Humidity Sensors:
1. Elements: Accurate within 3 percent full range with linear output.
    - a. Accuracy shall include temperature effects.
  2. Resolution: Plus/minus 1 percent.
  3. Drift: Less than 1 percent full scale per year.

4. Sensing Range: 0 to 100 percent relative humidity.
  5. Room Sensors: Provide housing with integral sensor. Housing shall be plastic, NEMA 250, Type 1. Provide with insulated backing suitable for exterior wall mounting.
  6. Duct Sensors: Insertion type probe with mounting plate. Housing shall be metal, NEMA 250, Type 1.
  7. Outside Air Sensors: With element guard and mounting plate.
- D. Pressure Transmitters:
1. Duct Static Pressure:
    - a. Type: Unidirectional, fixed range.
    - a. Performance Characteristics:
      - 1) Accuracy: Plus/minus one percent of full scale.
      - 2) Thermal Effects: Temperature compensated over a minimum 40 to 120 F range. Zero and span shift of plus/minus 0.06 percent or less of full scale per degree F.
      - 3) Sensing Range: Select sensor so that the high end of the nominal sensor range is not less than 150 percent and not more than 300 percent of maximum expected input.
      - 4) Long Term Thermal Stability: Plus/minus one percent full scale per year.
    - b. Construction:
      - 1) Insertion or traverse type sensor suitable for use in flat oval, rectangular, and round duct configurations.
      - 2) Insertion length selected as appropriate for duct size.
      - 3) Traverse sensors shall have at least one pickup point every 6 inches.
      - 4) Element: Variable capacitance sensing technology.
      - 5) Housing: Fire retardant glass-filled polyester, brass, stainless steel, or aluminum.
  2. Space Static Pressure:
    - a. Type: Bi-directional, fixed range.
    - b. Performance Characteristics:
      - 1) Accuracy: Plus/minus 0.5 percent of full scale.
      - 2) Thermal Effects: Temperature compensated over a minimum 40 to 120 F range. Zero and span shift of plus/minus 0.06 percent or less of full scale per degree F.
      - 3) Sensing Range: Select sensor so that the high end of the nominal sensor range is not less than 150 percent and not more than 300 percent of maximum expected input.
      - 4) Long Term Thermal Stability: Plus/minus 0.5 percent full scale per year.
    - c. Construction:
      - 1) Sensing Port Wall Mounting: Wall plate with integral sensor, sized to fit standard single gang electrical box. Back of sensor plate fitted with union fitting for tubing connection.
      - 2) Sensing Port Ceiling Mounting: Round plate with union fitting for tubing connection.
      - 3) Sensor Element: Variable capacitance sensor technology.
      - 4) Sensor Housing: Fire retardant glass-filled polyester, brass, stainless steel, or aluminum.
  3. Hydronic Pressure:
    - a. Type: Unidirectional, fixed range.
    - a. General Sensor Performance Characteristics:
      - 1) Accuracy: Plus/minus 1.0 percent of full scale.
      - 2) Thermal Effects: Temperature compensated minimum 30 to 150 F range. Zero and span shift of plus/minus 0.02 percent or less of full scale per degree F.
      - 3) Long Term Thermal Stability: Plus/minus 0.5 percent full scale per year.

- 4) Range: Select sensor so that the scheduled differential pressure setpoint is near the midrange of the sensor pressure range.
  - b. Performance Characteristics for Chiller/Boiler Equipment Differential Pressure:
    - 1) Application: Variable-Primary Flow Systems.
    - 2) Accuracy: Plus/minus 0.05 percent of full scale.
    - 3) Thermal Effects: Temperature compensated minimum 30 to 150 F range. Zero and span shift of plus/minus 0.02 percent or less of full scale per degree F.
    - 4) Long Term Thermal Stability: Plus/minus 0.125 percent full scale per year for minimum 5 years.
    - 5) Range: Select sensor so that the scheduled differential pressure setpoint is near the midrange of the sensor pressure range.
    - 6) Manufacturers:
      - a) Rosemount, 3051S
      - b) Approved equal.
  - c. Construction:
    - 1) Suitable for the media temperature and pressure.
    - 2) Chiller/Boiler differential sensor shall have push button zero and span adjustments. No internal mechanical linkages shall be used in the transmitter.
    - 3) Element: Diaphragm type, stainless steel.
    - 4) Housing: Fire retardant glass-filled polyester, stainless steel, or aluminum.
4. Gas Pressure:
- a. Type: Uni-directional, fixed range.
  - b. Performance Characteristics:
    - 1) Accuracy: 0.35% full scale.
    - 2) Operating Temperature Range: -40 to 260 F.
    - 3) Long Term Drift: Plus/minus 0.2% full scale per year.
    - 4) Sensor Output: 4-20 mA.
    - 5) Range: Select sensor so that the scheduled pressure setpoint is near the midrange of the sensor pressure range.
  - c. Construction:
    - 1) Suitable for the media temperature and pressure.
    - 2) Sensor Element: 17-4 PH or 316L stainless steel.
    - 3) Housing: Stainless steel with FKM, EPDM or all welded seals.
- E. Equipment Operation Sensors:
1. Status Inputs for Airside Equipment:
    - a. Type: Fixed range differential pressure switch with adjustable setpoint.
    - b. Performance Characteristics:
      - 1) Range: Not greater than two times the design fan static pressure.
    - c. Construction:
      - 1) Enclosure: Comply with NEMA enclosure ratings, suitable for the ambient conditions encountered.
      - 2) Provide Insertion tube for use in duct configurations. Insertion length selected as appropriate for duct size.
      - 3) Contact Type: Single-pole, single-throw (SPST). Provide multiple poles or throw contacts to meet additional alarms required.
  2. Status Inputs for Hydronic Equipment:
    - a. Differential Pressure Switch: Fixed range type with adjustable setpoint.
      - 1) Range: Not greater than two times the design equipment differential pressure.
      - 2) Enclosure: Comply with NEMA enclosure ratings, suitable for the ambient conditions encountered.
      - 3) Contact Type: Single-pole, single-throw (SPST). Provide double-throw contacts to meet additional alarms required.
    - b. Flow Switch:

- 1) Thermal dispersion flow switch enclosed in insertion device, of material suitable for fluid encountered and magnetic setpoint coordinated with the desired flow rate.
  - a) Range: Sensitivity suitable for the maximum and minimum design flow rates of the system in which it is installed.
  - b) Enclosure: Comply with NEMA enclosure ratings, suitable for the ambient conditions encountered, with LED status indicators for visual switch indication.
  - c) Contact Type: Automatic reset upon regain of flow.
- c. Liquid Level Switch:
  - 1) Electric Probe Type:
    - a) Stainless steel construction with minimum wire lead length required to adjust probe height for appropriate water level control.
    - b) Provide individual probes to meet the required control points specified on the drawings.
3. Status Inputs for Electric Motors:
  - a. Analog Current Transducer:
    - 1) Type: Split core design, cable of being installed or removed without dismantling the primary bus cables.
    - 2) Performance Characteristics:
      - a) Accuracy: Plus/minus 2 percent of selected range.
      - b) Range: Multi-range device, suitable for the amperage encountered with internal zero and span adjustment.
      - c) Analog output signal: Generate a proportional control signal relative to the amount of current through the primary bus cables.
    - 3) Construction:
      - a) 24 V or Self-powered (passive).
      - b) Provide with integral command relay.
      - c) Device shall accept overcurrent up to twice its trip into range.
      - d) Enclosure: UL 94 approved thermoplastic, rated for V-0. No metal parts shall be exposed other than the terminals.
  - b. Binary Current Sensing Relay:
    - 1) Type: Split core with current transformers, adjustable and set to 175 percent of rated motor current.
    - 2) Self-powered (passive) with solid-state circuitry and a dry contact output.
    - 3) Adjustable trip point.
    - 4) Contact Type: Single-pole, double-throw (SPDT).
    - 5) LED indicating the on or off status.
    - 6) A conductor of the load shall be passed through the window of the device.
    - 7) Device shall accept overcurrent up to twice its trip into range.
- F. Leak Detection Sensors
  1. Leak detection sensors shall be stand alone as described in Division 23 Section, Common Work Results for HVAC". Monitor leak detection sensors as noted on the drawings.
- G. Carbon Monoxide Detectors:
  1. Factory calibrated, single or multichannel dual level detectors, using solid state sensors with three year minimum life. Sensor replacement shall take maximum 15 minutes. Suitable over temperature range of 23 to 130 degrees F.
  2. Provide individual indicators and contractors for each level, initially calibrated for 25 ppm and 200 ppm.
  3. Maximum response time to 100 ppm CO calibration gas: Two minutes.
  4. Accuracy: Plus/minus 5 ppm or plus/minus 5 percent of reading, whichever is lower.
  5. Drift: Certified by manufacturer to drift no more than 5 percent per year.
  6. Calibration: Certified by manufacturer to require calibration no more frequently than once per year.

- H. Carbon Dioxide Sensors:
1. General: Provide non-dispersive infrared (NDIR) CO<sub>2</sub> sensors with integral transducers and linear output.
    - a. Linear, CO<sub>2</sub> Concentration Range Display: 0 to 2000 ppm.
    - b. Full Scale Accuracy: Plus/minus 75 ppm at concentrations of both 600 and 1,000 ppm when measured at sea level at 77 degrees F.
    - c. Maximum Response Time: 1 minute.
    - d. Analog Output: 0-10 Vdc or 4-20 mA.
    - e. Rated Ambient Conditions:
      - 1) Air Temperature: Range of 32 to 122 degrees F.
      - 2) Relative Humidity: Range of 0 to 95 percent (non-condensing).
  2. Calibration Characteristics:
    - a. Factory calibrated and certified by the manufacturer to require calibration not more frequently than once every 5 years.
    - b. Automatically compensating algorithm for sensor drift due to sensor degradation.
    - c. Sensor shall be temperature compensated throughout entire operating range.
    - d. Maximum Drift: 2 percent per year.
  3. Construction:
    - a. Sensor Chamber: Non-corrosive material for neutral effect on carbon dioxide sample.
    - b. Duct Mounting: Provide duct mounted sensors with duct probe designed to protect sensing element from dust accumulation and mechanical damage.
    - c. Wall/Surface Mounting: Construct for surface or wall box or enclosure suitable for wall mounting.

## 2.8 OUTPUT CONTROL DEVICES

- A. Control Relays:
1. Provide relay with contact rating, configuration, and coil voltage that is suitable for the application.
  2. Provide NEMA 1 enclosure when relay is not installed in a local control panel.
  3. Control relays shall be UL listed plug-in type with dust cover and LED "energized" indicator.
  4. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus/minus 200 percent minimum from setpoint.
  5. Electromechanical relays shall be UL listed, compact in size, provided with quick connect terminals and be impervious to shock and vibration.
  6. Electronic relays shall be microcomputer-based with PI, time proportioning control capability, have average life greater than 500,000 cycles, have a built-in transformer and have LED status indication.
- B. Fan Speed Controllers:
1. Solid-state model providing field-adjustable proportional control of motor speed. Equip with filtered circuit to eliminate radio interference.
- C. Magnetic Door or Window Contact
1. Provide contact with rating and configuration that is suitable for the application by Interlogix or approved equal.
  2. Contacts shall be UL listed and factory tested.
  3. The magnetic contacts shall be designed for easy installation and shall be replaceable without damaging the door or window.
  4. Coordinate final sensor type and location with Architect prior to ordering.

## 2.9 POWER SUPPLIES

- A. Reference Division 23 Section "Direct Digital Controls for HVAC" for DC power supply requirements.



- B. Control power transformers shall meet NEMA/ANSI standards.
- C. Control power transformers shall be UL listed for Class 2 current-limited service or provided with over-current protection on both primary and secondary circuits for Class 2 current-limited service.
- D. Connected load on the transformer shall not exceed 80 percent of the transformer's rated capacity.
- E. The core and windings shall be completely encased in a UL approved thermoplastic. No metal parts shall be exposed other than the terminals.
- F. Performance Characteristics:
  - 1. Accuracy: Plus/minus 1 percent at 5.0 A full scale output.
- G. Provide a disconnect switch for each transformer.

## 2.10 THERMOSTATS

- A. General:
  - 1. Programmable, with the following features:
    - a. LCD or LED display screen.
    - b. Button or touch-screen Interface.
    - c. 7-day programmable scheduling.
    - d. Temperature information display.
    - e. Setpoint display and adjust.
    - f. Operation mode display and adjust.
    - g. Override.
    - h. Remote temperature sensor interface terminal.
    - i. Lockout.
  - 2. Performance Requirements:
    - a. Accuracy: Plus/minus 1.0 degree F minimum.
    - b. Resolution: Plus/minus 0.2 degrees F.
    - c. Range:
      - 1) Operating Temperature: 32 degrees F to 122 degrees F minimum.
      - 2) Operating Humidity: 0 percent to 95 percent relative humidity, non-condensing.
      - 3) Setpoint Control:
        - a) Cooling: 54 degrees to 100 degrees F.
        - b) Heating: 40 degrees to 90 degrees F.
    - d. Multi-stage as required to match unit cooling and heating stages scheduled on the drawings.
- B. Room Thermostat Accessories:
  - 1. Thermostat Covers: Brushed aluminum.
  - 2. Insulating Bases: For thermostats located on exterior walls.
  - 3. Thermostat Guards: Metal mounted on separate base.
  - 4. Adjusting Key: As required for device.
  - 5. Aspirating Boxes: Where indicated for thermostats requiring flush installation.
  - 6. Integrated sensors: At the contractor's option, the following sensors may be provided with the thermostat in a single device. Refer to the drawings where additional sensors are required. Refer to "Input/Output Sensors" section of this specification for language governing performance of the integrated sensors.
    - a. Occupancy sensor.
    - b. Humidity sensor.
    - c. Carbon dioxide sensor.
- C. Immersion Thermostat:
  - 1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint and adjustable throttling range.

- D. Airstream Thermostat:
  - 1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.
  - 2. Averaging service remote bulb element: minimum 7.5 feet or length as required to fit duct.
- E. Electric Low Limit Thermostat:
  - 1. Snap acting, single pole, single throw, manual or automatic reset switch as indicated on the drawings that trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint,
    - a. Provide double-throw contacts (one for direct equipment control, one for BAS system notification) where additional alarms are scheduled.
  - 2. Bulb length: Minimum 1 foot for every 1 square foot of coil cross sectional area.
  - 3. Provide one thermostat for every 20 sq ft of coil surface.
  - 4. Setpoint shall be adjustable.
- F. Electric High Limit Thermostat:
  - 1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above setpoint,
  - 2. Bulb length: Minimum 1 foot for every 1 square foot of coil cross sectional area.
  - 3. Provide one thermostat for every 20 sq ft of coil surface.
  - 4. Setpoint shall be adjustable.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

#### **3.2 INSTALLATION**

- A. Cooperate with other contractors performing work on this project as necessary to achieve a complete and coordinated installation. Each Contractor shall consult the Drawings and Specifications for all trades to determine the nature and extent of others work.
- B. Coordinate with other contractors performing work to provide emergency power to all control devices required to operate on emergency power.
  - 1. Coordinate emergency power to BAS network control panels.
  - 2. Coordinate emergency power to firefighter smoke control panel.
  - 3. Coordinate power wiring for smoke control equipment is installed in metallic conduit.
- C. General Workmanship:
  - 1. Install equipment, piping, and wiring/raceway parallel to building lines wherever possible.
  - 2. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
  - 3. Install all equipment in readily accessible locations.
  - 4. All installations shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.
  - 5. Install all products in accordance with manufacturer's instructions.

## D. Sensors:

1. Mount sensors rigidly and adequately for the environment within which the sensor operates.
2. Provide thermistor type temperature sensors for temperature ranges between minus 30 degrees F to 230 degrees F. Provide RTD type temperature sensors for extended ranges beyond minus 30 degrees F to 230 degrees F.
3. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing. Coordinate installation of room/space sensors with architect and other trades to ensure a neat and orderly installation.
4. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
5. Sensors used in mixing plenums and hot and cold decks shall be of averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.
6. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 1 foot of sensing element for each square foot of coil area.
7. Do not install temperature sensors within the vapor plume of a humidifier. If installing a sensor downstream of a humidifier, install it at least 10 feet downstream.
8. Install temperature, humidity, and smoke detectors for both supply air and return air applications a minimum of 10'-0" downstream or upstream of the air handling unit and prior to any branch duct takeoffs.
9. All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
10. Install outdoor air temperature sensors on north wall, complete with sun shield where shown on the plans. If not shown, locate sensors in an accessible location, a minimum of 15 feet away from exhaust or relief air locations.
11. Differential air static pressure.
  - a. Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.
  - b. Return Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor or the plenum.
  - c. Building Static Pressure: Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building. Pipe the high-pressure port to a location suitable to sense common building pressure or as indicated on the drawings.
    - 1) Panel mount the transducer adjacent to its associated building automation system controller. Provide an independent manometer gauge next to transducer for calibration.
  - d. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
  - e. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
  - f. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shutoff valves installed before the tee.
12. Adjust flow switch to meet sensitivity required to ensure minimum flow through the equipment.
13. Verify location and mounting height of thermostats, humidistats, and exposed control sensors with plans and room details before installation. Align with adjacent lighting switches and humidistats.

- a. Install devices to meet ADA requirements unless otherwise noted on the plans.
  14. Mount freeze protection thermostats using flanges and element holders.
    - a. Install thermostat completely across the surface the thermostat serves.
  15. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.
  16. Provide separable sockets for liquids and flanges for air bulb elements.
  17. Provide thermostats in aspirating boxes in areas where flush mounting is required.
  18. Provide guards on thermostats in areas indicated on the drawings.
  19. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
  20. Install shutoff valves in the high and low pressure reference lines connecting to hydronic pressure sensors and switches. Install a shunt valve across the high and low reference pressure ports for servicing. Valves may be ordered as an integral option with the sensor.
- E. Control Valves:
1. Do not install brass valves in open-loop systems.
  2. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.
  3. Install flanges or unions to allow valve removal and installation.
  4. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
  5. Valve Orientation:
    - a. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
    - b. Install valves in a position to allow full stem movement.
    - c. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.
  6. Provide valves with position indicators where sequenced with other controls.
  7. Tag valves in accordance with Division 23 Section, "Identification for HVAC Piping and Equipment."
  8. Install a pressure/temperature port on each side of pressure independent control valves (PICVs) which are not factory provided with integral ports.
- F. Control Dampers:
1. Install dampers with extruded aluminum or stainless steel frames and blades in corrosive environments and areas with high humidity.
  2. Install smooth transitions, not exceeding 30 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.
  3. Clearance:
    - a. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
    - b. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.
  4. Service Access:
    - a. Dampers and actuators shall be accessible for visual inspection and service.
    - b. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Division 23 Section, "Air Duct Accessories."
  5. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting.
  6. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.

7. Provide mixing dampers of parallel blade construction arranged to mix streams. Where shown on the drawings, provide separate minimum outside air damper section adjacent to return air dampers with separate damper motor.
  8. Provide isolation (two position) dampers of parallel blade construction.
  9. Provide opposed blade damper configuration for all other applications.
  10. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
  11. After installation of low-leakage dampers and seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.
- G. Operators:
1. Mount and link control damper actuators according to manufacturer's instructions.
    - a. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5 degrees open position, manually close the damper, and then tighten the linkage.
    - b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
    - c. Provide all mounting hardware and linkages for actuator installation.
  2. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5 degree available for tightening the damper seals.
  3. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer.
- H. Control Panels:
1. Install control panels where shown on the drawings and where required to house controllers for the controlled systems and equipment.
  2. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
  3. Coordinate 120V power requirements with Division 26 to panels used for the building automation system and transformers for low voltage power to controllers.
- I. Fire Fighter Control Panel:
1. Provide automatic weekly testing of the smoke control system as required by the building code for verification of system operation via BAS programming. Verification test sequence shall include positive confirmation of the following:
    - a. Actuation.
    - b. Testing.
    - c. Manual override.
    - d. Presence of power downstream of all disconnects.
  2. The test sequence shall report abnormal conditions audibly, visually, and by printed report. Email the results to the building operator if BAS is capable. An abnormal condition is any conditions that creates a fault at the fire fighter control panel or does not meet the smoke control sequence of operations.
  3. The test sequence shall operate all devices, equipment, and components used for smoke control.
  4. Execute the test sequence during unoccupied hours, when ambient conditions will not interfere with building operation, or during a time acceptable to the Owner.
  5. Where operation of the test sequence may produce unwanted effects to normal building operation, coordinate with the authority having jurisdiction and Owner to approve exemptions for devices, equipment, and components affected. Submit documentation to the Owner and Engineer as defined in the section titled, "Submittals."
    - a. For any exempted devices, equipment, or components, at a minimum verify the presence of power downstream of all disconnects by a listed control unit.
  6. Coordination with Division 26:

- a. Firefighter smoke control panel shall be powered from a 120 volt, single phase power source from the building standby power system.
  - a. Firefighter smoke control panel shall be provided with an uninterruptible power system (UPS) to allow for continuous operation of all equipment during loss of normal power until stand by power is achieved.
    - 1) Size the UPS to operate for a minimum of 5 minutes.
  - b. Transformers shall be provided as required to convert 120 volt power source to the control signal needed.
- J. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
  - K. Provide an insulation standoff on control devices, cables, and other items that do not require flush mounting to ductwork, piping, or equipment.

**3.3 MAINTENANCE**

- A. Refer to Division 01 closeout requirements for additional requirements relating to maintenance service.
- B. Provide service and maintenance of control system for one year from Date of Substantial Completion.
- C. Provide complete service of controls systems, including call backs, and submit written report of each service call.
- D. Smoke control diagrams shall be posted and be kept on file within the Fire Command Center and maintenance room upon completion.

**3.4 STARTUP AND DEMONSTRATION**

- A. Control Dampers and Valves:
  - 1. Stroke and adjust control valves and dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.
  - 2. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.
  - 3. For control valves and dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.
  - 4. Verify that all two-position dampers and valves operate properly and that the normal positions are correct.
  - 5. Verify that all modulating dampers and valves are functional, that the start and span are correct, that direction and normal positions are correct, and that they achieve proper closure.
- B. PI Control Valves:
  - 1. Field verify installation and operating differential pressure range of all PI control valves.
  - 2. Verify total system flow to be within plus/minus 10 percent of system design.
  - 3. Individual field adjustments for the PI control valve assembly shall be performed using the PI control valve manufacturer's documented procedures.

**3.5 DAMPER SCHEDULE**

<u>SERVICE</u>	<u>RUSKIN MODEL</u>	<u>MATERIAL</u>
Outside, Exhaust and Relief Air Control, Stairway and Shaft Vents	CD-50	Aluminum
Fire/Smoke Damper for Smoke Control	FSD-60	Galvanized Steel

Smoke Damper for Smoke Control	SD-60	Galvanized Steel
Corrosive Environments	CD-50-CE	Aluminum
Corrosive Environments	CD-36-CE	Stainless Steel
All Other	CD-356	Galvanized Steel

### 3.6 DAMPER OPERATOR VOLTAGE SCHEDULE

<u>SERVICE</u>	<u>VOLTAGE</u>
Interlocked with HVAC fans	120V
Multi-section dampers	120V
Large dampers ( 60 inches in any dimension)	120V
All other operators control wiring	24V

- Note: Coordinate with Division 26 if 120V power is required for operator to achieve appropriate torque requirements for damper actuation.

### 3.7 CONTROL VALVE SCHEDULES

- A. Allowable Valve Type and Size by Control Application:

<u>VALVE TYPE</u>	<u>CONTROL APPLICATION</u>	
	<u>MODULATING</u>	<u>TWO-POSITION</u>
Globe	≤ 4 IN	≤ 2 IN
Characterized Ball	≤ 6 IN	≤ 6 IN
Butterfly	6 IN	≥ 2-1/2 IN

- B. Allowable Valve Body Material by Service Application:

<u>VALVE BODY MATERIAL</u>	<u>SERVICE APPLICATION</u>	
	<u>CLOSED LOOP</u>	<u>OPEN LOOP</u>
Bronze	Allowed	Allowed
Brass	Allowed	Not Allowed
Iron	Allowed	Allowed
Stainless Steel	Allowed	Allowed

- C. Allowable End Connection by System Material:

- Copper Tube:
  - 2-1/2 Inch and smaller: Threaded ends.
- Steel Pipe:
  - 2 Inch and Smaller: Threaded.
  - 2-1/2 Inch and Larger:
    - Flanged.
    - Grooved ends for water systems.

- D. Allowable End Connection by Size Schedule:

<u>VALVE TYPE</u>	<u>END CONNECTION TYPE</u>		
	<u>THREADED</u>	<u>FLANGED</u>	<u>GROOVED</u>
Globe	≤ 2-1/2 IN	≤ 4 IN	N/A
Characterized Ball	≤ 2-1/2 IN	≤ 3 IN	N/A
Butterfly	N/A	≥ 2-1/2 IN	≥ 2-1/2 IN

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 23 09 14 - REFRIGERANT MONITORING SYSTEMS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Refrigerant Monitoring Systems.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical product data for the refrigerant monitoring system furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.
- B. Shop Drawings: Submit shop drawings for the refrigerant monitoring system, containing the following information:
  - 1. Schematic flow diagram of system showing control panel and sensing device(s).
  - 2. Label each control device with setting or adjustable range of control.
  - 3. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
  - 4. Provide details of faces of control panels, including controls, instruments, and labeling.
  - 5. Include description of sequence of operation.
- C. Maintenance Data: Submit maintenance instructions and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 01.

**1.3 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of refrigerant monitoring equipment, of types and sizes required, whose products have been in satisfactory use for a minimum of three years. Manufacturer shall submit a list of 12 similar projects.
- B. Codes and Standards:
  - 1. ASHRAE Compliance: Comply with ASHRAE 15 Safety Standard for Refrigeration Systems.
  - 2. NEMA Compliance: Comply with NEMA standards pertaining to enclosures for refrigerant control systems
  - 3. NFPA Compliance: Comply with NFPA 70 "National Electric Code" where applicable for electric equipment, devices and wiring.

**1.4 DELIVERY STORAGE AND HANDLING**

- A. Provide factory shipping cartons for each piece of equipment, and control device
- B. Maintain cartons through shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment.
- C. Store equipment and materials inside and protect from weather.

**1.5 SPARE PARTS**

- A. Provide two sets of spare filters for each type of sensing device furnished.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Critical Environment Technologies
- B. Genesis International, Inc.
- C. Honeywell Analytics.
- D. Macurco Gas Detection.
- E. MSA, Instruments Division.
- F. O-I-Analytical Corporation.
- G. Sentech Corporation.
- H. Specified Controls.
- I. Thermal Gas System.
- J. ToxAlert.
- K. Trane.
- L. YEW, Yokagowa.

**2.2 REFRIGERANT MONITORING SYSTEM**

- A. General: Provide complete refrigerant monitoring system as specified, consisting of control panel, sampling system, and sensing devices as required for a complete installation. Except as otherwise indicated, provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer.
- B. System Requirements: Meet the following general requirements:
  - 1. Detect presence of any HCFC or HFC refrigerant regardless of which chiller is furnished. Coordinate with the Contractor the specific requirements for this installation.
  - 2. Indicate, alarm, shut down equipment and communicate with the temperature control system specified in Division 23 Section "Direct Digital Control for HVAC" through an RS-232 or RS-485 port.
  - 3. Locate leak detection monitoring sensors for early warning indication to prevent a major loss of refrigerant without alarm, should a leak occur.
- C. Control Panel and Equipment: Provide control panel with suitable brackets for wall mounting, for each refrigerant monitoring system. Install panel at location shown on the drawings.
  - 1. Fabricate panels of galvanized steel, painted steel, or extruded aluminum alloy, totally enclosed, with hinged doors and keyed lock, NEMA 4 rated.
  - 2. Analyzer: Employ infrared sensor technology to provide sensing down to one part per million (ppm). Analyzer shall be compound specific and calibrated for the refrigerant application. System shall be capable of switching to another refrigerant type by changing one part and recalibration.
  - 3. Alarm Contacts: Provide three adjustable levels of alarm and indicator lights for alarm levels, malfunction, loss of low and zero cycle. Alarm relays shall be rated for 120 Vac at 5 amps.
  - 4. LED Display: Provide local LED display for indication of ppm level.
  - 5. Calibration: Provide auto zero calibration manually at the monitor, automatically at user selected intervals between 15 minutes and 24 hours, or remotely via a dry contact input. Automatically zero by drawing air from an uncontaminated air source. Include a built-in sampling pump.
  - 6. Flow Loss: Continuously sample flow. Indicate a flow loss when flow drops below 500 ml/min.

7. Operating Conditions: Capable of operating in ambient conditions of 0 to 40 degrees C, 0 to 99 percent relative humidity, non-condensing. System shall be insensitive to vibration.
  8. Remote Sample Location: Capable of sampling from locations up to 500 feet from control panel.
  9. Capable of expanding to a minimum of four sampling points with sequential sampling and output signals to allow monitoring from multiple remote sampling locations.
- D. Refrigerant Sensor and Tubing: Provide refrigerant sensor(s) for monitoring refrigerant leaks in the chiller system. Provide application specific refrigerant sensor and particulate filters. Provide refrigerant sensing tubing of 1/4 inch diameter nylon tubing rated for a working pressure of 425 psi and burst pressure of 1,700 psi. Provide tubing with compatible fittings. Tubing shall be Parker Series NR or approved equal.
1. Refrigerant to Be Monitored: R-513A
  2. Accuracy: Sensor shall have accuracy of  $\pm 5$  ppm over range of 0 to 100 ppm and  $\pm 5$  percent of reading between 100 to 1,000 ppm.
  3. Repeatability: Plus or minus 1 percent of full scale.
  4. Detection Level Set Points:
    - a. Detection Level 1: 100 ppm.
    - b. Detection Level 2: 500 ppm.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION**

- A. Examine areas and conditions under which refrigerant monitoring systems are to be installed.
- B. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

#### **3.2 INSTALLATION OF REFRIGERANT MONITORING SYSTEMS**

- A. General: Install systems and materials in accordance with manufacturer's instructions.
  1. Install electrical components and use electrical products complying with requirements of applicable Division 26 sections of these specifications.
  2. Mount control panel at location indicated on the drawings at convenient height for user interface.
- B. Control Wiring: Install control wiring including conduit in accordance with requirements specified in Division 23 Section "Direct Digital Control for HVAC."
- C. Refrigerant Sensor(s): Install refrigerant sensor(s) at locations indicated on the drawings at height as recommended by the refrigerant monitoring system manufacturer.
- D. Sensor Tubing: Install sensor tubing in accordance with manufacturer's instructions parallel to building columns. Support tubing as required to prevent sagging.

#### **3.3 ADJUSTING AND CLEANING**

- A. Start-Up: Start-up, test, and adjust refrigerant monitoring system in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint. Replace sensor filters, if contaminated during installation work.
- C. Final Adjustment: After completion of installation, adjust refrigerant monitoring system to meet system requirements.

- D. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of refrigerant monitoring system.

### 3.4 TRAINING

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
  - 1. Overview of the system and/or equipment as it relates to the facility as a whole.
  - 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
  - 3. Review data included in the operation and maintenance manuals. Refer to Division 01 Section "Operating and Maintenance Data."
- C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

**SECTION 23 09 23 - DIRECT-DIGITAL CONTROL FOR HVAC****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. System Description.
- B. Operator Interface.
- C. Controllers.
- D. Electrical Control Power Wiring and Low Voltage Wiring.
- E. Local Area Network.
- F. System Software.
- G. Controller Software.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Coordinate routing of DDC power wiring and conduits requiring a fire-resistive protective assembly or electrical circuit protective system. Fire-resistive protective assembly or electrical circuit protective system shall have a fire-resistance rating of not less than 2 hours and shall be provided where required by NFPA or local building codes. Types of DDC power wiring and conduits requiring a fire-resistive protective assembly include, but are not limited to:
  - 1. Wiring for Emergency Power systems.
  - 2. Smokeproof Enclosure Pressurization systems.
  - 3. Smoke Control systems.
  - 4. Smoke Removal systems.
  - 5. Fire service and Occupant Evacuation Elevator systems.

**1.3 DEFINITIONS**

- A. ASC: Application Specific Controller. Examples include controllers for specific applications (e.g., FCU, VAV box, etc.) that can be configured through any network services software.
- A. ATU: Air Terminal Unit (e.g., VAV boxes, fan-powered boxes, fan coil units).
- B. BAS: Building Automation System.
- C. BTL: BACnet Testing Laboratories. Third party independent testing and listing program for devices which have been tested according to ASHRAE Standard 135.
- D. Control Wiring: Includes conduit, wire and wiring devices to install complete control systems including motor control circuits, interlocks, thermostats, EP and IP switches and like devices. Includes all wiring from Intelligent Devices and Controllers to all sensors and points defined in the input/output summary shown on the drawings or specified herein and required to execute the sequence of operations
- E. DDC: Direct Digital Control.
- F. EMT: Electrical Metallic Tubing
- G. High voltage: 50 volts or higher.
- H. IP: Internet Protocol.

- I. LAN: Local Area Network.
- J. VLAN: Virtual Local Area Network.
- K. Low voltage: Below 50 volts.
- A. NiCS: Niagara Compatibility Statement license.
- L. OSI: Open System Interconnection
- M. PC: Personal Computer.
- N. PICS: Protocol Implementation Conformance Statement.
- O. Point: Point is a generic term used to describe a single item of information in a BAS. Points may be further described as input, output, digital, binary, discrete, analog, modulating, internal, external, virtual or global. Each unique point used by digital controllers, or in a BAS, is typically identified by an address.

#### 1.4 CONTRACTOR RESPONSIBILITIES

- A. Reference the following sections for additional contractor responsibilities and coordination:
  - 1. Division 23 Section "Electrical Coordination for Mechanical Equipment."
  - 2. Division 23 Section "Commissioning for HVAC."
  - 3. Division 23 Section "Instrumentation and Control Devices for HVAC."
- B. Reference Part 3 for additional electrical contractor responsibilities for BAS controls.

#### 1.5 SUBMITTALS

- A. Refer to Division 01 and Division 23 Section "General Mechanical Requirements" for submittal procedures.
- B. General:
  - 1. The drawings and specifications are not intended to show all details. The BAS contractor shall secure satisfactory information before submitting the proposal and include in the proposal a sum sufficient to cover all items of labor and material required for the complete installation for the devices and system described.
  - 1. Inform Engineer in writing of any deviation in the exhibits submitted from the requirements of the drawings, specifications, and sequences of operations.
- C. Product Data:
  - 1. Submit manufacturer technical data for each system component and software module required for a complete installation.
  - 2. Indicate dimensions, weights, and enclosure construction for all BAS distributed controllers.
  - 2. Submit technical data on all new software supplied including description of functions performed by software and location within the system where software shall reside. Include all software licensing agreements.
  - 3. Submit the PICS for each BACnet device used in the BAS.
  - 4. Submit the NiCS for each type of Niagara station in the BAS.
- D. Power and Communication Wiring Transient Protection:
  - 1. Submit catalog data sheets providing evidence that all BAS products offered by the manufacturer are tested and comply with IEEE C62.41.2.
  - 2. Testing shall include power and communication trunk wiring.
  - 3. Compliance with IEEE C62.41.2 shall imply conformance with IEEE C37.90.1 based on the stated position of ANSI and IEEE.
- E. Shop Drawings:

1. Submit a trunk cable schematic showing locations of all programmable control units, controllers, and workstations, with associated network wiring.
  - a. Indicate equipment served by each controller on the diagram.
  - b. Indicate switches, power requirements to each controller, and daisy chained controllers.
3. Submit detailed schematic control drawings for each controlled device and equipment.
  - c. Reference all control components to manufacturer make and model number.
  - d. Include all control and power wiring with termination point (controller and terminal number).
  - e. Include clearly indicated and written sequences of operation referenced to specific control components (e.g., "shall modulate valve V-3").
  - f. Include default position (e.g., N.O., N.C., etc.) for all components where applicable.
  - g. Clearly differentiate between existing components and new components.
  - a. Include detailed wiring diagrams showing methods of connections to VFDs, motor starters, energy meters, and all other devices, and all other field wiring necessary for system installation.
    - b. The use of "typicals" will be allowed where appropriate.
2. Submit detailed drawings for each individual BAS distributed controller.
  - a. Include controller identification.
  - b. Include components included in the controller.
  - c. Include numbering of terminals and communications ports.
  - d. List connected data points, including connected control unit and input device.
  - e. Include type of cable connected to each terminal port.
  - f. Identify specific field devices wired to each terminal including identification of each field device and application.
  - g. Clearly differentiate between existing controllers and new controllers.
  - h. Indicate source (electrical panel ID) of 120V power to each panel to which 120V power is connected.
  - i. Indicate method of connecting controller to equipment supplied by others and to existing communications networks.
  - j. Indicate device instance and network number.
3. Submit floor plans that indicate the following:
  - a. Location of all new BAS distributed controllers and control panels.
  - b. Routing of all new building level network communications wiring not located in mechanical and electrical rooms.
  - c. Routing of wiring to controllers, sensors, and control points not located in mechanical and electrical rooms.
  - d. Location of building system connection to Owner's campus wide data network.
4. Submit methods and materials used to integrate into existing networks.
5. Submit proposed smoke control system testing procedure based on Smoke Control Rational Analysis Report and smoke control drawings. Testing procedures to be approved by life safety consultant and engineer.
6. All control drawings and schematics shall be generated using AutoCAD software or equivalent. All project drawings shall be supplied to the Owner in a format as desired by the Owner upon project completion.
4. Submit system identification nomenclature.
  - a. Nomenclature shall be consistent throughout the network and consistent with any existing networks that are integrated. If not defined, nomenclature shall be similar to the point names shown on the drawings.
  - b. Object name and ID number shall be unique within a control device.
  - c. Control device instance name and ID number shall be unique within the network.
  - d. Network number shall be unique for each unique electrical segment in the BAS.
7. Indicate system graphics indicating monitored systems, data (connected and calculated) and operator notations.

- a. Submit example graphic visualizations and screenshots for the BAS. At a minimum, submit examples for major HVAC equipment components, including chillers, boilers, air handling units, fan coil units, heat pumps, fans, etc.
  - b. Font size and type shall be manufacturer standard.
  - c. Provide graphics demonstration package in a format as desired by the Owner.
8. Indicate description and sequence of operation of operating, user, and application software.
- F. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.
- G. Manufacturer's qualification statement.
- H. Installer's qualification statement.
- I. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
1. Revise shop drawings to reflect actual installation and operating sequences.
  2. Include submittals data in final "Record Documents" form.
  3. All additions or changes to the BAS during the course of construction shall be reflected upon the drawings and submitted to the Engineer before project close-out.
- J. Testing and Commissioning Reports and Checklists: Submit completed versions of all reports and checklists, along with all trend logs, used to meet the requirements of Part 3, Startup and Demonstration.
- K. Operation and Maintenance Data:
1. Include maintenance data and recommended spare parts list for digital control equipment and control components.
  2. Include trouble-shooting maintenance guides.
  3. Include interconnection wiring diagrams showing complete field installed systems with identified and numbered system components and devices.
  4. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
  5. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
  6. Include a maintenance manual which contains the information listed above, product data, shop drawings, final software code for sequences of operation and maintenance data in accordance with requirements of Division 01.
  7. Include logbook for documentation of software updates and patches applied BAS for the time period included in the software licensing agreement.
  8. Provide names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
- L. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- M. Maintenance Materials:
1. Refer to Division 01 for additional provisions.
  2. Extra Stock Materials: Two printer cartridges and cartons of printer paper.

## 1.6 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 70.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. BACnet devices used in the BAS shall be BTL listed according to its device profile.



- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- E. Installer Qualifications: Company specializing in performing the work of the type specified and with minimum documented experience as follows:
  - 1. All personnel of the BAS Contractor shall have a minimum of three years of experience within their appropriate trades.
  - 2. All subcontractors utilized by the BAS Contractor shall have a minimum of five years experience within their appropriate trades.
- F. Additional BAS Contractor Requirements:
  - 1. Personnel, Coverage and Response Capabilities: The BAS Contractor shall have a fully staffed office with service technicians and systems engineers within a 50 mile radius of the project location.
  - 2. Emergency Service: The BAS Contractor shall have an established 24 hour emergency service organization. A dedicated telephone number shall be provided to the Owner for requesting emergency service. A maximum of four hour, electronic service technician on sight, response time shall be guaranteed by the BAS Contractor.
  - 3. Parts Stocking: The BAS Contractor shall have an independently verifiable inventory of electronic service parts. This electronic service parts inventory must have a worth of at least 100,000 per year over the last five years.
  - 4. Past Projects: The BAS Contractor shall have completed a minimum of twenty five projects within the last five years which are at least equal in dollar value and comparable scope to this project. A list of similar projects, dollar volume, scope, contact name and contact number shall be provided by the BAS Contractor if asked for by the Owner.

## 1.7 WARRANTY

- A. Refer to Division 01 for additional project warranty requirements.
- B. Labor and materials for the BAS specified shall be warranted free from defects in workmanship and material for a period of 1 year after Substantial Completion and system acceptance.
- C. BAS failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner.
- D. All work shall have a single warranty date, even when the Owner has received beneficial use due to an early system start-up. If the work specified is split into multiple contracts or a multi-phase contract, then each contract or phase shall have a separate warranty start data and period.
- E. Provide updates to operator workstation software, project-specific software, graphic software, database software, and firmware that resolve Contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
- F. Provide five year manufacturer's warranty for field programmable micro-processor based units.
- G. Special warranty on instrumentation:
  - 1. All instrumentation shall be covered by manufacturer's transferable one-year "No Fault" warranty. If manufacturer warranty is not available, the BAS installer shall provide the same.

## 1.8 PROTECTION OF SOFTWARE RIGHTS

- A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
  - 1. Limiting use of software to equipment provided under these specifications.
  - 2. Limiting copying.

3. Preserving confidentiality.
  4. Prohibiting transfer to a third party.
- B. Software provider shall provide software updates and patches to the BAS as part of the software licensing agreement as the updates and patches are released. If any security vulnerabilities are discovered by the provider, the provider shall notify the client within five business days.
- C. Ownership of Proprietary Material: Project-specific software and documentation shall become Owner's property upon project completion. This includes, but is not limited to the following:
1. Graphics.
  2. Record drawings.
  3. Database.
  4. Application programming code.
  5. Documentation.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Corporate Edition Products: The following manufacturers and product lines shall be manufacturer's most current vintage and of open protocol design. Corporate editions shall be based on manufacturer developed software.
1. Automated Logic, WebCtrl.
  2. Delta Controls, enteliBUS.
  3. Johnson Controls, Metasys.
  4. Siemens, Apogee – Desigo CC.
- B. The above list of manufacturers applies to operator workstation software, controller software, the custom application programming language, building controllers, custom application controllers, and application specific controllers. All other products specified under Division 23 Section "Instrumentation and Control Devices for HVAC" need not be manufactured by the above manufacturers.

### **2.2 SYSTEM DESCRIPTION**

- A. General:
1. The BAS shall consist of all necessary hardware and software to perform the control sequences of operation as called for in the Specifications and Drawings. Contractor shall install and commission all necessary devices to ensure a reliable and stable network.
  2. System design is based on a distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
  3. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
  4. The BAS shall be capable of integrating multiple devices, sensors, and functions from multiple control vendors into a common front end, including equipment supervision and control, alarm management, energy management, and trend data collection.
  5. The BAS shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, ASC's, and operator devices.
  6. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
- B. Local Area Network:
1. The BAS shall be set up as a physically separate network within the building.
- C. Network Architecture: The BAS network architecture shall be based upon the OSI basic reference model in accordance with ISO 7498.

1. Application/Network Layer:
    - a. BACnet protocol complying with ASHRAE Standard 135.
  2. Physical/Data Link Layer:
    - a. Hard-wired type:
      - 1) Ethernet according to ISO 8802-2 protocol.
      - 2) EIA-485 Twisted Cable Pair according to Master Slave/Token-Passing (MS/TP) protocol.
  3. Communication between operator workstation(s) and building controller(s):
    - a. Ethernet.
  4. Communication between building controller(s) and application specific and custom application controllers:
    - a. MS/TP.
    - b. PTP.
- D. Web Services Enabled Network:
1. The network shall be capable of being accessed remotely over the internet via a virtual link according to Internet Protocol.
  2. System software shall be based on a client/server architecture, designed around the open standards of web technology. The BAS server shall be accessed using a web browser over the BAS network, Owner's LAN, and remotely over the Internet (through the Owner's LAN).
  3. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to edit programming. Connection shall be browser agnostic.
  4. Software applications shall be designed and optimized for hand-held device interface (e.g., tablets, smart phones, etc.). Interface shall grant visibility and control access, at a minimum, to the following data: Summary, Alarm, Setpoints, Status, Schedule, and Trending.
- E. Network Integration:
1. The BAS network shall be integrated with other automation networks controlled by the Owner. Coordinate with the Owner's information technology (IT) department for networks that shall be integrated.
  2. Provide gateways or other integration devices across networks with different communication protocol to provide a single network visibility and interoperability at the operator workstation. Coordinate communication protocol with each automation system specified.
  3. Interoperable networks shall be capable of sharing all point and point information across networks to a single BAS front end.
  4. Interoperable networks shall be capable of automatically downloading application program changes.
  5. For integrated networks that cannot automatically download application program changes, provide a link to the Controller Manual Download Schedule, as defined in the submittals section of Part 1 on the BAS front end summary page
  6. Integrate the following networks:
    - a. Boiler plant master firing controller.
    - b. Chiller controller.
    - c. Life safety systems.
    - d. Fire alarm control panels.
    - e. Refrigerant monitoring controller.
  7. Uninterruptible Power System (UPS): Provide a UPS to allow for continuous operation of all equipment during loss of normal power until stand by power is achieved.
    - a. Applicable Systems:
      - 1) BAS.
      - 2) Smoke Control System.
    - b. Size the UPS to operate for a minimum of 15 minutes.

- c. Elements of the control system susceptible to power surges shall be protected by conditioners, suppressors or other approved means.
- d. Coordinate the size of the UPS with Division 26.
- 8. Requirements for Smoke Control Networks:
  - a. Network controllers and components used for smoke control operations shall be U.L. 864 – UUKL rated.
  - b. Control wiring used for smoke control operations shall be installed in a fire-resistive cable assembly. Reference Division 26 Section “Low-Voltage Electrical Power Conductors and Cables.”
  - c. Control system shall be capable of communicating with the building’s fire alarm system to fulfill the sequences of operation specified in this section or on the drawings.
  - d. The BAS Contractor shall provide a Fire Fighter’s Smoke Control Panel to manually control the smoke evacuation system. Reference Section 230913 for panel requirements.
- F. Network Interoperability:
  - 1. Provide communication between control units over local area network (LAN).
  - 2. Communication services over the LAN shall result in operator interface and value passing that is transparent to the network architecture as follows:
    - a. Connection of an operator interface device to any one controller on the network shall allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the network.
    - b. All database values (e.g., objects, software variables, custom program variables) of any one controller shall be readable by any other controller on the network. This value passing shall be automatically performed by a controller when a reference to an object name not located in that controller is entered into the controller’s database. An operator/installer shall not be required to set up any communication services to perform network value passing.

## 2.3 OPERATOR INTERFACE

- A. General:
  - 1. The Operator Interface shall provide overall BAS supervision and system software interface. Communications from the workstation shall be executed directly to and between the integration level building controllers and field level controllers.
  - 2. The operator interface shall be capable of command entry, information and alarm management, database management, access of all system data, and be independent of hardware technology.
- B. Hardware:
  - 1. Laptop:
    - a. Laptop(s) to be provided by BAS controls manufacturer.
    - b. Laptop shall be general purpose and commercially available, with sufficient memory and processing capability to meet the requirements of the BAS.
    - a. Quantity: 1.
    - c. Minimum RAM: 4.0 Gigabytes.
    - d. Minimum Processing Speed: Intel i3 Dual Core Microprocessor or better running at no less than 3.0 gigahertz.
    - e. Minimum Hard Drive Memory: 500 Gigabyte.
    - f. Drives: External 32X CD/8X DVD drive with USB connection.
    - g. Ports: Minimum of 2 USB 2.0 or faster.
    - h. Display: Minimum 15 inch.
    - i. Network Connection:
      - 1) Suitable for network technology provided.

- 2) Ethernet interface card with minimum speed: 10/100/1000.
- 3) Wireless interface card, dual band.

## 1.2 CONTROLLERS

### C. Building Controllers

1. General:
  - a. Input Power Requirements: 24Vac.
  - b. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
  - c. Provide sufficient memory to support controller's operating system, database, and programming requirements.
  - d. Share data between networked controllers.
  - e. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
  - f. Utilize real-time clock for scheduling.
  - g. Continuously check processor status and memory circuits for abnormal operation.
  - h. Monitor and assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
  - i. Communication with other network devices to be based on assigned protocol.
  - j. Monitor the status of all overrides, and include this information in logs and summaries to inform the operator that automatic control has been inhibited.
2. Communication:
  - a. Perform routing when connected to a network of custom application and application specific controllers.
  - b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
    - 1) Port shall be USB type.
3. Anticipated Environmental Ambient Conditions:
  - a. Outdoors and/or in Wet Ambient Conditions:
    - 1) Mount within NEMA 4X waterproof enclosures.
    - 2) Rated for operation at 40 to 150 degrees F and 95 percent RH, non-condensing.
  - b. Conditioned Space:
    - 1) Mount within NEMA 1 dustproof enclosures.
    - 2) Rated for operation at 32 to 120 degrees F.
4. Local Keypad and Display for each Controller:
  - a. Use for interrogating and editing data.
  - b. System security password prevents unauthorized use.
  - c. If the manufacturer does not normally provide a keypad and display for the controller, provide software and interface cabling needed to use a portable operator terminal for the system.
5. Provisions for Serviceability:
  - a. Diagnostic LEDs for power, communication, and processor.
  - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
6. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
7. Power and Noise Immunity:
  - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
  - b. Perform orderly shutdown below 80 percent of nominal voltage.
  - c. Upon restoration of normal power, the controller shall automatically resume full operation without manual intervention.
  - d. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

8. Surge and Transient Protection:
  - a. Isolation shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard C62.41.2.
  - b. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.
- D. Custom Application Controllers
  1. General:
    - a. Input Power Requirements: 24Vac.
    - b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
    - c. Share data between networked, microprocessor based controllers.
    - d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
    - e. Utilize real-time clock for scheduling.
    - f. Continuously check processor status and memory circuits for abnormal operation.
    - g. Monitor and assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
    - h. Communication with other network devices to be based on assigned protocol.
    - i. Monitor the status of all overrides, and include this information in logs and summaries to inform the operator that automatic control has been inhibited.
  2. Communication:
    - a. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
  3. Anticipated Environmental Ambient Conditions:
    - a. Outdoors and/or in Wet Ambient Conditions:
      - 1) Mount within NEMA 4X waterproof enclosures.
      - 2) Rated for operation at 40 to 150 degrees F and 95 percent RH, non-condensing.
    - b. Conditioned Space:
      - 1) Mount within NEMA 1 dustproof enclosures.
      - 2) Rated for operation at 32 to 120 degrees F.
  4. Provisions for Serviceability:
    - a. Diagnostic LEDs for power, communication, and processor.
    - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
  5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
  6. Power and Noise Immunity:
    - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
    - b. Perform orderly shutdown below 80 percent of nominal voltage.
    - c. Upon restoration of normal power, the Digital Panel shall automatically resume full operation without manual intervention.
    - d. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.
  7. Surge and Transient Protection:
    - a. Isolation shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard C62.41.2.
    - b. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.
- E. Application Specific Controllers
  1. General:
    - a. Input Power Requirements: 24Vac.

- b. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
  - c. Customized for operation within the confines of equipment served.
  - d. Provide sufficient memory to support controller's operating system, database, and programming requirements.
  - e. Communication with other network devices to be based on assigned protocol.
    - 1) Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
  - f. Monitor and assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
2. Communication:
    - a. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
  3. Anticipated Environmental Ambient Conditions:
    - a. Outdoors and/or in Wet Ambient Conditions:
      - 1) Mount within NEMA 4X waterproof enclosures.
      - 2) Rated for operation at 40 to 150 degrees F.
    - b. Conditioned Space:
      - 1) Mount within NEMA 1 dustproof enclosures.
      - 2) Rated for operation at 32 to 120 degrees F and 95 percent RH, non-condensing.
  4. Provisions for Serviceability:
    - a. Diagnostic LEDs for power, communication, and processor.
    - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
  5. Memory. In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
  6. Power and Noise Immunity:
    - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
    - b. Perform orderly shutdown below 80 percent of nominal voltage.
    - c. Upon restoration of normal power, the controller shall automatically resume full operation without manual intervention.
    - d. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.
  7. Surge and Transient Protection:
    - a. Isolation shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard C62.41.2.
    - b. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.
- F. Input/Output Interface
1. Hardwired inputs and outputs shall tie into the BAS through building, custom application, or application specific controllers.
  2. All Input/Output Points:
    - a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
    - b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
    - c. Universal-type inputs or outputs configurable between binary and analog are acceptable.
  3. Binary Inputs:
    - a. Allow monitoring of On/Off signals from remote devices.
    - b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.

- c. Sense dry contact closure with power provided only by the controller.
4. Pulse Accumulation Input Objects: Conform to all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
  - a. Allow for monitoring of low voltage 0 to 10 Vdc, 4 to 20 mA current, or resistance signals (thermistor, RTD).
  - b. Compatible with and field configurable to commonly available sensing devices.
6. Binary Outputs:
  - a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
  - b. Outputs provided with three position (On/Off/Auto) override switches.
  - c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
  - a. Monitoring signal provides a 0 to 10 Vdc or a 4 to 20 mA output signal for end device control.
  - b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
  - c. Drift to not exceed 0.4 percent of range per year.
8. Tri State Outputs:
  - a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
  - b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
    - 1) VAV terminal units.
    - 2) Duct mounted heating coils.
    - 3) Zone dampers.
    - 4) Radiant devices.
  - c. Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

## 2.4 ELECTRICAL CONTROL POWER AND LOW VOLTAGE WIRING

- A. Power Wiring: Copper wiring, plenum cable, and raceways shall be as specified in the applicable section of Division 26.
- B. Power and Communication Wiring Transient Protection:
  1. Comply with IEEE C62.41.2.
  2. Communications trunk wiring shall be protected with a transient surge protection device providing the minimal protection required.
  3. Communication circuitry, input/output circuitry, and communication unit shall provide protection against a 1000 volt, 3 amp transient signal, directly applied to the communication or input/output terminations.
    - a. For systems not complying with this requirement, provide equivalent protection external to the automatic temperature control system controller. Protection shall be provided for the individual communications and input/output terminations for each automatic temperature control system controller.
    - b. Submittal documentation shall clearly define how this requirement will be met and how the external protection will not affect the performance of the controllers.
- C. Power Supplies:
  1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
  2. Limit connected loads to 80 percent of rated capacity.
  3. Match DC power supply to current output and voltage requirements.



4. Supplies shall be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
  5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
  6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
  7. Operational Ambient Conditions: 32 to 120 degrees F.
  8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD 810 for shock and vibration.
  9. Line voltage units UL recognized and CSA approved.
- D. Power Line Filtering:
1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
  2. Minimum surge protection attributes:
    - a. Dielectric strength of 1000 volts minimum.
    - b. Response time of 10 nanoseconds or less.
    - c. Transverse mode noise attenuation of 65 dB or greater.
    - d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.
- E. Input/Output Control Wiring
1. Control wiring shall be sized to accommodate the voltage drop associated with the distance between the control device and the controller. Minimum size shall be as specified herein.
  2. In all communication conduits, provide one spare twisted pair to be installed, tagged and labeled at each end.
  3. Control wiring not installed in conduit shall be UL rated for plenum installation.
  4. Ethernet control wiring shall be fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.
  5. RTD wiring shall be three-wire or four-wire twisted, shielded, minimum number 22 gauge.
  6. Other analog inputs shall be a minimum of number 22 gauge, twisted, shielded.
  7. Binary control function wiring shall be a minimum of number 18 gauge.
  8. Analog output control functions shall be a minimum of number 22 gauge, twisted, shielded.
  9. Binary input wiring shall be a minimum of number 22 gauge, twisted, shielded.
  10. Thermistors shall be equipped with the manufacturer's calibrated lead wiring.
  11. 120V control wiring shall be #14 THHN in 3/4 inch conduit. Provide 20% fill extra wire in each conduit.
- F. Splices: Splices in shielded cables shall consist of terminations and the use of shielded cable couplers that maintain the integrity of the shielding.
- G. Conduit and Fittings
1. Conduit for Control Wiring, Control Cable and Transmission Cable: EMT with compression fittings, cold rolled steel, zinc coated or zinc-coated rigid steel with threaded connections.
  2. Outlet Boxes (Dry Location): Sheradized or galvanized drawn steel suited to each application, in general, four inches square or octagon with suitable raised cover.
  3. Outlet Boxes (Exposed to Weather): Threaded hub cast aluminum or iron boxes with gasket device plate.
  4. Pull and Junction Boxes: Size according to number, size, and position of entering raceway as required by National Electrical Codes. Enclosure type shall be suited to location.
- H. Relays
1. Relays other than those associated with digital output cards shall be general purpose, enclosed plug-in type with 8-pin octal plug and protected by a heat and shock resistant duct cover. Number of contacts and operational function shall be as required.
  2. Solid State Relays (SSR):
    - a. Input/output isolation: Greater than 10 E 9 ohms with a breakdown voltage of 1500V root mean square or greater at 60 Hz.
    - b. Contact Life: 10 x 10 E 6 operations or greater.

- c. Ambient Temperature Range: Minus 20 to 140 degrees F.
  - d. Input impedance: Not be less than 500 ohms.
  - e. Relays shall be rated for the application. Operating and release time shall be for 100 milliseconds or less. Transient suppression shall be provided as an integral part of the relay.
3. Contactors:
    - a. Type: Single coil, electrically operated, mechanically held, double-break, silver-to-silver type protected by arcing contacts.
    - b. Positive locking shall be obtained without the use of hooks, latches, or semi permanent magnets.
    - c. The number of contacts and rating shall be selected for the application. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices.

## 2.5 SYSTEM SOFTWARE

- A. General:
  1. Provide all necessary system software to form a complete operating system for all operator interface devices.
  2. System software shall integrate with all controller software and allow management of software applications at the operator workstation.
  3. System software display language: English.
- B. Device Profile: BACnet devices shall Conform to the following device profiles as specified in ASHRAE/ANSI 135 BACnet Annex L:
  1. Operator workstation: BACnet Operator Workstation (B-OWS)
  2. Building Controller: BACnet Building Controller (B-C).
  3. Advanced Application Controller: BACnet Advanced Application Controller (B-AAC).
  4. Application Specific Controller: BACnet Application Specific Controller (B-ASC).
- C. Software Programming:
  1. Provide programming for the system and adhere to the sequences of operation provided. Provide actions for all possible situations. All other system programming necessary for the operation of the system shall be provided by the Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Provide text-based, graphic-based, and parameter-based programming where appropriate.
- D. Operating System:
  1. Concurrent, multi-tasking capability.
  2. Common Software Applications Supported:
    - a. Microsoft Windows and Microsoft Office Suite.
    - b. Open platform compatible database: Microsoft Access, Oracle Database, IBM Analytics, or other SQL database software. Proprietary databases shall not be acceptable.
  3. Acceptable Operating Systems: Most recent version of operating system.
- E. System Graphics:
  1. Color type, saved in an industry-standard format such as BMP, JPEG, PNG, or GIF.
  2. Allow simultaneous display for comparison and monitoring of system status.
  3. Web based graphics shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X, Java Virtual Machine, and Adobe Flash).
  4. Animate displayed objects by shifting image files of objects based on object status.
  5. Functionality: Provide method for operator with password to perform the following:
    - a. Move between, change size, and change location of graphic displays.
    - b. Modify on-line.

- c. View a summary of the most important data for each controlled zone or piece of equipment.
- d. View a summary of the most important global data for the project, including but not limited to date, day of week, time, outdoor dry bulb temperature, and humidity.
- e. Use point-and-click navigation between graphic screens.
- f. Edit setpoints and other specified parameters.
  - a. Edit equipment names and numbers.
  - b. Edit room names and numbers.
  - g. Indicate areas or equipment in an alarm condition using color or other visual indicator.
  - h. Add, delete, or change dynamic objects consisting of:
    - 1) Analog and binary values.
    - 2) Dynamic text.
    - 3) Static text.
    - 4) Animation files.
  - i. Display graphic file, text, and dynamic object data together on a single graphic. Display all measured and commanded data, setpoints, calculated values, and input and output control points with appropriate engineering units associated with each system schematic.
  - j. Dynamic Data Displays: Dynamic temperature values, humidity values, flow values, and status indication shall be shown in their actual respective locations, and shall automatically update to represent current conditions without operator intervention.
  - k. Dynamic Data Displays shall be capable of including point data from multiple ASC's.
- 6. Include at least one graphic for each of the following:
  - a. Each piece of equipment.
  - b. Occupied zone.
  - c. Hydronic system (chilled water, condenser water, hot water, steam, heat pump, etc.)
  - d. Floor plan displays of the building. Indicate summary conditions for each floor.
  - e. Indicate thermal comfort on floor plan using dynamic colors to represent zone temperature relative to zone setpoint.
- 2. Graphic Tree Structure:
  - f. Structure graphic system tree to allow access to individual graphic screens from a macro to a micro level.
  - g. Allow each level of graphic direct access to the graphic screen above and below the graphic screen in the system tree.
  - h. Allow direct access to the main summary graphic screen/map from any individual graphic screen.
- 7. Sequence of Operation Graphics:
  - a. Display the complete Sequence of Operation or include a link to a separate text file that contains the sequence of operation, as submitted by the Contractor and approved by the Engineer with each system schematic view. The Sequence of Operation text shall be in a separate frame above, below, or to the side of the graphic as appropriate for the graphic size and content.
- 8. Custom Graphics Generation Package:
  - a. Allow operator to create, delete, modify, and save custom graphic files and displays. File format of graphics shall be compatible with BAS software.
  - b. Web-based Graphics: HTML graphics to support web browser compatible formats.
  - c. The BAS Contractor shall provide libraries of pre-engineered screens and symbols depicting standard components with which custom graphics may be built. Standard components include but are not limited to
    - 1) Air handling unit components (e.g., fans, cooling coils, filters, dampers, etc.).
    - 2) Complete mechanical systems (e.g., constant volume-terminal reheat, VAV, etc.).
    - 3) Hydronic system components (e.g., chillers, boilers, pumps, piping, valves, etc.).
    - 4) Electrical symbols.

- d. The graphic development package shall use a mouse or similar pointing device in conjunction with a drawing program to allow the user to perform the following
    - 1) Define symbols.
    - 2) Position and size symbols.
    - 3) Define background screens.
    - 4) Define connecting lines and curves.
    - 5) Locate, orient and size descriptive text.
    - 6) Define and display colors for all elements.
    - 7) Establish correlation between symbols or text and associated system points or other displays.
    - 8) Capture or convert graphics from AutoCAD.
  - e. Graphical displays shall be capable of representing a group of objects. Groups shall be capable of representing any logical grouping of system points or calculated data based upon building function, mechanical system, building layout, or any other logical grouping of points which aids the operator in the analysis of the building.
3. Standard HVAC Graphics Library: Furnish a complete library of standard HVAC equipment graphics and standard symbols for ancillary equipment in a file format compatible with the graphics generation package program. Graphics shall include, but not be limited to, the following:
    - a. HVAC Equipment:
      - 1) Chillers.
      - 2) Boilers.
      - 3) Air Handlers.
      - 4) Terminal HVAC Units.
      - 5) Fan Coil Units.
    - b. Ancillary Equipment:
      - 1) Fans.
      - 2) Pumps.
      - 3) Coils.
      - 4) Valves.
      - 5) Piping.
      - 6) Dampers.
      - 7) Ductwork.
- F. Workstation System Applications:
1. General Application Functions:
    - a. All applications shall be capable of being executed automatically without the need for operator intervention, and shall be flexible enough to allow user customization.
    - b. Allow BAS configuration and future changes or additions by operators with password protection.
    - c. Execute configured processes defined by the user to automatically perform calculations and control routines.
    - d. Process Inputs and Variables: It shall be possible to use any of the following in a configured process:
      - 1) Any system-measured point data or status
      - 2) Any calculated data
      - 3) Any results from other processes
      - 4) Boolean logic operators (and, or)
    - e. Process Triggers: Configured processes may be triggered based on any combination of the following:
      - 1) Time of day
      - 2) Calendar Date
      - 3) Other processes
      - 4) Events (e.g., point alarms)

- f. Data Access: A single process shall be able to incorporate measured or calculated data from any and all other ASC's. In addition, a single process shall be able to issue commands to points in any and all other ASC's on the local network.
2. Network Configuration:
  - a. Allow for configuration of the BAS network.
  - b. Provide alarm when a break in communication between devices is detected.
  - c. Enable the operator to add, delete, or modify the following:
    - 1) Building controllers and ASC's.
    - 2) Points of any type, point parameters, and tuning constants.
  - d. Provide automatic reconfiguration if any station is added or lost.
3. Save and Restore:
  - a. Automatic System Database Save and Restore Functions:
    - 1) Store current database copy of each Building Controller on hard disk or server.
    - 2) Backup database on a user adjustable frequency basis. Default frequency shall be monthly.
    - 3) Automatically update upon change in any system panel.
    - 4) In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
  - b. Manual System Database Save and Restore Functions by Operator with Password Clearance:
    - 1) Save database from any system panel.
    - 2) Clear a panel database.
    - 3) Initiate a download of a specified database to any system panel.
4. On-line Help:
  - a. Include context-sensitive system to assist operator in operation and editing.
  - b. Include topics available for all applications.
  - c. Include relevant screen data provided for particular screen display.
  - d. Include additional help via hypertext.
5. Security:
  - a. Require user name and password for Operator log-on to view, edit, add, or delete data.
  - b. Include selectable system security for each operator. Support a minimum of five levels of access:
    - 1) Level 1 Read-only data access and display.
    - 2) Level 2 Level 1 scheduling.
    - 3) Level 3 Level 2 operator overrides and commands.
    - 4) Level 4 Level 3 database generation and modification.
    - 5) Level 5 Level 4 Audit trail management.
    - 6) Operators shall be able to perform only those commands available for their respective passwords. Menu selections displayed at any operator device shall be limited to only the items defined as accessible for the user.
    - 7) Support a minimum of 4 passwords at each Building Controller.
  - c. Allow system supervisor to set passwords and security levels for all other operators.
  - d. Allow operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
  - e. Include automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
  - f. Store all system security data in encrypted format.
  - g. Log all user actions and store data for audit with permission access by system administrator only.
    - 1) Include the modified system.
    - 2) Include the value modified.
    - 3) Include the time of modification.
6. System Diagnostics:

- a. Operations Automatically Monitored:
    - 1) Workstations.
    - 2) Printers.
    - 3) Network connections.
    - 4) Building management panels.
    - 5) Controllers.
  - b. Device failure is annunciated to the operator.
7. Alarm Management:
- a. Allow alarm prioritizing to minimize nuisance reporting and to speed operator response to critical alarms.
    - 1) Provide a minimum of three, user definable priority levels.
    - 2) Enable users to manually inhibit alarm reporting for each point.
    - 3) Enable users to manually inhibit nuisance alarm reporting for maintenance or repair work that is scheduled to be performed.
    - 4) Enable user to define conditions under which point changes need to be acknowledged by an operator, and/or logged for analysis at a later date.
    - 5) Allow alarm prioritization to lock out or circumvent other alarms that may be generated as a result of primary alarm.
  - b. Prohibit interference with the ability of the system software to report alarms by either operator activity at the local I/O device, or communications with other system controllers on the network.
  - c. Allow all system objects that are configurable to "alarm in" and "alarm out" of normal state.
  - d. Configurable Objects:
    - 1) Alarm limits.
    - 2) Alarm limit differentials.
    - 3) States.
    - 4) Reactions for each object.
    - 5) Alarm delay.
  - e. Alarm Messages:
    - 1) Descriptor: English language. Acronyms or mnemonics for objects in alarm are not acceptable.
    - 2) Recognizable Features:
      - a) Source.
      - b) Location.
      - c) Nature.
      - d) Time and Date.
      - e) Alarm message box to more fully describe the alarm condition or direct operator response.
      - f) Each Alarm messages shall be assignable to any point in the BAS. Alarm messages shall be assignable to multiple points.
        - a) Notification of an alarm override.
  - f. Configurable Alarm Reactions by Workstation and Time of Day:
    - 1) Logging.
    - 2) Printing.
    - 3) Starting programs.
    - 4) Displaying messages.
    - 5) Phone text message.
    - 6) Email.
    - 7) Providing audible annunciation.
    - 8) Displaying specific system graphics.
8. Custom Trend Logs:
- a. Maintain trend information for minimum 365 days.
  - b. Definable for any data object in the system including interval, start time, and stop time.
    - 1) Resolution: Interval periods shall be adjustable down to one minute.

- 2) Multiple Interval Period: Each trended point shall have the ability to be trended at a different trend interval.
    - c. Trend Data:
      - 1) Sampled and stored on the building controller panel.
      - 2) Auto-Delete Period: Software shall be capable of automatically deleting stored trend data after a user-adjustable period of time. Each trended point shall have the ability to have a different auto-delete interval period.
      - 3) Archivable on hard disk or server.
      - 4) Retrievable for use in reports, spreadsheets and standard database programs.
      - 5) Protected and encrypted format to prevent manipulation or editing of historical data and event logs.
    - d. Trend Graph Display:
      - 1) Group Trend Time Series Plots:
        - a) Provide user-selectable Y-axis points.
        - b) Provide user editable titles, point names, and Y-axis titles.
        - c) Individual trended points shall be able to be grouped into groups of up to four points per plot with up to four plots per page.
      - 2) X-Y Trend Plots:
        - a) User selectable X and Y trend inputs.
        - b) User editable titles, point names, and X and Y-axis titles.
        - c) User selectable time period options:
          - i) 1-day 24-hour period.
          - ii) 1-week 7-day period.
          - iii) 1-month period with appropriate days for the month selected.
          - iv) 1-year period.
          - v) User shall be able to select the beginning and ending period for each X-Y chart, within the time domain of the database being used.
          - vi) User selectable display up to 6 plots per screen in 2 columns.
      - 3) Automatic Scaling: System shall automatically scale the axis on which trends are displayed when multiple points with different trend interval periods are selected for graphical display.
      - 4) Dynamic Update: Trends shall be able to dynamically update at operator-defined intervals.
      - 5) Zoom: Software shall allow zoom-in function for detailed examination of trends.
    - e. Numeric Value Display: Software shall display value of any sample on a trend when picked.
  9. Alarm and Event Log:
    - a. View all system alarms and change of states from any system location.
    - b. List events chronologically.
    - c. List alarm priority.
    - c. Allow operator with proper security to acknowledge and clear alarms. Log operator and time when alarm is acknowledged.
    - d. Archive alarms not cleared by operator to the workstation.
  10. Object, Property Status, and Control:
    - a. Provide a method to view, edit if applicable, the status of any object and property in the system.
    - b. Status Available by the Following Methods:
      - 1) Menu.
      - 2) Graphics.
      - 3) Custom Programs.
  11. Clock Synchronization:
    - a. The real-time clocks in all building control panels and workstations shall be able to automatically synchronize daily from any operator-designated device in the system.

- b. The system shall automatically adjust for daylight savings and standard time, if applicable.
- 12. Reports and Logs:
  - a. Reporting Package:
    - 1) Allow operator to select, modify, or create reports.
    - 2) Definable as to data content, format, interval, and date.
    - 3) Under no conditions shall the operator need to specify the address of hardware controller to obtain system information.
    - 4) Provide ability to obtain real-time logs of all objects available by type or status such as alarm, lockout, normal, etc.
    - 5) Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
    - 6) Allow printing on operator command or specific time(s).
  - b. Standard Report Format Options:
    - 1) Objects with current values.
    - 2) Global modification values.
    - 3) Current alarms not locked out.
    - 4) Disabled and overridden objects, points and variables.
    - 5) Objects in manual or automatic alarm lockout.
    - 6) Objects in alarm lockout currently in alarm.
    - 7) Objects currently in override status.
    - 8) Objects in Schedules
      - a) Daily.
      - b) Weekly.
      - c) Holiday.
    - 9) Logs:
      - a) Alarm History.
      - b) System messages.
      - c) System events.
      - d) Trends.
  - c. Custom Report Format Options:
    - 1) Daily.
    - 2) Weekly.
    - 3) Monthly.
    - 4) Annual.
    - 5) Time and date stamped.
    - 6) Title.
    - 7) Facility name.
    - 8) Point Groups.
      - a) User-selectable.
      - b) Group may be comprised of specific points, group of equipment objects, group of groups, or for the entire facility without restriction due to the hardware configuration of the BAS.
  - d. Electrical, Fuel, and Weather:
    - 1) Electrical Meter(s):
      - a) Monthly showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.
      - b) Annual summary showing monthly electrical consumption and peak demand with time and date stamp for each meter.
    - 2) Fuel Meter(s):
      - a) Monthly showing daily fuel consumption for each meter.
      - b) Annual summary showing monthly consumption for each meter.
    - 3) Weather:
      - a) Monthly showing minimum, maximum, average outdoor air temperature and heating/cooling degree-days for the month.
- 13. Global Modify:



- a. Allow global modification of all editable data. Similar data shall be grouped into logical objects based on building function, mechanical system, building layout, or any other logical grouping of points.
  - b. Allow each common type of equipment to be excluded or included within the global editing process.
  - c. Display status information on all similar points in one global report.
  - d. Allow modification of the following:
    - 1) Individual data point edited.
    - 2) List of all points within the category.
    - 3) Global change field.
    - 4) Copy feature to assist in downloading the new changes.
    - 5) Verification that all changes were completed.
  - e. Include a change-all feature to change all selections.
  - f. Prevent acceptance of changes until an accept icon is acknowledged.
- G. Workstation Applications Editors:
- 1. Provide editing software for each system application at the PC workstation.
  - 2. Edited applications shall be automatically downloaded and executed at the controller panel.
  - 3. Programming Description: Definition of operator device characteristics, ASC's, individual points, applications and control sequences shall be performed through fill-in-the-blank templates.
  - 4. System Definition/Control Sequence Documentation: All portions of system definition shall be self-documenting to provide hard copy printouts of all configuration and application data.
  - 5. System definition and modification procedures shall not interfere with normal system operation and control.
  - 6. Provide consistent text-based displays of all system point and system applications.
  - 7. Point identification, engineering units, status indication, and application naming conventions shall be the same at all operator devices.
  - 8. Full screen editor for each application shall allow operator to view and change:
    - a. Configuration.
    - b. Name.
    - c. Control parameters.
    - d. Set-points.
    - e. Schedules.
  - 9. Scheduling:
    - d. Allow scheduling down to the zone or room level.
      - a. Monthly calendar indicates schedules, holidays, and exceptions.
      - b. Allows several related objects to be grouped, scheduled, and copied to other objects or dates.
      - c. Start and stop times adjustable from master schedule.
      - e. Schedule expiration.
      - d. Temporary overrides of systems with user adjustable time-out.
      - f. Provide minimum three tiers of priorities for scheduling.
        - 1) Priority 1: Event, temporary, or override.
        - 2) Priority 2: Calendar.
        - 3) Priority 3: Default.
      - g. Higher priority schedules shall overlay with lower priority schedules without interrupting or deleting them. Upon expiration of a higher priority schedule, schedule shall revert to next lower priority.
      - h. Expired priority 1 and priority 2 schedules shall be automatically deleted after execution.
  - 10. Custom Application Programming:
    - a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
    - b. Programming Features:

- 1) English oriented programming language, allowing for free form programming.
- 2) Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
- 3) Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
- 4) Allows the development of independently, executing, program modules designed to enable and disable other modules.
- 5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
- 6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
- 7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.
- 8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values can be used in IF/THEN comparisons, calculations, programming statement logic, etc.
- 9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

## 2.6 CONTROLLER SOFTWARE

- A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.
- B. System Security:
  1. User access secured via user passwords and user names.
  2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
  3. User Log On/Log Off attempts are recorded.
  4. Automatic Log Off occurs following the last keystroke after a user defined delay time.
- C. Object or Object Group Scheduling:
  1. Weekly Schedules Based on Separate, Daily Schedules:
    - a. Include start, stop, optimal stop, and night economizer.
    - b. 10 events maximum per schedule.
    - c. Start/stop times adjustable for each group object.
  2. Exception Schedules:
    - a. Based on any day of the year.
    - b. Defined up to one year in advance.
    - c. Automatically discarded and replaced with standard schedule for that day of the week upon execution.
  3. Holiday or Special Schedules:
    - a. Capability to define up to 99 schedules.
    - b. Repeated annually.
    - c. Length of each period is operator defined.
- D. System Coordination: Provide a standard application for equipment coordination. The application shall provide the operator with a method of grouping together equipment based on function and location. Groups shall be capable of being used for scheduling and other applications.
- E. Alarms:
  1. Binary object is set to alarm based on the operator specified state.
  2. Analog object to have high/low alarm limits.

3. All alarming is capable of being automatically or manually disabled.
4. Alarm Reporting:
  - a. Operator determines action to be taken for alarm event.
  - b. Alarms to be routed to appropriate workstation.
5. Reporting Action Options:
  - a. Start Programs.
  - b. Print.
  - c. Logged.
  - d. Custom messaging.
  - e. Graphical displays.
  - f. Dial out to workstation receivers via system protocol.
- F. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.
- G. Sequencing: Application software based upon specified sequences of operation on the control drawings.
- H. PID Control Characteristics:
  1. Provide proportional-integral algorithms.
  2. Direct or reverse action.
  3. Anti-windup.
  4. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
  5. User selectable controlled variable, set-point, and PI gains.
- I. Staggered Start Application:
  1. Prevents all controlled equipment from simultaneously restarting after power outage.
  2. Order of equipment startup is user selectable.
- J. Anti-Short Cycling:
  1. All binary output objects protected from short-cycling.
  2. Allows minimum on-time and off-time to be selected.
  3. Allows the number of times each piece of equipment may be cycled within any one-hour period.
- K. On-Off Control with Differential:
  1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
  2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.
- L. Trending: Building controllers shall allow collection and delivery of (time, value) pairs.
- M. Totalization:
  1. Run-Time Totalization:
    - a. Totalize run-times for all binary input objects.
    - b. Provides operator with capability to assign high run-time alarm.
    - c. Generates unique, user-specified messages when the limit is reached.
    - d. Resolution: Adjustable down to one minute.
  2. Pulse Totalization:
    - a. Totalize consumption for user-selected analog and binary pulse input-type objects.
    - b. Configurable for a daily, weekly, or monthly basis.
    - c. Provide calculation and storage accumulations of up to 9,999,999 units (e.g. KWH, gallons, KBTU, tons, etc.).
    - d. Resolution: Adjustable down to one minute.
    - e. Warning Limit: User definable. Generate unique, user-specified messages when the limit is reached.
    - f. The information available from the Pulse Totalization shall include, but not be limited to, the following:
      - 1) Peak Demand, with date and time stamp
      - 2) 24-hour Demand Log
      - 3) Accumulated KWH for day

- 4) Sunday through Saturday KWH usage
  - 5) Sunday through Saturday Demand kW
  - 6) Demand kW annual history for past 12 periods
  - 7) KWH annual history for past 12 periods
3. Event Totalization:
- a. Count user-selected events, such as the number of times a pump or fan system is cycled on and off.
  - b. Provide storage accumulations of up to 9,999,999 events before reset.
  - c. Warning Limit: User definable. Generate unique, user-specified messages when the limit is reached.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- D. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices and wiring are installed prior to installation proceeding.
- E. Verify the integrity of control wiring, raceways, control panels, sensors, and control devices prior to reusing for the new work.
- F. Verify wiring insulation is defect free and test wiring for continuity and ground faults.

### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Coordination:
  1. Cooperate with other contractors performing work on this project as necessary to achieve a complete and coordinated installation. Each Contractor shall consult the Drawings and Specifications for all trades to determine the nature and extent of others work.
  2. Coordinate with other contractors performing work to provide standby power to all control devices required to operate on standby power.
  3. Coordinate with the Owner to display additional virtual points on individual schematic graphic screens that are not directly associated with that system. Examples may include outdoor air temperature or global alarm conditions.
- B. Web Services Enabled Network:
  4. Provide an IP network data drop for connection of BAS into Owner's IP network. Coordinate final location of IP network data drop with the Owners' IT staff.
  5. If the Owner has no preference or not indicated on the drawings, locate data drop within the main BAS control panel.
  6. Coordinate with the Owner's IT department to implement proper security measures, including secure access to the network data drop and firewalls at all virtual access points to the internet to protect access to the BAS.
- C. General Workmanship:
  1. Install equipment, piping, and wiring/raceway parallel to building lines wherever possible.
  2. Install all equipment in readily accessible locations.
  3. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
  4. All installations shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

7. Control wiring routed in wall cavities shall be installed in conduit.
  8. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
  9. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation.
- C. Controllers:
1. Install controllers in a locked control panel. Provide common keying for all controller covers.
  2. Provide a separate controller for each piece of controlled equipment, such as an AHU, FCU, VAV box, etc. A controller may control more than one piece of equipment provided that all points associated with the equipment are assigned to the same BAS controller. Global points used for control loop reset are exempt from this requirement.
  3. Select building controllers and custom application controllers to provide the required I/O point capacity required to monitor all of the hardware points listed on the control drawings.
  4. Application specific controllers may be used where factory programming is capable of executing all control functions specified in the sequences of operation. Contractor shall add supplemental controllers, devices, and programming as required to execute the specified control function if the ASC cannot.
- D. Wiring:
1. All control and interlock wiring shall comply with national and local electrical codes.
  5. Properly ground all controllers.
  6. Wire all safety devices through both hand and auto positions of motor starting device to ensure 100 percent safety shut-off.
  2. Provide interlock wiring between devices as indicated on the control drawings.
  3. Provide electrical wiring for relays (including power feed) for temperature and pressure indication.
  4. All NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and Division 26 requirements.
  5. All low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be sub-fused when required to meet Class 2 current limit.
  7. Conceal all low voltage wiring in finished rooms.
  8. Conceal all low voltage wiring in unfinished rooms below the elevation of the lights. Low voltage wiring above the elevation of the lights may be exposed.
  9. Routing of low voltage wiring above working heights in equipment rooms and above accessible ceilings is acceptable subject to following criteria:
    - a. Wiring shall be plenum rated.
    - b. Do not lay wiring on ceiling tiles.
  6. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL listed for the intended applications.
  7. All wiring in mechanical, electrical, service rooms, or where subject to mechanical damage, shall be installed in raceway at levels below 10 feet.
  8. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two wires (e.g., relays and transformers).
  9. Where Class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it and neatly tied at 10 foot intervals.
  10. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
  11. All wire-to-device and wire-to-wire connections shall be made at a terminal block or terminal strip.
  12. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

13. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, coordinate with Division 26 to provide step-down transformers.
14. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
15. Install plenum wiring in sleeves where it passes through floors and walls. Maintain fire rating at all penetrations.
16. Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.
17. Include one pull string in each raceway 1 inch and larger.
18. Use coded conductors throughout with conductors of different colors.
19. Control and status relays shall be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
20. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6 inches from high-temperature equipment (e.g., steam pipes or flues).
21. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
22. Install insulated bushing on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.
23. Terminate all control and/or interlock wiring and maintain updated (as-built) wiring diagrams with terminations identified at the job site.
24. Terminate BAS sensor input wiring cable shield by taping back at the field device and connect shield to the grounded control panel chassis or sub-panel.
25. Terminate BAS comm bus cable shield between controllers per manufacturer recommendations.
26. Terminate management level/enterprise level network wiring cable shield by wrapping the drain wire around the foil shield and connecting the ground strip to the drain wire.
27. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 feet in length and shall be supported at each end. Flexible metal raceway less than 1/2 inch electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.
28. Raceway shall be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations shall be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

E. Communication Wiring:

1. Adhere to the items listed in the "Wiring" article in Part 3 of this specification in addition to the requirements listed below.
2. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication wiring.
3. Do not exceed 328 feet in Ethernet wiring length between switches or repeaters.
4. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.
5. Do not install power wiring, in excess of 30 Vac RMS, in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, use separate twisted shielded pairs with the shields grounded in accordance with the manufacturer's wiring practice.
6. Communication conduits shall not be installed closer than six feet from high power transformers or run parallel within six feet of electrical high power cables. Care shall be taken to route the cable as far from interference generating devices as possible.
7. Do not exceed maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer during installation.

8. Verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
  9. When a cable enters or exits a building, install a lightning arrestor between the lines and ground. Install the lightning arrestor according to the manufacturer's instructions.
  10. Ground (earth ground) all shields at one point only, to eliminate ground loops.
  11. All runs of communications wiring shall be unspliced length when that length is commercially available.
  12. Terminate shielded cable splices in accessible locations. Harness cables with cable ties.
  13. Make all wire-to-device and wire-to-wire connections at a terminal block or terminal strip.
  14. Label all communications wiring to indicate origination and destination data.
  15. Ground coaxial cable in accordance with NEC regulations.
  16. Install BACnet MS/TP communications wiring in accordance with ASHRAE/ANSI Standard 135
    - a. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 17 pF per foot at 76,800 Baud.
    - b. The maximum length of an MS/TP segment shall be 3000 ft with AWG 22 or 24 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485.
    - c. The maximum number of nodes per segment shall be 50. Additional nodes may be accommodated by the use of repeaters.
    - d. An MS/TP EIA-485 network shall have no T connections.
- F. Identification of Hardware and Wiring:
1. Label all wiring and cabling, including that within factory-fabricated panels, at each end within 2 inch of termination with the BAS address or termination number.
  2. Permanently label or code each point of field terminal strips to show the instrument or item served.
  3. Identify control panels with minimum 1/2 inch letters on laminated plastic nameplates.
  4. Identify all other control components with permanent labels. Label all plug-in components such that removal of the component does not remove the label.
  5. Identify room sensors related to terminal box or valves with nameplates.
  6. Maintain manufacturers' nameplates and UL or CSA labels visible and legible after equipment is installed.
  7. Identifiers shall match record documents.

### 3.3 STARTUP AND DEMONSTRATION

- A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing the BAS in permanent operation.
- B. Contractor shall provide an on-site controls technician or programmer familiar with the project BAS installation and system programming to assist the Commissioning Agent as directed during all phases of system functional testing.
- C. Coordinate with Owner the setup of logins, passwords, and security level access for individuals requiring access to the BAS.
- D. BAS graphics shall be updated with final equipment names, equipment numbers, room names and room numbers to match the final construction documents and any Owner changes made prior to occupancy.
- D. BAS shall be set up and checked by factory trained technicians skilled in the setting and adjustment of the BAS equipment used in this project. Technicians shall be experienced in the type of HVAC systems associated with this project.
- E. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.

- F. Test each control device to ensure that it is operating properly and is calibrated to the appropriate operating requirements. Run each control device through its range of operation and sequence. Verify all normal positions are correct. Adjust and tune PID control constants to achieve proper system operation.
1. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
  2. Demand limiting. The Contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
  3. Optimum start/stop. The Contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.
  4. Any tests that fail to demonstrate the operation of the BAS shall be repeated at a later date. The Contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.
- G. Test and verify control interfaces to other building systems integrated into the network.
- H. Verify all alarms and interlocks.
1. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
  2. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
  3. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.
  4. Verify fire/smoke and smoke damper functionality. Verify that they respond to the proper fire alarm system general, zone, and/or detector trips.
- I. Document on system equipment schedules the final setting of controller PID constant settings, setpoints, manual reset values, maximum and minimum controller output, and ratio and bias settings in units and terminology specific to the controller. Store documentation with operator workstation.
- J. Demonstrate complete and operating system to Owner.
1. Prior to acceptance, the BAS shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.
  2. The tests described in this section are to be performed in addition to the tests that the Contractor performs as a necessary part of the installation, start-up, and debugging process.
  3. The Contractor shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. Any test equipment required to provide the proper operation shall be provided by and operated by the Contractor.
  4. Demonstrate compliance with sequences of operation through all modes of operation.
  5. Demonstrate complete operation of operator interface.
- K. Acceptance:
1. All tests described in this specification shall have been performed to the satisfaction of the Owner prior to the acceptance of the BAS as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the completion requirements if stated as such in writing by the Contractor and submitted for approval by the Owner. Such tests shall then be performed as part of the warranty.
  2. The BAS shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved.



**3.4 MAINTENANCE SERVICE**

- A. Provide service and maintenance of energy management and control systems for one year from Date of Substantial Completion.

**3.5 TRAINING**

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of sixteen hours on the operation and maintenance of the equipment provided under this section.
- B. Organize the training into sessions or modules for different levels of operators. Owner designated personnel shall be trained based on the level of operator training described below.
- C. Day-to-day Operator Training:
  - 1. Overview of the system and/or equipment as it relates to the facility as a whole.
  - 2. Proficiently operate the BAS.
  - 3. Understand BAS architecture and configuration.
  - 4. Understand BAS components.
  - 5. Understand system operation, including BAS control and optimizing routines (algorithms).
  - 6. Operate the workstation and peripherals.
  - 7. Log on and off the system.
  - 8. Access graphics, point reports, and logs.
  - 9. Adjust and change system set points, time schedules, and holiday schedules.
  - 10. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
  - 11. Understand BAS drawings and Operation and Maintenance manual.
  - 12. Understand the job layout and location of control components.
  - 13. Access data from BAS controllers and ASCs.
  - 14. Operate portable operator's terminals.
  - 15. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
- D. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
- E. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- F. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 23 21 13 - HYDRONIC PIPING****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Hydronic system requirements.
- B. Hydronic piping materials.
- C. Hydronic piping fittings.
- D. Hydronic piping joining materials.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

**1.3 SUBMITTALS**

- A. Submit in accordance with conditions of Contract and Division 01 submittal procedures.
- B. Reference Division 23 Section, "Basic Piping Materials and Methods" for additional submittal requirements.
- C. Reports as specified in Part 3 of this Section.

**1.4 QUALITY ASSURANCE**

- A. Comply with Division 23 Section, "Basic Piping Materials and Methods."
- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this Section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this Section, with minimum three years of documented experience.

**1.5 DELIVERY STORAGE AND HANDLING**

- A. Comply with Division 23 Section, "Basic Piping Materials and Methods."

**PART 2 - PRODUCTS AND MATERIALS****2.1 HYDRONIC PIPING MATERIALS**

- A. Carbon Steel Pipe:
  - 1. NPS 2 inch and Smaller: ASTM A53 or A106, Type E electric-resistance welded or Type S seamless, Grade B, Schedule 40, black steel, plain ends.
  - 2. NPS 2-1/2 inch through 10 inch: ASTM A53 or A106, Type E electric-resistance welded or Type S seamless, Grade B, Schedule 40, black steel, plain or beveled ends.
  - 3. NPS 12 inch and Larger: ASTM A53 or A106, Type E electric-resistance welded or Type S seamless, Grade B, Schedule STD, black steel, plain or beveled ends.
- B. Copper Tubing:

1. Drawn Temper Tubing: ASTM B306, Type DWV
2. Drawn Temper Tubing: ASTM B88, Type M.
3. Drawn Temper Tubing: ASTM B88, Type L.
4. Annealed Temper Tubing: ASTM B88, Type K.

## 2.2 HYDRONIC PIPING FITTINGS

- A. General: Fittings shall be of wall thickness, pressure rating, and material matching adjoining pipe.
- B. Reference Division 23 Section "Basic Piping Materials and Methods" for basic piping materials and fittings.
- C. Threaded:
  1. All threads shall conform to ASME B1.20.1.
  2. Malleable-Iron: ASME B16.3, standard pattern.
  3. Cast-Iron: ASME B16.4, standard pattern.
  4. Galvanized: ASTM A197, standard pattern.
- D. Flanged:
  1. Cast-Iron Threaded: ASME B16.1, raised ground face, bolt holes spot faced.
  2. Cast-Bronze Flanges: ASME B16.24, raised ground face, bolt holes spot faced.
  1. Galvanized Threaded: ASME B16.5, raised ground face, bolt holes spot faced.
  3. Wrought Cast-Iron, Forged Steel, and Stainless Steel: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connection, and facing:
    - a. Material Group: 1.1.
    - b. End Connections: Butt welding.
    - c. Facings: Raised face.
  4. Gaskets: ASME B16.21, non-metallic, asbestos free, 1/8 inch thick, full-face for cast-iron flanges and raised-face steel flanges, suitable for chemical and thermal conditions of piping system contents.
  5. Flange bolts and nuts: ASME B18.2.1, hex head carbon steel according to ASTM A307, Grade B.
- E. Welded:
  1. Carbon and Galvanized Steel: ASME B16.9, seamless weld conforming to ASTM A234.
- F. Solder-Joint: Wrought-copper, ASME B16.18 or B16.22, streamlined pattern.
- G. Brazed-Joint: Wrought-copper, ASME B16.50, streamlined pattern.

## 2.3 HYDRONIC PIPING JOINING MATERIALS

- A. Reference Division 23 Section "Basic Piping Materials and Methods" for basic joining materials.

## PART 3 - EXECUTION

### 3.1 INSTALLATION GENERAL

- A. Install products in accordance with manufacturer's instructions.
- B. Install piping to ASME B31.9 requirements.
- C. Reference Division 23 Section "Basic Piping Materials and Methods" for general piping installation requirements.
- D. Do not install PVC or non-plenum rated CPVC piping in return air plenums.

**3.2 PIPE APPLICATION SCHEDULE**

- A. Mechanically Joined Hydronic Piping:
  - 1. Contractor may provide mechanically joined hydronic piping systems as an option in lieu of, in whole of, or in part of, the pipe fitting and joining methods for the specific systems indicated in Article "Pipe Applications." Reference Division 23 Section "Mechanically Joined Hydronic Piping Systems."
- B. Heating Hot Water Piping, Above Grade:
  - 1. Acceptable Pipe Materials:
    - a. Carbon steel with threaded fittings for pipes 2 inch and smaller, and flanged or welded fittings for pipes 2-1/2 inch and larger.
    - b. Type L copper with soldered, brazed, or flanged fittings.
  - 2. Fitting Pressure Class: Minimum rating of 125psig.
- C. Chilled Water Piping, Above Grade:
  - 1. Acceptable Pipe Materials:
    - a. Carbon steel with threaded fittings for pipes 2 inch and smaller, and flanged or welded fittings for pipes 2-1/2 inch and larger.
    - b. Type L copper with soldered, brazed, or flanged fittings.
  - 2. Fitting Pressure Class: Minimum rating of 125 psig.
- D. Condenser Water Piping, Above Grade:
  - 1. Acceptable Pipe Materials:
    - a. Carbon steel with threaded fittings for pipes 2 inch and smaller, and flanged or welded fittings for pipes 2-1/2 inch and larger.
    - b. Type L copper with soldered, brazed, or flanged fittings.
  - 2. Fitting Pressure Class: Minimum rating of 125psig.

**3.3 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment using jointing system specified.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

**3.4 PIPING INSTALLATION**

- A. Provide long radius elbows with a minimum centerline radius of 1-1/2 times the pipe diameter. Short radius elbows with a minimum centerline radius of 1 times the pipe diameter may be used only where space does not permit the long radius elbows.
- B. Install piping at a uniform grade of 1 inch in 40 feet upward in the direction of flow.
- C. Make reductions in pipe sizes using eccentric reducer fitting installed with the level side up.
- D. Install branch connections to mains using Tee fittings in main with take-off out the top or side of the main unless otherwise shown on the drawings. Up-feed risers shall have take-off out the top of the main line.
  - 1. Tee-drilling is prohibited as a means for connecting branch taps into any main.
  - 2. Bull-head tees are prohibited. Do not install tee fittings in such a way that the flow through the branch leg equals the sum of the flows through the two main legs.
- E. Anchor piping to ensure proper direction of expansion and contraction. Expansion loops and joints are indicated on the Drawings and specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

- F. Terminate condensate piping outside the building at nearest drain or other location as shown on the plans with air gap.

### 3.5 PIPE HANGERS AND SUPPORTS APPLICATION

- C. Comply with the requirements of Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- A. Provide vibration isolation on piping as specified in Division 23 Section "Vibration Isolation for HVAC."
- B. Install hangers with the following minimum rod sizes and maximum spacing:

Nom. Pipe Size - In.	Steel Pipe Max. Span - Ft.	Copper Tube Max. Span - Ft.	Min. Rod Dia. - In.
Up to 3/4	7	5	3/8
1	7	6	3/8
1-1/4	7	7	3/8
1-1/2	9	8	3/8
2	10	8	1/2
2-1/2	11	9	1/2
3	12	10	1/2
4	14	12	5/8 (1/2 for copper)
5	16	13	5/8 (1/2 for copper)
6	17	14	3/4 (5/8 for copper)
8	19	16	7/8 (3/4 for copper)
10	20	18	7/8 (3/4 for copper)
12	23	19	7/8 (3/4 for copper)
14	25		1
16	27		1
18	28		1 1/4
20	30		1-1/4
24	32		1-1/4
30	33		1-1/4

- C. Use copper tube maximum hanger span requirements for PVC and CPVC supports and hangers, unless manufacturer's recommendations specify closer hanger spacing.
- D. Support vertical runs at roof, at each floor, and at maximum 15-foot intervals between floors.
- E. Install a support within one foot of each change of direction.
- F. Space supports not more than five feet apart at valves, strainers, or piping accessories in piping larger than 2 inches.

### 3.6 PIPE JOINT CONSTRUCTION

- A. Reference Division 23 Section, "Basic Piping Materials and Methods" for basic pipe joint construction.
- B. Where more than one pipe material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
- C. Install non-conductive dielectric connections whenever joining dissimilar metals.

- D. Pipe-to-Valve and Pipe-to-Equipment Connection: Install flanges or unions between piping and valves and equipment for servicing. Do not use direct welded, brazed, or soldered connections unless specifically called for in the manufacturer's installation instructions.

### 3.7 FIELD QUALITY CONTROL

- A. Preparation for Testing:
1. Prepare hydronic piping in accordance with ASME B31.9.
  2. Leave joints, including welds, uninsulated and exposed for examination during the test.
  3. Provide temporary restraints for expansion joints which cannot sustain the reactions due to test pressure. If temporary restraints are not practical, isolate expansion joints from testing.
  4. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.
  5. Install relief valve set at a pressure no more than 1/3 higher than the test pressure, to protect against damage by expansion of liquid or other source of overpressure during the test.
- B. Pressure Testing:
1. Use ambient temperature water as the testing medium, except where there is a risk of damage due to freezing. Another liquid may be used if it is safe for workmen and compatible with the piping system components.
  2. Use vents installed at high points in the system to release trapped air while filling and prevent vacuum while draining the system. Use drains installed at low points for complete removal of the liquid.
  3. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low pressure filling lines are disconnected.
  4. Subject piping system to a hydrostatic test pressure which at every point in the system is 1.5 times the maximum system design pressure but not less than 100 psi. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test. Make a check to verify that the stress due to pressure at the bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength, or 1.7 times the "SE" value in Appendix I of ASME B31.9, Code For Pressure Piping, Building Services Piping.
  5. After the hydrostatic test pressure has been applied for at least 15 minutes, examine piping, joints, and connections for leaks. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.
  6. Provide test reports summarizing the test procedures and results of the tests.
- C. Flushing:
1. After satisfactory pressure test is obtained, flush piping system using a minimum velocity of 4 FPS through all portions of the system.
  2. Make all provisions required to isolate HVAC equipment, coils, control valves, automatic flow control valves, pressure independent control valves, and balance valves during flushing.
  3. Provide temporary valves, connections, and bypasses where required.
  4. System pumps may be used for flushing. Where system pumps are not used, provide temporary pumps with temporary connections.
  5. Continue flushing until discharge water shows no discoloration and strainers are no longer collecting dirt and other foreign materials.
  6. Upon completion of flushing, drain all water from system at low points, and remove, clean, and replace strainers.
  7. Open vents installed at high points in the system to release trapped air while filling and prevent vacuum while draining the system.

**3.8 AD USTING AND CLEANING**

- A. After installation of entire system, fill, clean, and treat systems. Refer to Section "HVAC Water Treatment" for additional requirements.
- B. Cleaning Agent Concentration:
  - 1. Use neutralizer agents on recommendation of system cleaner supplier and approval of Engineer.
- C. Hot Water Heating Systems:
  - 1. Apply heat while circulating, slowly raising temperature to 160 F and maintain for 12 hours minimum.
  - 2. Remove heat and circulate to 100 F or less, drain systems as quickly as possible.
  - 3. Refill with clean water and circulate for 6 hours at design temperatures, then drain.
  - 4. Refill with clean water and repeat until system cleaner is removed.
- D. Chilled Water and Closed Loop Condenser Water Systems:
  - 1. Circulate for 48 hours, then drain systems as quickly as possible.
  - 2. Refill with clean water, circulate for 24 hours, then drain.
  - 3. Refill with clean water and repeat until system cleaner is removed.
- E. Open Loop Systems:
  - 1. Flush open systems with clean water for one hour minimum. Drain completely and refill.
- F. Open vents installed at high points in the system to release trapped air while filling and prevent vacuum while draining the system.
- G. Remove and clean or replace strainer screens.
- H. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.
- I. After cleaning system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.
- J. Mark calibrated name plates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- K. Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.
- L. Inspect valves for leaks after piping systems have been tested and put into service, but before final adjusting and balancing. Adjust or replace packing, as required, on valves with leaks. Replace valve if leak persists.

**3.9 STARTUP**

- A. Fill system and perform initial chemical treatment. For systems with antifreeze or glycol, fill systems with specified percentages. Refer to Division 23 Section "HVAC Water Treatment" for chemical treatment.
- B. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
- C. Before operating the system perform these steps:
  - 1. Open valves to full open position. Close coil bypass valves.
  - 2. Remove and clean strainers.
  - 3. Check pump for proper direction of correct improper wiring.
  - 4. Set automatic fill valves for required system pressure.
  - 5. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).



6. Set temperature controls so all coils are calling for full flow.
7. Check operation of automatic bypass valves.
8. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.
9. Lubricate motors and bearings.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 23 21 13 - BURIED HYDRONIC AND STEAM PIPING****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Buried piping requirements.
- B. Pre-insulated piping system, buried.

**1.2 DEFINITIONS**

- A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing:
  - 1. Document and mark existing utilities prior to starting excavation.
  - 2. Ensure that utility connections are achieved in an orderly and expeditious manner.

**1.4 SUBMITTALS**

- A. Submit in accordance with conditions of Contract and Division 01 submittal procedures.
- B. Reference Division 23 Section, "Basic Piping Materials and Methods" for additional submittal requirements.
- C. Reports as specified in Part 3 of this Section.

**1.5 QUALITY ASSURANCE**

- A. Comply with Division 23 Section, "Basic Piping Materials and Methods."
- B. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this Section, with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified in this Section, with minimum three years of documented experience.
- D. Welder Qualifications: Certify in accordance with ASME BPVC-IX.

**1.6 DELIVERY STORAGE AND HANDLING**

- A. Comply with Division 23 Section, "Basic Piping Materials and Methods."

**PART 2 - PRODUCTS AND MATERIALS****2.1 BURIED HYDRONIC SYSTEM REQUIREMENTS**

- A. Coordinate the material type and pressure class of underground piping with above ground piping systems specified in other Division 23 sections. Provide required transition fittings and adapters where different materials are specified for above ground and underground joined piping systems.
- B. Mechanically Joined Hydronic Piping:

1. Contractor shall not use mechanically joined hydronic piping systems for hydronic piping in lieu of welded, threaded or flanged piping methods.
- C. Piping Materials:
2. Carbon Steel Pipe:
    - a. NPS 2 inch and Smaller: ASTM A53 or A106, Type E electric-resistance welded or Type S seamless, Grade B, Schedule 40 and Schedule 80, black steel, plain ends.
    - b. NPS 2-1/2 inch through 10 inch: ASTM A53 or A106, Type E electric-resistance welded or Type S seamless, Grade B, Schedule 40 and Schedule 80, black steel, plain or beveled ends.
    - c. NPS 12 inch and Larger: ASTM A53 or A106, Type E electric-resistance welded or Type S seamless, Grade B, Schedule STD, black steel, plain or beveled ends.
  2. Copper Tubing:
    - a. Copper Tube Size (CTS): ASTM B88, Type K, drawn.
  3. CPVC Pipe:
    - b. ASTM F441, Schedule 80, plain ends.
  3. HDPE Pipe:
    - a. ASTM F714, SDR 32.5 to 7.3 according to ASTM D3035 or D3350, plain ends.
- D. Fittings:
1. General: Fittings shall be of wall thickness, pressure rating, and material matching adjoining pipe.
  2. Reference Division 23 Section "Basic Piping Materials and Methods" for additional fittings.
  3. Threaded:
    - a. All threads shall conform to ASME B1.20.1.
    - b. Cast-Iron: ASME B16.4, standard pattern.
  4. Flanged:
    - a. Cast-Iron Threaded: ASME B16.1, raised ground face, bolt holes spot faced.
    - b. Cast-Bronze Flanges: ASME B16.24, raised ground face, bolt holes spot faced.
    - c. Wrought Cast-Iron, Forged Steel, and Stainless Steel: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connection, and facing:
      - 1) Material Group: 1.1.
      - 2) End Connections: Butt welding.
      - 3) Facings: Raised face.
    - d. Gaskets: ASME B16.21, non-metallic, asbestos free, 1/8 inch thick, full-face for cast-iron flanges and raised-face steel flanges, suitable for chemical and thermal conditions of piping system contents.
    - e. Flange bolts and nuts: ASME B18.2.1, hex head carbon steel according to ASTM A307, Grade B.
  5. Welded:
    - a. Carbon and Galvanized Steel: ASME B16.9, seamless weld conforming to ASTM A234.
  6. Solder-Joint: Wrought-copper, ASME B16.22, streamlined pattern.
  7. Brazed-Joint: Wrought-copper, ASME B16.50, streamlined pattern.
  8. Socket-Joint:
    - a. PVC: ASTM D2466, Schedule 40 and ASTM D2467, Schedule 80.
    - b. CPVC: ASTM F439, Schedule 80.
  9. Fusion-Joint:
    - a. HDPE: ASTM D2683, socket fusion or ASTM D3261, butt fusion. HDPE resin shall be made to match pipe dimensions and class.
  10. Transition Fittings for plastic to metal piping shall be of the plastic material of the adjoining pipe, one-piece, with a threaded brass or copper insert and schedule 80 solvent cement or fusion end.
- E. Joining Materials:
4. Reference Division 23 Section "Basic Piping Materials and Methods" for basic joining materials.

**2.2 PRE-INSULATED PIPING SYSTEM BURIED**

- A. Manufacturers
1. Insul-Tek Piping Systems, Inc.
  2. ISCO Industries.
  3. Perma-Pipe, Inc.
  4. Rovanco Piping Systems, Inc.
  5. Thermacor Process, L. P.
  6. Tricon Piping Systems, Inc.
  7. Urecon Pre-Insulated Pipe
- B. Conduit Pipe Pre-Insulated System:
1. Description: Factory-fabricated, watertight, drainable, pressure-tested conduit piping system with internal carrier pipe, pipe supports, and insulation.
  2. Carrier Pipe: As specified for the buried hydronic system in Part 3.
  3. Carrier Pipe Support Spacer: Corrugated galvanized steel with a maximum spacing of 10 feet.
    - a. Carrier pipe support shall provide the following minimum clearances:
      - 1) Between carrier pipe insulation and conduit, 1-inch.
      - 2) Between insulation of multiple carrier pipes, 3/16 inch.
      - 3) Between bottom of uninsulated carrier pipe and casing, 1-3/8 inches.
  4. Conduit Pipe:
    - a. Material: ASTM D3350 HDPE, with outside dimensions and wall thickness per ASTM D3035 or D2447.
    - b. Fittings: Factory-fabricated and -insulated elbows and tees compatible with the carrier pipe. Elbows may be bent pipe equal to carrier pipe.
    - c. Joints: Half-shell kits, with pourable or split insulation, casing sleeve, and shrink wrap sleeve.
    - d. Expansion Compensation: Size conduit at offsets with additional clearance required to contain piping expansion.
  5. Accessories:
    - a. Water Shed: Terminal end protector for carrier pipes entering building through floor, 3 inches deep and 2 inches larger than conduit; terminate casing 20 inches above the floor level.
    - b. Guides and Anchors: Steel plate welded to carrier pipes, complete with vent and drainage openings inside casing.
    - c. End Seals: Steel plate welded to carrier pipes, complete with drain and vent openings on vertical centerline.
    - d. Gland Seals: Packed stuffing box and gland follower mounted on steel plate, welded to end of conduit, permitting axial movement of carrier piping, with drain and vent connections on vertical centerline.
- C. Cased Pipe Pre-Insulated System:
1. Description: Factory-fabricated, watertight, drainable, cased piping system with internal carrier pipe and insulation.
  2. Carrier Pipe: As specified for the buried hydronic system in Part 3.
  3. Casing:
    - a. Material: ASTM D3350 HDPE, with minimum wall thickness as specified:
      - 1) Jacket size less than or equal to 12": 100 mils.
      - 2) Jacket sizes 12" to 24": 125 mils.
      - 3) Jacket sizes larger than 24": 150 mils.
    - b. Fittings: Factory-fabricated and -insulated elbows and tees compatible with the carrier pipe. Elbows may be bent pipe equal to carrier pipe.
    - c. Joints: Half-shell kits, with pourable or split insulation, casing sleeve, and shrink wrap sleeve.

- d. Expansion Compensation: Provide expansion cushions external to the system or elastomeric foam insulation blanket internal to the casing, formed to fit over carrier pipe and sized to accommodate the thermal expansion.
4. Accessories:
- a. Water Shed: Terminal end protector for carrier pipes entering building through floor, 3 inches deep and 2 inches larger than conduit; terminate casing 20 inches above the floor level.
  - b. Guides and Anchors: Steel plate welded to carrier pipes, complete with vent and drainage openings inside casing.
  - c. End Seals: Insulated and sealed watertight around casing and carrier pipe.
  - d. Gland Seals: Packed stuffing box and gland follower mounted on steel plate, welded to end of conduit, permitting axial movement of carrier piping, with drain and vent connections on vertical centerline.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION GENERAL**

- A. Install products in accordance with manufacturer's instructions.
- B. Install piping to ASME B31.9 requirements.
- C. Coordinate the location of underground piping systems with other underground utilities.
- D. Do not install underground piping when bedding is wet or frozen.
- B. Reference Division 23 Section "Basic Piping Materials and Methods" for general piping installation requirements.
- E. Provide manholes where access to the underground piping system is needed.

#### **3.2 EARTHWORK**

- A. See Division 31 Section "Earth Moving" for excavation, trenching, and backfilling.
- B. Reference Division 23 Section, "General Mechanical Requirements" for additional excavation, trenching, and backfilling requirements.

#### **3.3 PIPE APPLICATION SCHEDULE**

- A. Condenser Water Piping:
  - 1. Acceptable Pipe Materials:
    - a. Schedule 40 carbon or galvanized steel with threaded fittings for pipes 2 inch and smaller, and welded or flanged fittings for pipes 2-1/2 inch and larger.
    - b. Type K copper with soldered, brazed, or flanged fittings.
    - c. CPVC pipe with socket-joint fittings.
    - d. HDPE pipe with fusion-joint fittings.
    - e. Flanged fittings are only acceptable in direct-bury applications.
  - 2. Fitting Pressure Class: Minimum rating of 150 psig.
  - 2. Acceptable Bury Methods:
    - a. Conduit pipe pre-insulated system.
    - b. Cased pipe pre-insulated system.
  - 3. Insulation Thickness:
    - a. Pre-Insulated Piping Systems: No insulation.

#### **3.4 PREPARATION**

- A. Preparation of foundation for below ground water distribution pipe and fittings

1. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.
  2. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicated invert elevation.
  3. Pipe Beds for Pre-Insulated Piping Systems or Uninsulated direct-buried piping:
    - a. Provide 6 inch thick sand pipe bed underneath and around sides of pipe, up to middle half of the pipe, including fittings. Tamp bed with mechanical tamper to 85 to 95 percent compaction. Provide first layer of sand backfill 6 inches above pipe, tamp backfill with mechanical tamper to 85 to 95 percent compaction.
    - b. For piping with rock trench bottoms, provide sand pipe bed 6 inches underneath and around sides of pipe, including fittings.
    - c. Provide backfill above top of pipe bed as required for field conditions.
- B. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- C. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- D. Remove scale and dirt on inside and outside before assembly.
- E. Prepare piping connections to equipment using jointing system specified.
- F. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

### 3.5 PIPING INSTALLATIONS

- A. Remove standing water in the bottom of trench.
- B. Do not backfill piping trench until field quality-control testing has been completed and results approved.
- C. Maintain 6 inches clearance from obstructions and provide thrust blocks at every branch connection and change in direction.
- D. Provide long radius elbows with a minimum centerline radius of 1-1/2 times the pipe diameter. Short radius elbows with a minimum centerline radius of 1 times the pipe diameter may be used only where space does not permit the long radius elbows.
- E. Install piping at uniform grade of 1 inch in 40 feet upward in the direction of flow.
- F. Make reductions in pipe sizes using eccentric reducer fitting installed with the level side up.
- G. Install branch connections to mains using Tee fittings in main with take-off out the top or side of the main unless otherwise shown on the drawings. Up-feed risers shall have take-off out the top of the main line.
  1. Tee-drilling is prohibited as a means for connecting branch taps into any main.
  2. Bull-head tees are prohibited. Do not install tee fittings in such a way that the flow through the branch leg equals the sum of the flows through the two main legs.
- H. Secure anchors with concrete thrust blocks. Concrete is specified in Division 03 Section "Cast-in-Place Concrete."
- I. See Division 26 Section "Cathodic Protection" for cathodic devices and connections to piping and conduit systems.

### 3.6 PIPE JOINT CONSTRUCTION

- A. Reference Division 23 Section, "Basic Piping Materials and Methods" for basic pipe joint construction.
- B. Reference Division 23 Section, "Expansion Fittings and Loops for HVAC Piping" for installation of anchors and expansion joints.

- A. Where more than one pipe material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
- B. Install non-conductive dielectric connections whenever joining dissimilar metals. Reference Section 230510 Basic Piping Materials and Methods.
- C. Pipe-to-Valve and Pipe-to-Equipment Connection: Install flanges or unions between piping and valves and equipment for servicing. Do not use direct welded, brazed, or soldered connections unless specifically called for in the manufacturer's installation instructions.
- D. Fusion Joints: Fuse joints in accordance with ASTM F2620.
- E. Conduit and Cased Piping Joints: Assemble sections and finish joints with pourable or split insulation and exterior jacket sleeve, and apply shrink-wrap seals.

### **3.7 IDENTIFICATION**

- A. Install continuous plastic underground warning tapes during back filling of trenches for underground piping. Locate tapes 6 to 8 inches below finished grade, directly over piping. See Division 31 Section "Earth Moving" for warning-tape materials and devices and their installation.

### **3.8 FIELD QUALITY CONTROL**

- A. Reference Division 23 Section "Hydronic Piping" for additional Field Quality Control requirements for carrier pipe testing and flushing.
- B. Pressure Testing of Conduit Pipe Pre-Insulated System:
  - 1. Seal vents and drains and subject conduit to 15 psig for four hours with no loss of pressure. Repair leaks and retest as required.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.

### **3.9 ADJUSTING AND CLEANING**

- A. Reference Division 23 Section, "Hydronic Piping" for additional Adjusting and Cleaning requirements.

### **3.10 STARTUP**

- A. Reference Division 23 Section, "Hydronic Piping" for startup requirements.

END OF SECTION



**SECTION 23 21 13 - MECHANICALLY JOINED HYDRONIC PIPING SYSTEMS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Mechanically joined piping system requirements.
- B. Carbon steel grooved piping system.
- C. Copper grooved piping system.
- D. Stainless steel grooved piping system.
- E. Stainless steel press-fit piping system.
- F. Copper press-fit piping system.
- G. Carbon steel plain end piping system.
- H. Carbon steel press fit piping system.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

**1.3 SUBMITTALS**

- A. Submit in accordance with conditions of Contract and Division 01 submittal procedures.
- B. Reference Division 23 Section, "Basic Piping Materials and Methods" for additional submittal requirements.
- C. Shop Drawings:
  - 1. Indicate grooved-joint couplings and fittings on drawings and product submittals, and specifically identify with the applicable style or series designation.
  - 2. If an assembly of flexible couplings are used for seismic vibration, thermal expansion, or noise and vibration reduction, submit shop drawings indicating location of assembly, including anchors and guides. Include movement analysis of the assembly, and performance data of the assembly.
- D. Piping Analysis:
  - 1. As a contractor's option, Victaulic can provide piping system design services to accommodate thermal movement, seismic movement, and for the settlement of the piping system. The service includes required grooved piping components detailed in CAD on an overlay of the mechanical contract drawing(s), including anchor load calculations and placement of anchors. A calculation report showing thermal movement and seismic accommodation shall be provided.
    - a. A design stamped by a qualified professional engineer of the manufacturer licensed in the jurisdiction where the project is being constructed is required.
- E. Maintenance Data: Include for each piping specialty and valve in Maintenance Manual specified in Division 01 and Division 23 Section "General Mechanical Requirements."
- F. Reports as specified in Part 3 of this Section. Include the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.

3. Failed test results and corrective action taken to achieve requirements.
- G. Submit a schedule of dissimilar metal joints and adaptor flanges and flange kits. Include joint type material, connection method and proposed flange kits to isolate dissimilar metals. Include minimum and maximum torque requirements for flange connections to valves. Dielectric flange kits are specified in Division 23 section "Basic Piping Materials and Methods".
- H. Submit training certificate of completion for each worker to engineer of record within 30-days of mobilization. Include copy of each worker's training certificate of completion with closeout documents.

#### **1.4 QUALITY ASSURANCE**

- A. Comply with Division 23 Section, "Basic Piping Materials and Methods."
- A. Single Source Responsibility: All components of each mechanically joined piping system used shall be of one manufacturer and conform to local code approval.
- B. Grooving and Joining Tools: Approved by the mechanically joined piping system manufacturer for use with their system and furnished by one manufacturer, though not necessarily the same as the grooved component manufacturer.
- C. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this Section, with minimum three years of documented experience and ISO 9001 certification.
  1. Date stamp all castings used for coupling housings, fittings, etc. for quality assurance and traceability.
- D. Installer Qualifications:
  1. Company specializing in performing work of the type specified in this Section, with minimum three years of documented experience.
- E. Obtain installation training from the mechanically joined piping manufacturer for all workers that will be installing or handling the mechanically joined piping components per Part 3 "Field Quality Control". Maintain a copy of each worker's training certificate of completion on site for the duration of the project.
- F. Pipe, fittings, and specialties shall be manufactured in plants located in the United States or certified to meet the specified ASTM, ASME, and ANSI standards.

#### **1.5 COORDINATION**

- A. Reference Division 23 Section "Hydronic Piping" for coordination and additional hydronic piping material and execution requirements.

#### **1.6 DELIVERY STORAGE AND HANDLING**

- B. Comply with Division 23 Section "Basic Piping Materials and Methods."

### **PART 2 - PRODUCTS**

#### **2.1 MECHANICALLY JOINED PIPING SYSTEM REQUIREMENTS**

- C. Antifreeze and Water Treatment:
  1. Refer to Division 23 Section "HVAC Water Treatment" for antifreeze and water treatment products.
- A. Pipe Materials:
  1. Refer to the specific product sections in Part 2 for the acceptable pipe materials.

- B. Fittings:
1. General: Fittings shall be of wall thickness, pressure rating, and material compatible with adjoining pipe as listed and approved by the manufacturer's current literature for the piping system used.
  2. Reference Division 23 Section "Basic Piping Materials and Methods" for additional fittings.
  3. Grooved:
    - a. All grooved joints shall be full-flow type and conform to AWWA C606 and ASTM F1476.
      - 1) Victaulic Advanced Groove System (AGS) pipe ends are an acceptable alternate.
    - b. Body Materials:
      - 1) Ductile Iron: Comply with ASTM A536, Grade 65-45-12 or ASTM A395 Grade 65-45-15.
      - 2) Wrought Steel: Comply with ASTM A234, Grade WPB, 0.375 inch wall.
      - 3) Carbon Steel: Comply with ASTM A53, Grade B or ASTM SA352, Grade LCC.
      - 4) Wrought copper: Comply with ASTM B75 Alloy C12200 or ASTM B152 Alloy C1100.
      - 5) Bronze Sand Cast: Comply with ASTM B16.18 and B584 ally UNS C89836.
      - 6) Stainless Steel: Type 304 or 316, conforming to ASTM A240, A312, A351, A403, A743, or A744, Grade CF8M.
    - c. Coating: Suitable enamel, epoxy, or hot-dipped galvanized according to ASTM A153 to match system requirements.
  4. Strapless Outlet Fittings:
    - a. Pipe Strapless Outlets: 1/2 inch or 3/4 inch NPT outlet for use on 4 inch and larger pipe sizes, rated for 300 psig.
      - 1) Housing: Ductile iron housing conforming to ASTM A536, Grade 65-45-12, painted black.
      - 2) Collar: Hot rolled steel collar conforming to ASTM A569, zinc electroplated to ASTM B633.
      - 3) Bushing: Brass conforming to UNS C37700.
      - 4) Seat/Liner Gasket: Same as Grooved Joint Gasket requirements specified under article "Joining Materials."
    - b. Press-In Branch Connector: 3/4 inch FNPT outlet for use on 1-1/2 inch through 6 inch Schedule 40 carbon steel pipe.
      - 1) Fitting: Carbon steel per ASTM A420 with corrosion resistant coating of zinc/nickel or equal.
      - 2) Thread: Conform to ASME B1.20.1.
      - 3) Sealing Element: EPDM or FKM seal.
      - 4) Working Pressure: 200 psig.
  5. Test Caps: Ductile iron cap according to ASTM A536, Grade 65-45-12, suitable for use on metallic IPS pipe with integral NPT ball valve, maximum test pressure of 250 psi and maximum test temperature of 110 degrees F. Victaulic T-60 test cap or approved equal.
  6. Press-Fit:
    - a. Press-Fit fittings shall comply with ASME B16.51, ASME B31.1 or ASME B31.9 as applicable for the material and project.
    - b. Press-Fit fittings shall comply with ASTM F3226.
    - c. Press-fit fittings shall include self-contained O-ring seals in the end connections.
    - d. Provide leak feature integral to the fitting body to detect unpressed fittings during the pressure testing process.
    - e. Body Materials:
      - 1) Stainless Steel: Type 304 or Type 316, conforming to ASTM A240, A312, A351, A743, or A744, Grade CF8M.
      - 2) Wrought Copper: Comply with ASTM B75 Allow C12200 or ASTM B152 Alloy C11000.
      - 3) Cast Copper: Comply with ASTM B584 Alloy C84400, C87600 or C87710.

- 4) Carbon Steel: Comply with ASTM A420 and have corrosion resistant zinc/nickel or equal coating.
  - f. End Connections:
    - 1) Threaded: All threads shall conform to ASME B1.20.1.
    - 2) Solder-Joint: Wrought-copper, ASME B16.18 or B16.22, streamlined pattern.
    - 3) Flared Ends: Comply with ASME B16.26.
- C. Joining Materials:
1. Reference Division 23 Section "Basic Piping Materials and Methods" for basic joining materials.
  1. Joining Tools: Approved by the mechanically joined piping system manufacturer for use with their system.
  2. Grooved Couplings: Multi-piece housing attached with bolts and nuts with pressure responsive elastomeric gasket, constructed of material specified under Article "Fittings" above and of the following styles.
    - a. Rigid Couplings: Designed with offsetting angle bolt pads to provide a rigid pipe joint to restrict axial or angular movement.
    - b. Flexible Couplings: Designed with flat bolt pads to provide a flexible pipe joint and accommodate a limited amount of linear and/or angular movement.
    - c. Reducing Couplings: Designed to include a direct pipe reduction on pipe run without additional components and includes steel washer to prevent telescoping of smaller pipe inside the larger pipe during a vertical system assembly.
  3. Coupling Bolts: Track-head type and constructed of the one of the following:
    - a. Type 304 or 316 stainless steel conforming to ASTM A193, Grade B8/B8M, Class 2 or ASTM F593 and F594, Group 2, Conditions CW.
    - b. Heat treated carbon steel conforming to ASTM A183 and A449, zinc electroplated to ASTM B633, with a minimum tensile strength of 110,000 psi.
  4. Nuts: Heavy-duty hexagonal type conforming to ASTM A563, Grade B or ASTM A194, Grade 8M.
  5. Washers: Flat type, plated carbon steel conforming to ASTM F436 or Type 304 or 316 stainless steel.
  6. Grooved-Joint Gaskets:
    - a. Molded synthetic rubber (EPDM compound) with central cavity and pressure responsive configuration, integral pipe stop, and complying with ASTM D2000, Grade 2CA615A25B24F17Z.
    - b. Gasket Grade: Type "E" or "EHP" for hydronic applications. Coordinate the appropriate gasket grade with the manufacturer for other applications.
    - c. Identification: Tagged with the appropriate color code to indicate the application.
    - d. Temperature operating range: -30 degrees F to 230 degrees F.
  7. Flange Adapters:
    - a. Cast-Bronze Flanges: ASME B16.24, raised ground face, bolt holes spot faced.
    - b. Wrought Cast-Iron, Forged Steel, and Stainless Steel: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connection, and facing:
      - 1) Material Group: 1.1.
      - 2) Facings: Raised face.
    - c. Gaskets: ASME B16.21, non-metallic, asbestos free, 1/8 inch thick, full-face for cast-iron flanges and raised-face steel flanges, suitable for chemical, thermal, and dielectric conditions of piping system contents.
    - d. Flange bolts and nuts: ASME B18.2.1, hex head carbon steel according to ASTM A307, Grade B.
  8. Pipe Transition Adapters:
    - a. Constructed of material, size, and end connection to join different pipe materials or joining methods.
    - b. Adapter shall be listed according to the manufacturer's literature for the application and joining methods.

- c. Reference Division 23 Section “Basic Piping Materials and Methods” for dielectric fittings.
  - 9. Press Couplings: Single-piece housing with self-contained O-ring seals in the end connections. O-ring seals shall comply with the following:
    - a. EPDM compound conforming to ASME B16.51.
    - b. Type “E” EPDM compound complying with ASTM D2000, Grade 2CA615A25B24F17Z.
    - c. Identification: Tagged with the appropriate color code to indicate the application.
    - d. Temperature operating range: -30 degrees F to 230 degrees F.
  - 10. Press Fit Sealing Elements
    - a. Peroxide cured EPDM or FKM elastomeric seal.
    - b. EPDM rated for 0 to 250 degrees F, FKM rated for 15 to 285 degrees F.
    - c. Uniform in size and width and free from manufactured deformities or indentions.
- D. General Duty Valves and Hydronic Specialties:
  - 1. Acceptable manufacturers listed within this specification may have comparable products which comply with the product specifications referenced in the sections below. These products are acceptable provided they meet the specified requirements and are compatible with the piping system. Reference the Valve and Hydronic Specialties Schedule in Part 3 for examples of acceptable products and design intent. Refer to manufacturer’s current literature for comparable products, sizes, pressure ratings, and connection methods compatible with the piping system. Products identified by model number are based on available size and pressure ranges from that manufacturer. Products offered by manufacturers with extended ranges are acceptable provided they meet the specified requirements.
  - 2. Reference Division 23 Section “General Duty Valves for HVAC Piping” for general duty valve requirements.
  - 3. Reference Division 23 Section “Hydronic Specialties” for hydronic specialty requirements.
- E. Expansion Joints:
  - 1. Reference Division 23 Section “Expansion Fittings and Loops for HVAC” for expansion joint requirements.
  - 2. Select expansion joint and support method in accordance with design conditions and performance data published in manufacturer’s literature using the following types:
    - a. Slip Type: Victaulic Style 150 Mover telescoping slip type or approved equal.
    - b. Standard Expansion Type: Style 155 expansion joint consisting of a series of flexible couplings joined in tandem or approved equal.

## 2.2 CARBON STEEL GROOVED PIPING SYSTEM

- A. Manufacturers:
  - 1. ASC Engineered Solutions.
  - 2. Shurjoint Piping Products.
  - 3. Victaulic.
- B. Carbon Steel Pipe:
  - 1. NPS 10 inch and Smaller: ASTM A53 or A106, Type E electric-resistance welded or Type S seamless, Grade B, Schedule 40, black steel, plain ends.
  - 2. NPS 12 inch and Larger: ASTM A53 or A106, Type E electric-resistance welded or Type S seamless, Grade B, Schedule STD, black steel, plain ends.

## 2.3 COPPER GROOVED PIPING SYSTEM

- A. Manufacturers:
  - 1. ASC Engineered Solutions.
  - 2. Shurjoint Piping Products.
  - 3. Victaulic.

- B. Copper Tubing:
  - 1. Copper Tube Size (CTS), ASTM B88 Type L, hard-drawn.

## **2.4 STAINLESS STEEL GROOVED PIPING SYSTEM**

- A. Manufacturers:
  - 1. ASC Engineered Solutions.
  - 2. Shurjoint Piping Products.
  - 3. Victaulic.
- B. Stainless Steel Pipe:
  - 1. NPS 2 inch and Smaller: ASTM A312, Type 304 or 316, Schedule 10S, plain ends.
  - 2. NPS 2-1/2 inch and larger: ASTM A312, Type 304 or 316, Schedule 10S, plain or beveled ends.

## **2.5 STAINLESS STEEL PRESS-FIT PIPING SYSTEM**

- A. Manufacturers:
  - 1. ASC Engineered Solutions "Gruvlok."
  - 2. Victaulic. Vic-Press.
  - 3. Viega ProPress and MegaPress.
- B. Stainless Steel Pipe:
  - 1. NPS, CTS or IPS 3/4 inch through 2 inch: ASTM A312, Type 304 or 316, Schedule 10S, plain or press fit ends.

## **2.6 COPPER PRESS-FIT PIPING SYSTEM (CTS)**

- A. Manufacturers:
  - 1. ASC Engineered Solutions "Gruvlok."
  - 2. Apollo "Xpress".
  - 3. Mueller Streamline PRS.
  - 4. NIBCO, Inc., Press System.
  - 5. Viega, ProPress.
- B. Copper Tubing:
  - 1. CTS 3/4 inch through 4 inch: ASTM B88 Type L, hard-drawn.

## **2.7 CARBON STEEL PLAIN END PIPING SYSTEM**

- A. Manufacturers:
  - 1. Victaulic, Quick-Vic Installation Ready.
- B. Carbon Steel Pipe:
  - 1. NPS 3/4 inch through 2 inch: ASTM A53 or A106, Schedule 40, plain ends.

## **2.8 CARBON STEEL PRESS FIT PIPING SYSTEM**

- A. Manufacturers:
  - 1. Apollo PowerPress.
  - 2. Mueller Streamline STL.
  - 3. NIBCO BenchPress.
  - 4. Viega, MegaPress
- B. Carbon Steel Pipe:
  - 2. NPS 3/4 inch through 2 inch: ASTM A53 or A106, Schedule 40, press-fit ends.

**PART 3 - EXECUTION****3.1 INSTALLATION GENERAL**

- A. Install products in accordance with manufacturer's instructions.
- B. Install piping to ASME B31.9 requirements.
- C. Reference Division 23 Section "Basic Piping Materials and Methods" for general piping installation requirements.
- D. Reference Division 23 Section "General Duty Valves for HVAC Piping" for general duty valve installation requirements.
- E. Reference Division 23 Section "Hydronic Specialties" for hydronic specialty installation requirements.

**3.2 PIPE APPLICATION SCHEDULE**

- A. Heating Hot Water System:
  - 1. Carbon Steel Grooved: 2 inch and larger.
  - 2. Copper Grooved: 2 inch through 8 inch.
  - 3. Stainless Steel Grooved: 2 inch and larger.
  - 4. Stainless Steel Press-Fit: 3/4 inch through 2 inch.
  - 5. Copper Press-Fit: 3/4 inch through 4 inch.
  - 6. Carbon Steel Plain End: 3/4 inch through 2 inch.
  - 7. Carbon Steel Press Fit End: 3/4 inch through 2 inch.
  - 8. Fitting Pressure Class: Minimum rating of 125psig.
- B. Chilled Water system
  - 1. Carbon Steel Grooved: 2 inch and larger.
  - 2. Copper Grooved: 2 inch through 8 inch.
  - 3. Stainless Steel Grooved: 2 inch and larger.
  - 4. Stainless Steel Press-Fit: 3/4 inch through 2 inch.
  - 5. Copper Press-Fit: 3/4 inch through 4 inch.
  - 6. Carbon Steel Plain End: 3/4 inch through 2 inch.
  - 7. Carbon Steel Press Fit End: 3/4 inch through 2 inch.
  - 8. Fitting Pressure Class: Minimum rating of 125 psig.
- C. Open condenser water system
  - 1. Carbon Steel Grooved: 2 inch and larger.
  - 2. Stainless Steel Grooved: 2 inch and larger.
  - 3. Stainless Steel Press-Fit: 3/4 inch through 2 inch.
  - 4. Carbon Steel Plain End: 3/4 inch through 2 inch.
  - 5. Carbon Steel Press Fit End: 3/4 inch through 2 inch.
  - 6. Fitting Pressure Class: Minimum rating of 125psig.
  - 7. .
- D. Use stainless steel couplings and fittings where design conditions require the use of non-ferrous piping materials for both interior and exterior piping surfaces.

**3.3 PREPARATION**

- A. Remove scale and dirt on inside and outside before assembly.
- B. Verify pipe and tube ends are free from indentations, projections, and roll marks in the area from tube end to groove from proper gasket sealing.
- C. Prepare piping connections to equipment using jointing system specified.

- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

### 3.4 PIPING INSTALLATIONS

- A. Hydronic piping installations shall be installed subject to Division 23 Section "Hydronic Piping" in addition to those requirements specified in this Section.

### 3.5 PIPE HANGERS AND SUPPORTS APPLICATION

- A. Comply with the requirements of Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

### 3.6 PIPE JOINT CONSTRUCTION

- A. Reference Division 23 Section "Basic Piping Materials and Methods" for basic pipe joint construction.
- B. Where more than one pipe material is specified, provide joining fittings or pipe transition adapters with appropriate dielectric isolation that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
- C. Grooved Joints:
  - 1. Ream, debur, and clean tube ends and verify they are free from indentations, projections and roll marks in the area from tube end to groove for proper gasket sealing.
  - 2. Roll and cut groove ends in accordance to manufacturer's current listed standards and according to AWWA C606. Use rolls sets designed and intended for use on the appropriate pipe material when grooving pipe.
    - a. Victaulic Advanced Groove System (AGS) pipe ends are an acceptable alternate. If Victaulic AGS grooved system is used, all couplings, adapters, fittings, and valves shall be compatible with AGS grooved ends.
    - b. Do not use cut groove ends in copper tubing, roll groove only.
    - c. Do not use cut groove ends in stainless steel pipe, roll groove only.
  - 3. Verify tolerances of and maintain grooving tool components for duration of grooving processes. Replace grooving tool components that are found out of tolerance with new as required.
  - 4. Flaring of CTS tube ends to IPS dimensions or to accommodate alternate sized couplings is not allowed.
  - 5. Verify the gasket style and elastomeric material (grade) is suitable for the intended service as specified and in combination with any system chemical additives.
  - 6. Reference latest published manufacturer's product data for additional pressure ratings and application information.
  - 7. Reference the latest published of manufacturer's field installation instructions or other included installation instruction prior to attempting assembly.
  - 8. Install gaskets with lubricant suitable for all piping services. Lubricant shall be by one manufacturer.
- D. Press-Fit Joints:
  - 1. Install press piping system in accordance with manufacturer's recommendations.
  - 2. Ream, debur, and clean tube ends and verify they are free from indentations, projections, burrs and foreign matter.
  - 3. Install permanent inspection mark on tube.
  - 4. Clean tube and fittings of all dirt and oil. Verify O-ring and all press connection components are in place and free of oil, grease or dirt.
  - 5. Push pipe or tube into fittings with twisting action to all the way to the fitting stop or shoulder.
  - 6. Mark tube with permanent marker to indicate proper tube insertion depth.
  - 7. Verify press tool has correct size jaw set for tube size used.



8. Complete one tool cycle with empty jaw to calibrate tool for each time new jaw is inserted into tool.
  9. Squeeze jaw arms to open tool jaws and place jaws around the contour of the fitting. Verify tool is perpendicular to the fitting and depress tool switch.
  10. Squeeze jaw open to remove the tool and observe witness mark.
  11. Verify crimped fitting connection for misalignment of the copper tube, misalignment of the tool or improper insertion of the tube. If any of these conditions are found cut out the joint and provide a new joint.
  12. Maintain minimum distance between joints per the manufacturer's published installation instructions.
  13. Perform pressure test for unpressed fitting detection per manufacturer's installation instruction prior to final pressure test.
- E. Stainless Steel to Copper Systems:
1. Stainless steel 4 inch and smaller to copper 2 inches and smaller:
    - a. Stainless steel reducing tee with 2 inch grooved side outlet.
    - b. Stainless steel rigid coupling, dielectric waterway adapter and CTS rigid coupling.
    - c. Contractors Option (in lieu of above) - 2 inch rigid CTS adapter coupling, 2 inch grooved X copper plain adapter (size as required).
  2. Stainless steel 6 inch and larger to copper 2 inches and smaller:
    - a. Stainless steel tee and welded pipet with 2 inch welded outlet.
    - b. 2 inch schedule 40 stainless steel short nipple with grooved and plain ends. Weld nipple to pipet.
    - c. Stainless steel rigid coupling, dielectric waterway adapter and CTS rigid coupling.
    - d. Contractors Option (in lieu of above) - Stainless steel reducing tee with 2 inch grooved side outlet, 2 inch rigid CTS adapter coupling, 2 inch grooved X copper plain adapter (size as required).
  3. Stainless steel 6 inch and larger to copper 2-1/2 inches to 4 inches:
    - a. Stainless steel tee or reducing tee with grooved side outlet:
    - b. Stainless steel rigid coupling, dielectric waterway adapter and CTS rigid coupling.
    - c. Contractors Option (in lieu of above):
      - 1) Rigid CTS adapter coupling, grooved X copper plain adapter (size as required).
      - 2) Grooved X stainless steel flange adapter nipple (X size as required), bronze flange and dielectric flange kit.
  4. Stainless steel to copper 6 inches to 8 inches:
    - a. Stainless steel tee or reducing tee with grooved side outlet.
    - b. Stainless steel rigid coupling.
    - c. Grooved X stainless steel flange adapter nipple (X size as required).
    - d. Bronze flange and dielectric flange kit.
- F. Dielectric Isolation Requirements: Refer to Division 23 Section "Basic Piping Materials and Methods" for dielectric fittings and their installation requirements. Provide dielectric flanges, flange kits, or dielectric transition couplings for the following joint types:
1. Flange Adapters to Iron, Ductile Iron or Steel Body Valves or Fittings (Except Butterfly Valves): Provide full face gaskets between flanges and adapter flanges. At each bolt, provide steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves on valve and adapter flanges.
  2. Flange Adapters to Butterfly Valves in Series with Iron, Ductile Iron or Steel Body Valves or Fittings: At each bolt, provide stainless steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves on adapter flange. Provide stainless steel bolts on butterfly valve flange.
  3. Flange Adapters to Butterfly Valves in Copper Tubing: Install flat washers at each bolt on adapter flange. Provide full face gasket only for butterfly valves without integral liner acting as a gasket.

4. Dielectric Transition Couplings: Provide dielectric transition coupling when connecting copper pipe to butterfly valves. Provide dielectric transition coupling when connecting grooved IPS pipe to CTS pipe.
- G. Couplings:
1. Install rigid couplings unless noted otherwise.
  2. Install flexible couplings at locations required to accommodate expansion and/or vibration isolation.
    - a. Install flexible couplings at pumps.
    - b. Install flexible couplings at expansion joints.
    - c. Install three flexible couplings at mechanical equipment connections for noise and vibration reduction in lieu of flexible connectors if preferred.
  3. Install reducing couplings at reductions in pipe size.
  4. Install press couplings in conjunction with the appropriate press piping system.
- H. Flange Adapters:
1. Install flange adapter washers when flange adapters are used against the following surfaces:
    - a. Rubber.
    - b. Adapting to ANSI/AWWA cast flanges.
    - c. Rubber faced lug valves.
    - d. Serrated flanged surfaces.
  2. Do not install flange adapters for applications that incorporate tie rods for anchoring or on standard grooved-end fittings within 90 degrees of each other.
- I. Miscellaneous Connections:
1. Install test caps for temporary use during piping system testing activities. Test caps shall not be permanently installed in the piping system.
  2. Test caps may be reused within the maximum test pressure and provided the product remains undamaged. Inspect and verify the suitability for service of all test caps prior to installation and use.
  3. Connect test caps to piping system with Victaulic Style 107V or equivalent rigid coupling.
  4. Test cap may be used for filling, testing, or draining purposes by connecting to the NPT outlet of the integral ball valve.
  5. Install blind flanges with separate means to fill, test, or drain system for testing if test caps are not available from manufacturer.

### 3.7 VALVE AND HYDRONIC SPECIALTIES SCHEDULE

- A. Reference Division 23 Section "General Duty Valves for HVAC Piping" for general duty valve applications.
- B. Valve and Hydronic Specialties Schedule: The following schedule references Victaulic model numbers, except where another manufacturer is noted. Manufacturers and model numbers represent examples of acceptable products and design intent.
1. Carbon Steel Grooved Piping System:
 

<u>Valve or Specialty Type</u>	<u>Model/Series Number</u>
Iron Ball Valve	726
Iron Butterfly Valve	761
Iron Swing Check	712
Iron Lift Check	716
Iron Venturi Check	779
Balancing Valve	785 through 789
Coil Kits	799 or 79V
T-Strainer	730
Y-Strainer	732
Suction Diffuser	731
  2. Copper Grooved Piping System:

	<u>Valve or Specialty Type</u>	<u>Model/Series Number</u>
	Brass Butterfly Valve	608N
3.	Stainless Steel Grooved Piping System:	
	<u>Valve or Specialty Type</u>	<u>Model/Series Number</u>
	Stainless Steel Ball Valve	726S
	Stainless Steel Butterfly Valve	461N
	Stainless Steel Swing Check	416 or 712S
4.	Stainless Steel Press-Fit Piping System:	
	<u>Valve or Specialty Type</u>	<u>Model/Series Number</u>
	Stainless Steel Ball Valve	P569
	Stainless Steel Check Valve	Viega 4015.5
5.	Copper Press-Fit Piping System:	
	<u>Valve or Specialty Type</u>	<u>Model/Series Number</u>
	Bronze Ball Valve	Hammond 8303A P2 Milwaukee #BA-400S-P2 Nibco PC585-70-66
	Bronze Gate Valve	Hammond IB640 P2 Milwaukee #105 P2 Nibco PF111
	Bronze Globe Valve	Hammond IB440 P2 Milwaukee 502 P2 Nibco PF211
	Bronze Swing Check	Hammond 509Y P2 Milwaukee 509Y P2 Nibco PF413
6.	Carbon Steel Press-Fit Piping System:	
	<u>Valve or Specialty Type</u>	<u>Model/Series Number</u>
	Carbon Steel Ball Valve	Viega 4870

### 3.8 HYDRONIC SPECIALTIES INSTALLATION

- A. Reference Division 23 Section "Hydronic Piping Specialties" for product requirements.
- B. Strainers:
  1. Provide copper press to connect X screwed NPT adapters for 2 inches and smaller.
  2. Provide press to connect adapter flanges for 2-1/2 inches to 4 inches.
  3. Provide copper grooved adapter flanges for 2-1/2 inches to 8 inches.

### 3.9 EXPANSION JOINT INSTALLATION

- A. Provide expansion joints where indicated. Expansion joints and their installation requirements are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping".
  1. Provide with copper press to connect ends or copper press to connect X screwed NPT adapters for 2 inches and smaller.
  2. Provide with copper press to connect ends or press to connect adapter flanges for 2-1/2 inches to 4 inches.
  3. Provide copper grooved adapter flanges for 2-1/2 inches to 8 inches.
- B. As a contractor's option and where field conditions allow, provide expansion joints consisting of an assembly of flexible couplings: Fabricated from a combination of couplings and nipples with rolled groove short type "K" or "L" copper tube nipples and flexible CTS couplings. Install with removable ties to hold joint compressed or expanded during piping fabrication. Provide the same gaskets as specified above for rigid couplings. Provide expansion joints of an assembly of flexible couplings with displacement identical expansion joints as indicated.

**3.10 EQUIPMENT CONNECTIONS**

- A. Grooved flexible style couplings may be used at equipment connections where specified for vibration isolation control only.
- B. Press to connect joints shall not be provided for equipment connections. Provide flanges, unions, di-electric unions or waterway fittings. Flanges, unions, di-electric unions and waterway fittings are specified in Division 23 Section "Basic Piping Materials and Methods."

**3.11 FIELD QUALITY CONTROL**

- A. Reference Division 23 Section "Hydronic Piping" for field quality control requirements in addition to those specified herein.
- B. The mechanically joined piping system manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving and joining tools and installation of mechanically joined piping products.
- C. Installing contractor shall schedule certification training session with the mechanically joined piping component manufacturer, or manufacturer's representative, for all workers that will be installing or handling the mechanically joined piping systems. Training shall cover the proper use of mechanically joining tools and installation of mechanically joined piping products. Mechanically joined piping component manufacturer, or manufacturer's representative shall provide a certificate of completion for each attending worker.
- D. Mechanically joined piping supplier shall provide certification training to Contractor without cost and without additional cost to Owner.
- E. Provide testing procedures as defined in Division 23 Section "Hydronic Piping" and as specified in mechanically joined piping manufacturer's installation instructions.
- F. The mechanically joined manufacturer's factory trained representative shall periodically visit the jobsite and review the installation to verify that the contractor is following best recommended practices in grooved product installation.
- G. Installing contractor shall visually inspect couplings and repair or replace any misaligned couplings and couplings with gaps prior to calling for substantial completion review as defined in Division 23 Section "Common Work Results for HVAC."
- H. Workers performing mechanically joined joints shall initial each joint with a permanent ink marker, such as a "Sharpie". Initials shall be block letters with a minimum height of 1/4".

**3.12 ADJUSTING AND CLEANING**

- A. Reference Division 23 Section "Hydronic Piping" for adjusting and cleaning procedures.

**3.13 STARTUP**

- A. Reference Division 23 Section "Hydronic Piping" for startup procedures.

END OF SECTION

**SECTION 23 21 14 - HYDRONIC SPECIALTIES****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Diaphragm/bladder expansion tanks.
- B. Air vents.
- C. Air separators.
- D. Strainers.
- E. Suction diffusers.
- F. Flexible connectors.
- G. Triple Duty Valves.
- H. Balancing valves.
- I. Relief valves.
- J. Combination Piping Packages (Coil Kits).
- K. Water filtration systems.

**1.2 SUBMITTALS**

- A. Submit in accordance with Division 01 Submittals and Division 23 General Mechanical Requirements.
- B. Product Data: Include rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties and accessories, component sizes, rough-in requirements, service sizes, and finishes.
  - 1. Balancing Valves and Diverting Fittings: Include flow and pressure drop curves based on manufacturer's testing.
- C. Water Filtration System: Include piping layout and assembly drawings of cooling tower basin sweeper systems. Include all dimensions, piping, water jets, couplings, valves, pressure gauges, and other components required to assemble the complete sweeper system inside the cooling tower basin.
- D. Certificates:
  - 1. Inspection certificates for pressure vessels for compliance with ASTM and ANSI manufacturing standards.
  - 2. Welders' certificates complying with the requirements specified in Article, "Quality Assurance."
- E. Manufacturer's installation instructions.
- F. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list for inclusion in Operating and Maintenance manual.

**1.3 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Comply with ASME B31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

- C. Fabricate and stamp air separators, air and dirt separators, expansion tanks, and buffer tanks to comply with ASME BPVC-VIII-1.
- D. Comply with ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification" for qualifications for welding processes and operators.
- E. Comply with AWWA Standards for governing filter media; American Water Works Association, Current Edition.
- F. Hydronic specialties shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

#### **1.4 DELIVERY STORAGE AND HANDLING**

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

### **PART 2 - PRODUCTS**

#### **2.1 DIAPHRAGM BLADDER EXPANSION TANKS**

- A. Manufacturers:
  - 1. American Wheatley.
  - 2. Amtrol, Inc.
  - 3. Armstrong Fluid Technology.
  - 4. Bell & Gossett; Xylem.
  - 5. Caleffi.
  - 6. Grundfos.
  - 7. John Wood Co.
  - 8. Patterson Pump Co.
  - 9. Taco, Inc.
  - 10. Wessels.
- B. Construction: Closed, welded carbon steel, tested and stamped in accordance with ASME BPVC-VIII-1; with flexible EPDM diaphragm or bladder sealed into tank, cleaned and prime coated; with tapings for installation of accessories.
  - 1. Pressure rating: As scheduled on the drawings.
  - 2. Maximum operating temperature: 240 degrees F.
- C. Accessories: Pressure gauge, air charging fitting, and drain fitting.

#### **2.2 AIR VENTS**

- A. Manufacturers:
  - 1. American Wheatley.
  - 2. Amtrol, Inc.
  - 3. Armstrong International.
  - 4. Bell & Gossett; Xylem.
  - 5. John Wood Company.
  - 6. Nexus Valves.
  - 7. Spirax Sarco.
  - 8. Taco, Inc.

- B. Manual Type: Bronze body and nonferrous internal parts; working pressure as defined by the ANSI fitting class of the system, 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; and having 1/8 inch discharge and inlet connections.
- C. Automatic Type: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; working pressure as defined by the ANSI fitting class of the system, 240 deg F operating temperature; and having 1/4 inch discharge connection and 1/2 inch inlet connection.

### 2.3 AIR SEPARATORS

- A. Air and Dirt Coalescing Medium Type:
  - 1. Manufacturers:
    - a. American Wheatley.
    - b. Armstrong Fluid Technology.
    - c. Bell & Gossett; Xylem.
    - d. Caleffi.
    - e. Spirotherm.
    - f. Taco, Inc.
    - g. Thrush.
    - h. Wessels.
  - 2. Construction: Closed, welded steel; tested and stamped according to ASME BPVC-VIII-1; with the bottom of the vessel extended for dirt separation with the system connection nozzles equidistant from the top and bottom of the vessel, and flanged connection or removable cover for access to the internal media for maintenance or cleaning.
    - a. Pressure rating: As scheduled on the drawings.
    - b. Maximum operating temperature: 270 degrees F.
  - 3. Coalescing Medium: Structured copper or stainless steel medium filling the entire vessel to suppress fluid turbulence and provide air elimination efficiency of 100 percent free air, 100 percent entrained air, and 99.6 percent dissolved air at the installed location.
  - 4. Air Vent: Integral float actuated air vent at the top fitting of tank, threaded to the top of the separator. There shall be no restrictions in the connection from the venting chamber to the vent. Provide side taps with shutoff valve to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.
  - 5. Inlet and Outlet Connections: Threaded for 2 inch NPS and smaller; flanged connections for 2-1/2 inch NPS and larger.
  - 6. Blowdown Connection: Bottom connection with threaded shutoff valve.
  - 7. Size: Not to exceed 10 feet per second at the scheduled flow rate.

### 2.4 STRAINERS

- A. Y-Strainers
  - 1. Manufacturers:
    - a. American Wheatley.
    - b. Armstrong International.
    - c. Hoffman Specialty; Xylem.
    - d. Keckley.
    - e. Metraflex Co.
    - f. Mueller Steam Specialties.
    - g. Spirax Sarco.
    - h. Nexus Valve.
    - i. Watts Water Technologies.
  - 2. Pressure Rating: Rated for working pressure as defined by the ANSI fitting class of the system.
  - 3. Size 2 inch and Smaller:
    - a. Body:
      - 1) Bronze, ASTM B62.

- 2) Forged brass ASTM B283.
      - 3) Cast iron ASTM A126 Class B.
      - 4) Type 304 stainless steel ASTM A240.
    - b. Ends: Threaded.
    - c. Cover: Screwed.
    - d. Screen: Type 304 stainless steel with mesh rating based on the Strainer Schedule in Part 3.
  4. Size 2-1/2 inch and Larger:
    - a. Body:
      - 1) Cast iron, ASTM A126 Class B.
      - 2) Carbon steel ASTM A216 Grade WCB.
      - 3) Type 304 stainless steel ASTM A240.
    - b. Ends: Flanged or grooved.
    - c. Cover: Bolted.
    - d. Screen: Type 304 stainless steel with mesh rating based on the Strainer Schedule in Part 3.
- B. Tee Strainers
1. Manufacturers:
    - a. Keckley
    - b. Mueller Steam Specialties.
  2. Pressure Rating: Rated for working pressure as defined by the ANSI fitting class of the system.
  3. Body:
    - a. Carbon steel ASTM A216 or A234.
    - b. Type 304 stainless steel ASTM A240.
  4. Ends: Welded or Flanged.
  5. Cover: Bolted.
  6. Screen: Type 304 stainless steel with mesh rating based on the Strainer Schedule in Part 3.

## 2.5 SUCTION DIFFUSERS

- A. Manufacturers:
1. American Wheatley.
  2. Armstrong Fluid Technology.
  3. Bell & Gossett; Xylem.
  4. Keckley.
  5. PACO; Grundfos Pumps Corp.
  6. Patterson Pump Co.
  7. Taco, Inc.
  8. Victaulic.
- B. Construction: Angle pattern, cast-iron body, threaded connections for 2 inch and smaller, flanged connections for 2-1/2 inch and larger.
1. Pressure Rating: As scheduled on the drawings, minimum working pressure as defined by the ANSI fitting class of the system.
  2. Maximum operating temperature: 300 degrees F.
- C. Accessories:
1. Inlet vanes with length 2-1/2 times pump suction diameter or greater.
  2. Cylinder strainer with 3/16 inch diameter openings with total free area equal to or greater than 5 times cross-sectional area of pump suction, designed to withstand pressure differential equal to pump shutoff head. Provide stainless steel strainer in condenser water system.
  3. Provide disposable screen (5/32 inch mesh) to fit over cylinder strainer for cleaning during startup procedures.



4. Adjustable foot support, designed to carry weight of suction piping.
5. Blowdown tapping in bottom; gauge tapping in side.
6. Permanent magnet located in flow stream, removable for cleaning.

## 2.6 FLEXIBLE CONNECTORS

- A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections.
- B. Metal-Type:
  1. Manufacturers:
    - a. American Wheatley.
    - b. Duraflex.
    - c. Flex-Hose, Inc.
    - d. Flexicraft Industries.
    - e. Flex Pipe USA
    - f. Hyspan Precision Products.
    - g. Mason Industries, Inc.
    - h. Metraflex Co.
    - i. Twin City Hose.
    - j. Unaflex, Inc.
  2. Construction:
    - a. Braided Hose: Flanged or threaded to match equipment connection, corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.
    - b. Bellows: Flanged, stainless-steel bellows with woven, flexible, stainless steel, wire-reinforcing protective jacket.
  3. Pressure Rating: Minimum working pressure as defined by the ANSI fitting class of the system.
  4. Maximum operating temperature: 250 degrees F.
  5. Lateral Movement: Capable of accepting 3/4 inch misalignment.
- C. Rubber-Type:
  1. Manufacturers:
    - a. American Wheatley.
    - b. Duraflex.
    - c. Flex-Hose, Inc.
    - d. Flexicraft Industries.
    - e. Flex Pipe USA.
    - f. General Rubber Corp.
    - g. Griswold Controls.
    - h. Hydronic Components Inc.
    - i. IMI Hydronic Engineering.
    - j. Mason Industries, Inc.
    - k. Mercer Rubber Co.
    - l. Metraflex Co.
    - m. Nexus Valves
    - n. Nutech Hydronic Specialty Products
    - o. Proco Products, Inc.
    - p. Twin City Hose.
    - q. Unaflex, Inc.
  2. Construction:
    - a. Braided Hose: Threaded, CPE or EPDM inner tube, stainless steel braid, stainless steel ferrules, brass or steel end connections.
    - b. Bellows Type: Flanged, fiber-reinforced EPDM rubber body with steel flanges. Do not use control rods.

- 1) Basis of Design: Mason Industries Type SFDEJ twin sphere connection or equal.
3. Pressure Rating: Minimum working pressure as defined by the ANSI fitting class of the system.
4. Maximum operating temperature: 250 degrees F.
5. Lateral Movement: Capable of accepting 3/4 inch misalignment.

## 2.7 TRIPLE DUTY VALVES

- A. Manufacturers:
  1. American Wheatley.
  2. Armstrong Fluid Technology.
  3. Bell & Gossett; Xylem.
  4. Keckley.
  5. PACO; Grundfos Pumps Corp.
  6. Taco, Inc.
  7. Watts Water Technologies.
- B. Construction: Straight or angle pattern, flanged, cast-iron body with bolt-on bonnet, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.
  1. Pressure Rating: Minimum working pressure as defined by the ANSI fitting class of the system.
  2. Maximum operating temperature: 300 degrees F.

## 2.8 BALANCING VALVES

- A. Manufacturers:
  1. American Wheatley.
  2. Armstrong Fluid Technology.
  3. Bell & Gossett; Xylem.
  4. Caleffi.
  5. Griswold Controls.
  6. Hays Fluid Controls.
  7. Hydronic Components Inc.
  8. IMI Hydronic Engineering.
  9. Nexus Valve.
  10. Nibco Inc.
  11. Nutech Hydronic Specialty Products
  12. Oventrop.
  13. Pro Hydronic Specialties.
  14. Taco, Inc.
  15. Victaulic Company of America.
- B. Construction: Provide balancing valve with fixed orifice flow balancing, flow measurement, and shut-off capabilities, memory stops, and minimum of two differential pressure metering ports.
  1. Quarter Turn: Provide ball or butterfly quarter turn style for measurement use in variable flow applications.
  2. Full Turn: Provide plug or globe, full or multiple turn style for balancing use in constant flow applications.
  3. Size 2 inch and Smaller: Bronze, forged brass or DZR forged brass body, threaded connections.
  4. Size 2-1/2 inches and Larger: Cast iron, carbon steel, or ductile iron body, with flanged or grooved connections.
  5. Pressure Rating: Minimum working pressure as defined by the ANSI fitting class of the system.
  6. Maximum operating temperature: 250 degrees F.

- C. Accessories: Valve shall include integral pointer and calibrated scale to register degree of valve opening, with position indication readout for repeatable regulation and control.

## 2.9 RELIEF VALVES

- A. Manufacturers:
  - 1. American Wheatley.
  - 2. Armstrong International.
  - 3. Bell & Gossett; Xylem.
  - 4. Caleffi.
  - 5. Keckley.
  - 6. Spence Engineering Company, Inc.
  - 7. Spirax Sarco.
  - 8. Watts Water Technologies.
- B. Safety Relief Valves: Forged brass, bronze, or cast iron, compatible with the piping system, Teflon seat, brass or stainless steel stem, stainless steel springs, EPDM or rubber diaphragm; designed, manufactured, tested, and labeled in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code.
- C. Combined Pressure/Temperature Relief Valves: Forged brass, bronze, or cast iron, compatible with the piping system, diaphragm operated, with low inlet pressure check valve, inlet strainer removable without system shut-down, and non-corrosive valve seat and stem. Provide with fast fill feature for filling hydronic system. Valve shall be factory-set at operating pressure and have the capability for field adjustment; designed, manufactured, tested, and labeled in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code.
- D. Pressure Rating: Minimum working pressure as defined by the ANSI fitting class of the system.
- E. Maximum operating temperature: 250 degrees F.
- F. Opening Pressure and Capacity Setpoint: As scheduled on the drawings.

## 2.10 COMBINATION PIPING PACKAGES (COIL KITS)

- A. Combination piping packages are allowed in lieu of individual components specified for hydronic coils and devices containing hydronic coils.
- B. Components shall be same size as piping serving the unit as shown on the drawings. Control valves do not need to be same size as piping subject to the sizing requirements set forth in Division 23 "Instrumentation and Control Devices for HVAC."
- C. Package shall include the components and shall match layouts specified on the Drawings. Each component of the combination piping package shall meet the specifications for the individual components being combined.

## 2.11 WATER FILTRATION SYSTEM

- A. Manufacturers:
  - 1. Griswold Water Systems.
  - 2. Lakos.
  - 3. Puroflux.
- B. Separator Pump Package:
  - 1. Description: Factory assembled and tested, piped, pre-wired filtration unit, including solids separator, pump and motor, piping, piping accessories, valves, gauges, and controls mounted to a steel skid.
    - a. Side Stream Installations: Control of solids in the re-circulated cooling water system shall be accomplished via a side-stream flow of not less than 10% of the full-stream

- system flow. The pump included with the package shall provide sufficient pressure for the re-introduction of side-stream fluid back into system flow.
- b. Separator package: Shall provide for initial pre-straining, followed by direct pumping through a specific centrifugal-action solids-from-liquid separator. Separated solids shall be continuously bled from the separator's collection chamber into the package's integral solids recovery vessel and solids collection bag. Excess liquid shall pass through the bag and return to system flow via piping connected to the package's pump suction line.
2. Components
    - a. Separator: Centrifugal-action design, unishell construction with SA-36, SA-53B or equivalent quality carbon steel or 304 stainless steel, manual and automatic air vents, solids purge outlet at the lowest point of separator accumulation chamber.
    - b. Exterior Coating: Shall be oil-based enamel or acrylic urethane, spray-on coating.
    - c. The separator shall be constructed in accordance with the standards of the American Society of Mechanical Engineers (ASME), Section VIII, Division 1 for pressure vessels. Certification shall be confirmed with the registered "U-stamp" on the body of the separator.
    - d. Solids Collection Vessel: Housing shall be 304 stainless steel with stainless steel basket and coated carbon steel lid with air pressure relief valve. Provide 25- micron fiber felt solids collection bag. Include flow control orifice. Solids capacity shall be minimum 360 cubic inches.
    - e. Inlet and Outlet: Shall be grooved, threaded, or flanged couplings of sizes as indicated on the drawings.
    - f. Purge Outlet: Solids purge outlet shall be threaded, minimum size of 1-1/2 inch.
    - g. Skid Plate: Stainless steel, 3/16-inch minimum thickness, structural steel framework on units with 8-inch and larger connections.
  3. Piping:
    - a. Schedule 80 PVC for piping installed inside cooling tower basin. Water filtration system manufacturer shall design basin sweeper piping layout.
    - b. Schedule 40 coated carbon steel interconnection piping within water filtration unit skid.
  4. Valves: Ball valves on purge line for isolation of solids-handling/purging equipment. Provide inlet/outlet isolation valves to unit.
  5. Pump: End-suction, single stage; TEFC motor; cast iron housing; iron impeller; bronze shaft sleeve; silicon carbide mechanical shaft seal; cast-iron pre-strainer with removable steel basket.
    - a. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  6. System Performance Requirements:
    - a. Independent Testing Laboratory: System performance shall be verified by published results from an independent and identified testing laboratory. Standard test protocol of upstream injection, downstream capture, and separator purge recovery is allowed with 50-200 mesh particles to enable effective, repeatable results. Single pass test performance shall not be less than 95% removal. Model tested shall be of same flow-design as specified unit.
    - b. In a single pass through the separator, given solids with a specific gravity of 2.6 and water at 1.0, performance shall be 98% of 74 microns and larger. Additionally, particles finer in size, heavier by specific gravity and some lighter by specific gravity shall also be removed, resulting in an appreciable aggregate removal of particles (up to 75%) as fine as 5 microns.
    - c. In a recirculation system, performance shall be 98 % of solids 40 microns and larger.
    - d. Maximum working pressure and operating temperature: 50 psig and 100 degrees F.
    - e. Purging and Solids Handling: System shall include manual isolation valves for use when servicing the collection bag; motorized ball valve with bronze or forged brass body and stainless steel ball for automatic purge of solids; sight glasses for

- verification of flow through the vessel; annunciator for indicating when the collector bag needs cleaning/replacement; flow control orifice to minimize fluid volume/velocity through the vessel and collector bag.
7. Electrical Controls: UL listed, NEMA 4X enclosure with door disconnect switch, HOA selector switch, motor short circuit/overload protection, transformer, pressure differential switch indicating internal bag cleaning/replacement, adjustable solid state purge timer, pump run indication status light, single point power connection, power requirement per schedule.
- C. Maintenance:
1. The separator shall feature the following access capabilities for either inspection or the removal of unusual solids/debris:
    - a. A hand-hole port at the collection chamber for all units with connections 4-inches and larger.
    - b. A 1/2-inch inspection port, located at the lowest point of the upper chamber.
    - c. A grooved coupling in the upper body to provide full access.

### **PART 3 - EXECUTION**

#### **3.1 HYDRONIC SPECIALTY APPLICATIONS**

- A. Reference Division 23 Section "General Duty Valves for HVAC Piping" for general duty valve applications.
- B. Air Vents:
1. Manual Type: High points in the system outside of mechanical rooms, at heat transfer coils, and elsewhere as required for system air venting.
  2. Automatic Type: Air separator outlets, expansion tank connections, high points in outlet piping of boilers and hot water heat exchangers, and elsewhere as required for system air venting within a mechanical room.
- C. Strainers: Inlet of each pressure reducing valve, pump, and elsewhere as indicated. Do not install strainers on the inlet of pumps serving open loop condenser water systems. Provide strainers in open loop condenser water system where shown on the drawings.
- D. Suction Diffusers: Install on the pump suction inlet. Do not include strainer in suction diffusers installed on pumps serving open condenser water systems, such as cooling towers. Provide strainers in open loop condenser water system where shown on the drawings.
- E. Flexible Connectors:
1. Metal Type: Inlet and discharge connections to pumps (unless otherwise indicated) and other vibration producing equipment.
  2. Rubber Type: Inlet and discharge connections to pumps (unless otherwise indicated) and other vibration producing equipment.
  3. Omit flexible connectors if replaced by series of three grooved couplings on projects where grooved pipe is used.
- F. Triple Duty Valves: Contractor has option to provide triple duty valve in the pump discharge line if lieu of balance and check valves. Shutoff valve is still required even if triple duty valve is used.
- G. Balancing Valves:
1. Constant Volume Pumping Systems: Where shown on the drawings and elsewhere as required to facilitate system balancing.
  2. Variable Volume Pumping Systems: Where shown on the drawings, sized for the smaller of the pipe size or to have a minimum pressure drop of 1 psig at the design flow rate.
- H. Relief Valves: Where located on the plans and at pressure tanks, hot water generators, low pressure side of reducing valves, heat exchangers, and expansion tanks. Install elsewhere as required by ASME Boiler and Pressure Vessel Code.

- I. Pressure Reducing Valves: Hot water generators, and elsewhere as required to regulate system pressure.

### 3.2 STRAINER SCHEDULE

- A. Acceptable strainer types based on fluid and pipe size:
  1. Hydronic in Pipes Smaller than 4 inch: Y-Type.
  2. Hydronic in Pipes Larger than 4 inch: Y-Type, T-Type, Basket.
- B. Acceptable strainer types based on orientation:
  1. Horizontal: Y-Type, T-Type, Basket.
  2. Vertical: Y-Type, T-Type.
- C. Screen Mesh Rating Based on Application:
  1. General Piping:
    - a. Pipe size 4 inch and smaller: 0.062 inches (12 mesh).
    - b. Pipe size larger than 4 inch: 0.125 inch (6 mesh).
  2. Upstream of automatic flow control valves: 0.0331 inch (20 mesh).
  3. Upstream of brazed plate heat exchangers: 0.0331 inch (20 mesh).
  4. Upstream of plate and frame heat exchangers: 0.0787 inch (10 mesh).

### 3.3 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Reference Division 23 Section "Basic Piping Materials and Methods" for general piping installation requirements.
- C. Expansion Tanks:
  1. Diaphragm/Bladder Tanks:
    - a. Install diaphragm/bladder-type expansion tanks on floor or support from structure as indicated on the drawings. Vent and purge air from hydronic system, charge tank with proper air charge to suit system design requirements.
    - b. Support tank as detailed on the Drawings. In the absence of details, provide support from the floor or structure above, sufficient for the weight of the tank, piping connections, and fittings, plus weight of water assuming a full tank of water. Do not overload building components and structural members.
    - c. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles.
- D. Air Vents:
  1. Where large air quantities can accumulate, provide enlarged air collection standpipes.
  2. Install manual air vents in piping mains with a tee fitting, 1/2 inch ball valve, threaded nipple, and cap.
  3. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- E. Air Separators:
  1. Install with shutoff valves on the inlet and outlet piping.
  2. Install air outlet piping to compression expansion tank with 1/4 inch per foot (2 percent) upward slope towards tank.
  3. Install automatic air vent at air outlet and run piping to floor drain.
  4. Install in-line air separators with drain valve on units 2 inch and larger.
  5. Install combination air and dirt separator blowdown piping with gate valve; extend to nearest drain.
  6. Install air and air/dirt separators on floor or support from structure as indicated on the drawings.

7. Support tank as detailed on the Drawings. In the absence of details, provide support from the floor or structure above, sufficient for the weight of the tank, piping connections, and fittings, plus weight of water assuming a full tank of water. Do not overload building components and structural members.
- F. Strainers:
1. Provide valved drain and hose connection on strainer blowdown connection for strainers 2 inch and larger.
- G. Suction Diffusers:
1. Adjust foot support to carry weight of suction diffuser. Install nipple and ball valve in blowdown connection.
- H. Triple Duty Valves:
1. Install triple duty valves with stem in upward position. Allow clearance above stem for check mechanism removal.
- I. Relief Valves:
1. Adjust relief valve setpoint as noted on the drawings.
  2. Pipe relief valve outlet to nearest floor drain.
  3. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- J. Water Filtration System:
1. Install water filtration system per manufacturer installation instructions. Provide support for unit as scheduled on the drawings.
  2. Install piping between water filtration system and cooling tower per water filtration system manufacturer recommendations.

### 3.4 STARTUP

- A. Reference Division 23 Section Hydronic Piping for general startup requirements.
- B. Start up and commissioning of water filtration unit shall be performed by a factory authorized representative.
- C. Start up and commissioning of glycol makeup unit shall be performed by a factory authorized representative.
- D. Remove temporary strainer after cleaning system.

### 3.5 TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water filtration equipment and/or glycol makeup equipment.
- B. Training for Owner's personnel shall include but not be limited to:
  1. Overview of the system and /or equipment as it relates to the facility as a whole.
  2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
- C. Review manufacturer's safety data sheets for handling of chemicals.
- D. Review data in maintenance manuals, especially data on recommended parts inventory and supply sources and on availability of parts and service. Refer to Division 1 and Division 23 Section "General Mechanical Requirements."
- E. Schedule at least four hours of training with Owner, through Architect, with at least seven days' advance notice.
- F. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time,

attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.

END OF SECTION



**SECTION 23 21 23 - HYDRONIC PUMPS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A.
- B. Vertical in-line, split-coupled inline pumps.

**1.2 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- C. Millwright's Certificate: Certify that base mounted pumps have been aligned.
- D. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.
- E. Alignment Report: Provide alignment and grout reports for alignment work specified in Part 3. Submit pictures of grouted base with the alignment report.
- F. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Pump Seals: for each type and size of pump.
  - 2. Extra Cartridges for Side-Stream Filters: One set for each filter.

**1.3 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacture, assembly, and field performance of pumps, with minimum three years of documented experience.
- B. UL Compliance: Fabricate and label pumps to comply with UL 778, "Motor-Operated Water Pumps," for construction requirements.
- C. Product Options: Drawings indicate size, profiles and connections requirements of pumps and are based on the specific types and models indicated. Other manufacturers' pumps with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- D. Regulatory Requirements: Fabricate and test pumps to comply with HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation," and HI 1.6, "Centrifugal Pump Tests."
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

**1.4 DELIVERY STORAGE AND HANDLING**

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.

- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

## 1.5 WARRANTY

- A. Warranty on Pumps: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, pumps with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement includes both parts and labor for removal and reinstallation.
  - 1. Warranty Period: One year from date of substantial completion.

## PART 2 - PART 2 PRODUCTS

### 2.1 HVAC PUMPS - GENERAL

- A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Minimum Quality Standard: .
- C. Base Mounted Pumps: Aligned by qualified millwright.
- D. Products Requiring Electrical Connection: Listed and classified by UL or testing agency acceptable to Authority Having Jurisdiction as suitable for the purpose specified and indicated.
- E. Pumps and Circulators: Factory-assembled and factory-tested. Fabricate casings to allow removal and replacement of impellers without necessity of disconnecting piping. Type, sizes, and capacities shall be as indicated.
- F. Preparation for Shipping: After assembly and testing, clean flanges and exposed machined metal surfaces and treat with an anticorrosion compound. Protect flanges, pipe openings, and nozzles.
- G. Motors: Conform to NEMA Standard MG-1, general purpose, continuous duty, Design B, except Design C where required for high starting torque; single, multiple, or variable speed with type of enclosure and electrical characteristics as indicated; have built-in thermal-overload protection, and grease-lubricated ball bearings. Select motors that are non-overloading within the full range of the pump performance curve. Refer to Section "Common Motor Requirements for HVAC Equipment" for additional requirements.
  - 1. Efficiency: Motors shall have a minimum efficiency meeting the requirements of the Energy Policy Act of 1992 as defined in NEMA MG-1 when tested in accordance with IEEE Standard 112, Test Method B.
    - a. Motor Frame: NEMA Standard 48 or 54; use pump manufacturer's standard.
- H. Apply factory finish paint to assembled, tested units prior to shipping.

### 2.2 VERTICAL IN-LINE SPLIT-COUPLED PUMPS

- A. Type: Pumps shall be centrifugal, close-coupled, single-stage, bronze-fitted, radially split case design, with mechanical seals, and rated for 175 psig working pressure and 225 deg F continuous water temperature.

- B. Motor: Direct-mounted to pump casing; with lifting and supporting lugs in top of motor enclosure.
- C. Casing: Cast iron, with threaded companion flanges for piping connections smaller than 2-1/2 inches, and threaded gauge tapings at inlet and outlet connections.
- D. Impeller: Statically and dynamically balanced, closed, overhung, single-suction, cast bronze, conforming to ASTM B 584, and keyed to shaft.
- E. Shaft: Ground and polished carbon steel shaft, screw or nut and bronze sleeve and integral thrust bearing. Provide flinger on motor shaft between motor and seals to prevent liquid that leaks past pump seals from entering the motor bearings.
- F. Seal: Carbon rotating against a stationary ceramic seat, 225 degrees F maximum continuous operating temperature. Provide 316 stainless steel gland plate. Provide factory installed flush line and manual vent.
- G. Coupling: Provide rigid spacer type of high tensile aluminum alloy. Coupling shall be designed to be easily removed on site to reveal a space between the pump and motor shafts sufficient to remove all mechanical seal components for servicing and to be replaced without disturbing the pump or motor.
- H. Lower Seal Chamber throttle bushing shall be provided to ensure seals maintain positive cooling and lubrication.
- I. Accessories: Provide a 50 micron cartridge filter and sight flow indicator suitable for the system working pressure in the flush line. Provide new filter after system is flushed and tested. Alternatively provide a maintenance free sediment separator in the flush line with sight flow indicator. Verify differential pressure is adequate for effective operation.
- J. Motor: Designed for vertical in-line, split coupled operation Provide a high tensile aluminum split coupler to connect the pump and motor shaft with sufficient gap to allow seal replacement without removing motor or dismantling pump.
- K. Manufacturers:
  - 1. American Marsh Pumps.
  - 2. Armstrong Fluid Technology, Inc.
  - 3. Aurora Pumps.
  - 4. Bell & Gossett, ITT.
  - 5. Goulds Water Technology.
  - 6. Grundfos Pumps Corp.
  - 7. Paco Pumps.
  - 8. Patterson Pump Co.
  - 9. Peerless Pump.
  - 10. Taco, Inc.
  - 11. Thrush Company, Inc.
  - 12. Weinman
  - 13. Wilo.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Verify that electric power is available and of the correct characteristics.

#### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.

- B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.
- C. Decrease from line size with long radius reducing elbows or eccentric reducers installed flat on top. Support piping adjacent to pump such that no weight is carried on pump casings. For Vertical In-line or base-mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
- D. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge. A separate strainer is not required if a suction diffuser with strainer is provided.
- E. Provide air cock and drain connection on horizontal pump casings.
- F. Provide drains for bases and seals, piped to and discharging into floor drains.
- G. Install flexible connectors on the suction and discharge side of each pump mounted on housekeeping pad. Install flexible connectors between the pump casing and the discharge valves, and upstream of the pump suction diffuser.
- H. Provide vibration isolation for pumps as specified in Section "Vibration Isolation for HVAC".
- I. Install a combination pressure gauge with tubing connected to the suction and discharge of each pump at the integral pressure gauge tapplings provided as well as a tap upstream of the suction diffuser and strainer.
- J. Install temperature and pressure gauge connector plugs in suction and discharge piping around pump. Temperature and pressure gauge connector plugs are specified in Section "Meters and Gauges."
- K. Check, align, and certify alignment of base-mounted pumps prior to start-up. Comply with pump and coupling manufacturer's written instruction.
- L. Install floor mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Refer to the drawings and Section "Vibration Isolation for HVAC" to determine where concrete inertia bases are required.
  - 1. Adjust alignment of pump and motor shafts for angular and parallel alignment by one of the two methods specified in the Hydraulic Institute "Centrifugal Pumps - Instructions for Installation, Operation and Maintenance."
  - 2. For pumps with flexible couplings requiring alignment and grouting per manufacturer's inspection, operation and maintenance (IOM) plan, measure alignment when pump is set and again after pump has been started. Misalignment shall be no greater than 5 thousandths angular and 3 thousandths parallel. Submit reports of alignment results in accordance with Submittals paragraph.
  - 3. After alignment is correct, tighten the foundation bolts evenly, but not too firmly. Fill the base plate completely with non-shrink, nonmetallic grout, with metal blocks and shims or wedges in place. After grout has cured, fully tighten foundation bolts.
- M. Lubricate pumps before start-up.

### 3.3 STARTUP

- A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:
  - 1. Lubricate oil-lubricated bearings.
  - 2. Remove grease-lubricated bearing covers and flush the bearings with kerosene and thoroughly clean. Fill with new lubricant in accordance with the manufacturer's recommendations.

3. Disconnect coupling and check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
  4. Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.
  5. Clean strainers.
  6. Check piping connections for tightness.
- B. Starting procedure for pumps with shutoff power not exceeding the safe motor power:
1. Prime the pump, opening the suction valve, closing the drains, and prepare the pump for operation.
  2. Open the valve in the cooling water supply to the bearings, where applicable.
  3. Open the cooling water supply valve if the stuffing boxes are water-cooled.
  4. Open the sealing liquid supply valve if the pump is so fitted.
  5. Open the warm-up valve of a pump handling hot liquids if the pump is not normally kept at operating temperature.
  6. Open the recirculating line valve if the pump should not be operated against dead shutoff.
  7. Start the motor.
  8. Open the discharge valve slowly.
  9. Observe the leakage from the stuffing boxes and adjust the sealing liquid valve for proper flow to ensure the lubrication of the packing. Do not tighten the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.
  10. Check the general mechanical operation of the pump and motor.
  11. Close the recirculating line valve once there is sufficient flow through the pump to prevent overheating.
- C. If the pump is to be started against a closed check valve with the discharge valve open, the steps are the same, except that the discharge valve is opened some time before the motor is started.
- D. Retouch any marred or scratched surfaces of factory-finished surfaces, using finish materials furnished by manufacturer.
- E. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for detailed requirements for testing, adjusting, and balancing hydronic systems.

### 3.4 TRAINING

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
1. Overview of the system and/or equipment as it relates to the facility as a whole.
  2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
  3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
- C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

**SECTION 23 25 00 - HVAC WATER TREATMENT****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Chemicals and test equipment.
- B. Chemical feeding equipment.

**1.2 SUBMITTALS**

- A. Submit in accordance with conditions of Contract and Division 01 submittal procedures.
- B. Product Data: Submit product cutsheets, materials, accessories, chemicals, and equipment, including electrical characteristics and connection requirements, rated capacities, water-pressure drops, shipping, installed, and operating weights for the water treatment system.
- C. Shop Drawings: Indicate system schematic, equipment locations, controls schematics, and electrical characteristics. Detail equipment assemblies indicating dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Detail power and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- D. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.
- E. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.
- F. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment to confirm compliance with performance requirements.
- G. Certificate: Submit certificate of compliance from Authority Having Jurisdiction indicating approval of chemicals and their proposed disposal.
- H. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.
- I. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations. Include in maintenance manuals specified in Division 1.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Sufficient chemicals for treatment and testing during required maintenance period.
- K. Warranty and maintenance agreement.

**1.3 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.
- B. Installer Qualifications: An experienced installer who is an authorized representative of the chemical treatment manufacturer for both installation and maintenance of chemical treatment equipment required for this Project.

- C. Comply with ASHRAE Guideline 12, Managing the Risk of Legionellosis Associated with Building Water Systems and ASHRAE Standard 188, Legionellosis: Risk Management for Building Water Systems.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

#### **1.4 WARRANTY**

- A. Warranty: Submit written warranty, signed by Manufacturer and countersigned by Installer and Contractor, agreeing to adjust or replace system or portions thereof, as required to achieve required performances, during 1-year period following final start-up for continued operation of condenser water system.
- B. Agreement to Maintain: Prior to time of final acceptance, manufacturer of water treatment system shall submit 4 copies of "Agreement for Continued Service and Maintenance" for water treatment system for Owner's possible acceptance. Offer terms and conditions for furnishing chemicals and providing continued testing and servicing, and including replacement of materials and equipment, for one-year with option for renewal of Agreement by Owner.

#### **1.5 SPARE PARTS**

- A. Chemicals, Water Treatment: Furnish 6 month supply of chemicals recommended by water treatment system manufacturer for treating water to meet specified water quality.
  - 1. Ascertain from water piping system Installer, what materials are used for pump seals. Provide only chemicals that are compatible with these materials.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. General: The following manufacturers of water treatment systems are acceptable. Manufacturers shall provide chemical feed equipment that meet the requirements specified herein.
  - 1. AmSolv Total Water Management
  - 2. Aquanomics
  - 3. Kurita
  - 4. MAC Water Technologies
  - 5. Nalco, an Ecolab Company.
  - 6. Suez Water Technologies.
  - 7. Water Treatment Vendor that is listed under Association of Water Technologies (ATW) with a Certified Water Technician (CWT).

#### **2.2 CHEMICALS AND TEST EQUIPMENT**

- A. General: Furnish chemicals of type and quantity as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment.
- B. System Cleaner:
  - 1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
  - 2. For closed systems, provide nonoxidizing biocide treatment if needed to meet biological parameters from water test performed after system is cleaned..



- C. Closed System Treatment (Water):
  - 1. Sequestering agent to reduce deposits and adjust Ph.
  - 2. Corrosion inhibitors.
  - 3. Conductivity enhancers.
- D. Condenser Water System Treatment (Cooling Towers):
  - 1. Sequestering agent to inhibit scaling.
  - 2. Corrosion inhibitor.
  - 3. Biocide chlorine release agents or microbiocide.
- E. Test Equipment:
  - 1. Manufacturer recommended equipment and chemicals, in a carrying case, for testing pH, total dissolved solids, sodium sulfite for dissolved oxygen, biocount, chloride, and total alkalinity and for calcium hardness field tests.
  - 2. Corrosion Test Coupon Assembly: Constructed of corrosion material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test coupon assembly.
    - a. Two station rack for closed-loop systems.
    - b. Four station rack for open condenser water systems.

### 2.3 CHEMICAL FEEDING EQUIPMENT

- A. Bypass (Pot) Feeder: Cast iron or steel, for introducing chemicals into system; with funnel shutoff valve on top, air-release valve on top, drain valve on bottom, and recirculating shutoff valves on sides.
  - 1. Capacity: 5 gal. for working pressure of 175 psig.
- B. Solution Metering Pump:
  - 1. Positive displacement, diaphragm or piston pump, simplex, self-priming, with adjustable flow rate, thermoplastic construction, continuous-duty fully enclosed electric motor and drive, and built-in relief valve, foot valve/strainer, ceramic sinker, suction and discharge tubing, and injection valve assembly. Rated for intended chemical with 25 percent safety factor for design pressure and temperature.
  - 2. Electrical Characteristics:
    - a. 120 volts, single phase, 60 Hz.
    - b. Cord and Plug: Provide unit with 6 foot cord and plug for connection to electric wiring system including grounding connector.
- C. Solution Tanks:
  - 1. 50 gallon capacity, chemical-resistant reservoir fabricated from high-density opaque polyethylene, self-supporting, 1 gallon graduated markings; factory-installed floating suction assembly, molded fiberglass cover with recess for mounting pump, agitator, and liquid level switch.
- D. Agitator:
  - 1. Direct drive, 1750 rpm, totally enclosed, continuous-duty electric motor, 1/2 inch diameter coated Type 316 stainless steel shaft and propeller, mounted on tank with angle adjustment and stainless steel clamp.
  - 2. Electrical Characteristics:
    - a. 120 volts, single phase, 60 Hz.
    - b. Cord and Plug: Provide unit with 6 foot cord and plug for connection to electric wiring system including grounding connector.
- E. Liquid-Level Switch:
  - 1. Polypropylene housing, integrally mounted PVC air trap, receptacles for connection to metering pump, and low-level alarm.
- F. Conductivity Controller:

1. Packaged monitor controller with solid state circuiting, five percent accuracy, linear dial adjustment, built-in calibration switch, on-off switch and light, control function light, output to control circuit and recorder.
- G. Water Meter:
1. Displacement type cold water meter, rotating-disc or turbine type, bronze or cast-iron body rated for 125 psig, with sealed, tamper-proof magnetic drive or impulse contact register, single pole, double throw dry contact switch, and at least six-digit totalizer.
  2. Electrical Characteristics:
    - a. 120 volts, single phase, 60 Hz.
- H. Solenoid Valve or Motorized Ball Valves:
1. Solenoid valve shall be forged brass body globe pattern, fail closed, general purpose solenoid enclosure, and continuous duty coil.
  2. Motorized ball valve shall be forged brass body with stainless steel ball, fail closed, with general purpose actuator.
  3. Electrical Characteristics:
    - a. 120 volts, single phase, 60 Hz.
- I. Timers:
1. Electronic timers, infinitely adjustable over full range, 150 second and five minute range, mounted together in cabinet with hands-off-automatic switches and status lights.
- J. Chemical Tubing: Schedule 40, PVC with solvent-cement joints; or polypropylene tubing with heat fusion.
- K. Plastic Ball Valves: Rigid PVC or CPVC body, integral union ends, and polytetrafluoroethylene seats and seals.
- L. Plastic-Body Strainer: Rigid PVC or CPVC with cleanable stainless-steel strainer element.
- M. Condenser Water System Treatment Controller (Cooling Towers)
1. Provide automatic electronic solid-state control system for inhibitor feed, blowdown and biocide feeds. Inhibitor application shall be meter activated, blowdown shall be conductivity activated, and biocide shall be meter fed with blowdown locked out to ensure biocide retention time.
  2. Control system shall incorporate solid state integrated circuits and digital LED displays, in NEMA-12 steel enclosure. Provide gasketed and lockable door.
  3. Base dissolved solids control on conductivity and include:
    - a. LED digital readout display (micro-ohm/cm).
    - b. Temperature compensated sensor probe adaptable to sample stream manifold.
    - c. High, low, normal conductance indicator lights (LED).
    - d. High or low conductance alarm light (flash or steady switch), trip points field adjustable. Flash or steady switch shall have silence position.
    - e. Illuminated legend shall indicate "ALARM" whenever alarm condition exists.
    - f. Hand-off-automatic switch for solenoid bleed valve.
    - g. Illuminated legend shall indicate "BLEED" when valve is operated.
    - h. Adjustable hysteresis or dead-band (internal).
  4. Base inhibitor feed control on make-up volume and include:
    - a. Solid state counter (1-15 field selectable).
    - b. Solid state timer (adjustable 1/4 to 5 minutes).
    - c. Test switch.
    - d. Hand-off-automatic switch for chemical pump.
    - e. Illuminated legend shall indicate when pump is activated.
    - f. Solid state lock-out timer (adj. 1/4 to 3 hours) and indicator light. Lock-out timer shall deactivate the pump and activate alarm circuits.
    - g. Panel totalizer (amount of makeup), electro-mechanical type.
  5. Biocide programmer to include:
    - a. 24 hour timer with 14 day skip feature to permit activation any hour of the day.

- b. Precision solid state bleed lock-out timer (0-9 hours) and biocide pump timer (0 - 2-1/4 hours), clock controlled.
- c. Solid state alternator to enable the use of two different formulations.
- d. Digital display of the time of day (24 hours).
- e. LED display of day of week (14 days).
- f. Fast and slow clock set controls (internal).
- g. Battery back-up so clock is not disturbed by power outages, quartz timekeeping accuracy.
- h. Hand-off-automatic switches for biocide pumps.
- i. Illuminated legend shall indicate "BIOCIDE A" or "BIOCIDE B" when pump is activated.

### **PART 3 - EXECUTION**

#### **3.1 PERFORMANCE REQUIREMENTS**

- A. Provide a water treatment system sized and equipped to treat raw make-up water available at project site.
- B. Maintain water quality for HVAC systems that controls corrosion and build-up of scale and biological growth for maximum efficiency of installed equipment without posing a hazard to operating personnel or the environment.
- C. Base chemical treatment performance requirements on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
- D. Coordinate the use of oxidizing agents supplemented with non-oxidizers sequentially to ensure organisms do not become immune to treatment per ASHRAE Guideline 12-2000.
- E. Except as otherwise indicated, provide water treatment system manufacturer's standard materials and components as indicated by published product information, and as recommended by manufacturer for application indicated.
- F. Comply with applicable codes for addition of non-potable chemicals to building mechanical systems and to public sewage systems.
- G. Perform work in accordance with local health department regulations.

#### **3.2 PREPARATION**

- A. Perform an analysis of supply water to determine the type and quantities of chemical treatment needed to maintain the water quality as specified.
- B. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- C. Place terminal control valves in open position during cleaning.
- D. Verify that electric power is available and of the correct characteristics.

#### **3.3 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install treatment equipment level and plumb.
- C. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- D. Install piping adjacent to equipment to allow service and maintenance.
- E. Electrical Coordination:
  - 1. Coordinate applicable electrical requirements in Division 26 sections for connecting and grounding electrical equipment.
  - 2. Coordinate electrical connectors and terminals are tightened according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.4 CLOSED SYSTEM TREATMENT

- A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.
- B. Introduce closed system treatment through bypass feeder when required or indicated by test.
- C. Provide 3/4 inch water coupon rack around circulating pumps with space for 2 test specimens.

### 3.5 CONDENSER WATER SYSTEMS (COOLING TOWERS)

- A. Passivate galvanized steel material in cooling towers for minimum of six weeks prior to full operation. Coordinate pH level concentrations with cooling tower manufacturer. Schedule this process to ensure work is done prior to cooling tower activation.
- B. Provide solution pumps to feed sequestering agent and corrosion inhibitor from solution tank into condenser water supply to tower. Provide agitator as required.
- C. Provide conductivity controller to sample condenser water and operate solenoid bleed valve and solution pumps.
- D. Provide solution pump to feed diluted acid from solution tank into condenser water supply to tower.
- E. Introduce oxidizing and nonoxidizing biocides to tower by intermittent slug feed.
- F. Provide water meter in make-up water line to tower, to activate solution pumps for preset time when condenser water pumps are running.
- G. Provide liquid level switch in each solution tank to deactivate solution pump and agitator and sound local alarm bell.
- H. Provide 3/4 inch water coupon rack around circulating pumps with space for 2 test specimens.

### 3.6 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
  - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
  - 3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
- B. Test chemical feed piping as follows:
  - 1. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
  - 2. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

3. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
  4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
  5. Repair leaks and defects with new materials and retest piping until satisfactory results are obtained.
  6. Prepare test reports, including required corrective action.
- C. Fluid Testing:
1. Coordinate with the testing requirements specified in Division 23 Section "Hydronic Piping"

### 3.7 AD USTING

- A. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and prepare certified test report for each required water performance characteristic. Where applicable, comply with ASTM D 3370 and the following standards:
1. Silica: ASTM D 859.
  2. Steam System: ASTM D 1066.
  3. Acidity and Alkalinity: ASTM D 1067.
  4. Iron: ASTM D 1068.
  5. Water Hardness: ASTM D 1126.
- B. Occupancy Adjustments: Within 12 months of Substantial Completion, perform two separate water analyses to prove that automatic chemical feed systems are maintaining water quality within performance requirements specified in this Section. Perform analyses at least 60 days apart. Submit written reports of water analysis.

### 3.8 CLOSEOUT ACTIVITIES

- A. Training: Train Owner's personnel on operation and maintenance of chemical treatment system.
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.
- C. Provide overview of the system and /or equipment as it relates to the facility as a whole.
- D. Review operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
- E. Review manufacturer's safety data sheets for handling of chemicals.
- F. Review data in maintenance manuals, especially data on recommended parts inventory and supply sources and on availability of parts and service. Refer to Division 1 and Division 23 Section "General Mechanical Requirements."
- G. Provide minimum of two hours of training with Owner with at least seven days advance notice.
- H. Have operation and maintenance data prepared and available for review during training.
- I. Conduct training using actual equipment after treated system has been put into full operation.
- J. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- K. Submit certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

**3.9 MAINTENANCE**

- A. Provide a separate maintenance contract for specified maintenance service.
- B. Perform maintenance work using competent and qualified personnel under the supervision and in the direct employ of the equipment manufacturer or original installer.
- C. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of Owner.
- D. Provide monthly technical service visits to perform field inspections and make water analysis on-site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.
- E. Provide laboratory and technical assistance services during this maintenance period.
- F. Analyses and reports of all chemical items concerning safety and compliance with government regulations.
- G. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

END OF SECTION

**SECTION 23 31 13 - METAL DUCTS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Metal ductwork.
- B. Duct liner.
- C. Duct sealants.
- D. Duct hangers and supports.
- E. Wire rope hanging system.
- F. Manufactured ductwork and fittings.
- G. Factory-fabricated grease exhaust ductwork.

**1.2 DEFINITIONS**

- A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:
  - 1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
  - 2. Joints: Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

**1.3 SYSTEM PERFORMANCE REQUIREMENTS**

- A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

**1.4 SUBMITTALS**

- A. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:
  - 1. Duct Liner.
  - 2. Sealing Materials.
  - 3. Fire-Stopping Materials.
- B. Shop drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:
  - 1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
  - 2. Duct layout, indicating pressure classifications, duct gauge and sizes in plan view. For exhaust ducts systems, indicate the classification of the materials handled as defined in this Section.
  - 3. Fittings.
  - 4. Reinforcing details and spacing.

5. Seam and joint construction details.
  6. Penetrations through fire-rated and other partitions.
  7. Terminal heating and cooling unit, coil, humidifier and duct silencer installations.
  8. Locations of fire and fire/smoke dampers and associated duct access doors.
  9. Locations of cleanout and access doors in grease exhaust ducts.
  10. Location of manual balancing dampers.
  11. Duct smoke detector locations. Refer to electrical drawings for general locations and coordinate locations with the electrical contractor.
  12. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
- C. Coordination drawings for ductwork installation in accordance with Division 23 Section "General Mechanical Requirements." In addition to the requirements specified in "General Mechanical Requirements" show the following:
1. Coordination with ceiling suspension members.
  2. Spatial coordination with other systems installed in the same space with the duct systems.
  3. Coordination of ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
  4. Coordination with ceiling-mounted lighting fixtures and air outlets and inlets.
- D. Leak test report for ducts specified to be leak tested in Part 3. Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK).
- E. Leak Test certificate for all smoke control duct joints and fittings in compliance with the locally adopted IMC.
- F. Leak Test certificate for all grease duct joints and fittings in compliance with the locally adopted IMC.
- G. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices, in accordance with Division 23 Section "General Mechanical Requirements" and Division 1.
- H. Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in "Quality Assurance" below.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.
- C. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" for hangers and supports and AWS D9.1 "Sheet Metal Welding Code."
- D. Qualify each welder in accordance with AWS qualification tests for welding processes involved. Certify that their qualification is current.
- E. NFPA Compliance: Comply with the following NFPA Standards:
1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.
  2. NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
  3. NFPA 96, "Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors for Commercial Cooking Equipment," Chapter 3, "Duct System," for kitchen hood duct systems, except as indicated otherwise.



- F. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA): Provide ductwork systems in conformance with "HVAC Duct Construction Standards – Metal and Flexible," latest edition.
- G. Underwriter's Laboratories (UL): Comply with the UL standards listed within this section. Provide mastic and tapes that are listed and labeled in accordance with UL 181A and marked according to type.
- H. National Air Duct Cleaners Association, Inc. (NADCA): Clean ductwork systems in accordance with the standard Assessment, Cleaning and Restoration of HVAC Systems (ACR 2002).

## 1.6 PROTECTION AND REPLACEMENT

- A. Protect ductwork during shipping and storage from dirt, debris and moisture damage. Provide plastic covers over ends of ductwork during shipping, storage and installation.
- B. Replace duct liner that is damaged and cannot be repaired satisfactorily, including insulation with vapor barrier damage and insulation that has been exposed to moisture during shipping, storage, or installation. Drying the insulation is not acceptable. Dry surfaces prior to installing new duct liner.

## 1.7 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 DUCT ASSEMBLIES

- A. Ducts: Galvanized steel, unless otherwise indicated. Provide sheet metal in thickness indicated (minimum 26 gauge), packaged and marked as specified in ASTM A700.
- B. Supply Air Ducts (constant volume or single zone VAV systems): 3 inches w.g pressure class, galvanized steel.
- C. Primary Supply Air Ducts (upstream of terminal boxes in multizone VAV systems): 4 inches water gauge.
- D. Secondary Supply Air Ducts (downstream of terminal boxes in multizone VAV systems): 2 inches water gauge
- E. Return and Relief: 2 inch w.g. pressure class, galvanized steel.
- F. General Exhaust: 2 inch w.g. pressure class, galvanized steel.
- G. Smoke Control Exhaust and Makeup Ducts: 3 inch w.g. pressure class, galvanized steel.
- H. Wet Area Exhaust Ducts, where noted on the drawings:
  - 1. Type 304, stainless steel, minimum 24 gauge. Provide continuously welded seams on top or sides of duct and flanged joints with watertight EPDM gaskets.
  - 2. Aluminum, minimum 24 gauge, with longitudinal seams and laps arranged on top of duct. Seal joints with silicone sealant to provide watertight joint.
- I. Type II (Cooking) Hood Exhaust Duct: 2 inch w.g. pressure class, rigid metallic material complying with SMACNA and Mechanical code.
  - 1. Galvanized Steel.
  - 2. Stainless Steel.
  - 3. Aluminum.

4. Seal ducts with welds, gaskets, mastics, liquid sealants or tapes.
- J. Dishwasher Hood Exhaust Ducts: 2 inch w.g. pressure class.
1. Type 304, stainless steel, minimum 18 gauge, with finish to match kitchen equipment and range hood. Provide continuously welded seams on top or sides of duct and flanged joints with watertight EPDM gaskets.
  2. Aluminum, with longitudinal seams and laps arranged on top of duct. Seal joints with silicone sealant to provide watertight joint.
- K. Type I (Grease) Hood Exhaust Ducts: 2 inch w.g. pressure class, comply with NFPA 96.
1. Concealed: Carbon-steel sheet, minimum 16 gauge.
  2. Exposed:
    - a. Interior to the Building: Type 304, stainless steel, minimum 18 gauge, with finish to match kitchen equipment and range hood.
    - b. Exterior to the Building:
      - 1) Type 304, stainless steel, minimum 18 gauge.
      - 2) Carbon-steel sheet, minimum 16 gauge, coated with an exterior rated, high temperature corrosion resistant paint.
  3. Weld and flange seams and joints.
  4. At Contractor's option, a UL listed concentric ductwork package may be used in lieu of the welded carbon or stainless steel duct for connecting hood to exhaust fan. Provide manufacturers UL listing number and verification certificate as a part of the shop drawing submittal. Install duct package in strict conformance with manufacturer's instructions and recommendations.
- L. Dryer Vent Ducts: 2 inch w.g. pressure class, rigid, smooth wall, aluminum or stainless steel duct, minimum 26 gauge.
- M. Outside Air Intake: 2 inch w.g. pressure class, galvanized steel.
- N. Combustion Air: 2 inch w.g. pressure class, galvanized steel, aluminum or stainless steel.
- O. Transfer Air and Sound Boots: 1/2 inch wg pressure class, galvanized steel.
- P. Natatorium, Hydrotherapy, Swimming Pool or Pool Equipment Ductwork: 2 inch w.g. pressure class.
1. Aboveground: Minimum 22 gauge aluminum sheet material.
  2. Underground: Polyvinyl Chloride up to 24" in diameter or fiber reinforced plastic (FRP). Refer to Section "Nonmetal Ducts".
- Q. Exterior Ductwork: Ductwork installed exterior to the building without weather-proof jacket or cladding shall be minimum #18 gauge with longitudinal and transverse joints welded or sealed airtight as specified under Paragraph "Seam and Joint Sealing".
- R. Duct Liner Application: Provide duct liner on the following interior air ducts and where specified on the drawings.
1. Supply Ductwork:
    - a. Exposed to public view rectangular ductwork.
    - b. Exposed to public view round ductwork.
    - c. First 15 feet of ductwork downstream of equipment outlets.
  2. Return Ductwork.
    - a. Exposed to public rectangular ductwork.
    - b. Exposed to public round ductwork.
    - c. Return air transfer ductwork and boots.

## 2.2 MATERIALS

- A. Sheet Metal, General: Provide sheet metal in thickness indicated (minimum 26 gauge), packaged and marked as specified in ASTM A 700.

- B. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, lock-forming quality with G90/Z275 coating.. Provide mill phosphatized or galvanized finish for surfaces of ducts exposed to view that is to be field painted. Provide bright galvanized finish for ductwork that is exposed to view and not field painted.
- C. Carbon Steel for Ducts: ASTM A1008/A1008M, Designation CS (commercial steel), cold-rolled, with oiled, exposed matte finish.
- D. Aluminum for Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength, with standard, one-side bright finish where ducts are exposed to view, and mill finish for concealed ducts.
- E. Stainless Steel for Ducts: ASTM A 480, Type 316, with No. 4 finish on exposed surface for ducts exposed to view; Type 304, sheet form, with No. 1 finish for concealed ducts.
- F. PVC-Coated Galvanized Steel: UL-181 Class 1 Listing. Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, lock-forming quality with G90/Z275 coating. Provide with factory-applied, 4-mil, PVC coating on exterior of ducts and fittings for underground applications, and the interior of ducts and fittings for fume-handing applications and 2-mil PVC coating on the reverse side of the ducts and fittings.
- G. Duct Liner
  - 1. General:
    - a. Comply with NFPA Standard 90A and North American Insulation Manufacturers Association (NAIMA) Standard AHC-101.
    - b. Liner shall have a flame spread rating of not more than 25 without evidence of continued progressive combustion and a smoke developed rating of no higher than 50, when tested in accordance with ASTM E84 or UL 723.
    - c. Duct sizes on mechanical plans indicate clear inside airflow dimensions. Sheet metal sizes for ductwork with duct liner shall be increased accordingly to account for liner thickness.
  - 2. Fiberglass: ASTM C1071, Type I or II, glass fibers firmly bonded together with a thermosetting resin with surface exposed to airstream coated to prevent erosion of glass fibers. Liner surface shall serve as a barrier against infiltration of dust and dirt, shall meet ASTM C 1338 for fungi resistance and shall be cleanable using duct cleaning methods and equipment outlined by NAIMA Duct Cleaning Guide. Duct liner shall be rated for air velocity of 6,000 fpm.
    - a. Rectangular fiberglass duct liner shall be Certainteed ToughGard T, JohnsManville Linacoustic RC, Knauf Atmosphere, Owens Corning QuietR or approved equal.
      - 1) Thickness and Density:
        - a) 1 inch, 1-1/2 pounds per cubic foot.
    - b. Round fiberglass duct liner shall be Certainteed ToughGard UltraRound, JohnsManville Spiracoustic Plus, Owens Corning QuietZone Spiral, or approved equal.
      - 1) Thickness and Density:
        - a) 1 inch, 4 pound per cubic foot.
    - c. Thermal Performance: Meet minimum "K-Factor" equal to 0.28 (Btu·in/h·sq ft·F) or better, at a mean temperature of 75°F and rated in installed condition in accordance with ASTM C518 and/or ASTM C177.
    - d. Noise Reduction Coefficient (NRC): Meet the following minimum NRC in accordance with ASTM C423 Type A Mounting:
      - 1) 1 Inch Thick: NRC 0.65.
    - e. Liner Adhesive: Comply with NFPA Standard 90A /UL 181 classified with flame spread/smoke development less than 25/50 and ASTM C 916. Adhesive shall be a minimum 35% solid content, water-based, non-oxidizing and have a service temperature of -20 to 200 F. Water-based adhesive shall be one of the following:
      - 1) Design Polymerics DP 2502.
      - 2) Duro Dyne WIT.

- 3) Foster 85-60.
  - 4) Childers CP-127.
  - 5) Johns Manville SuperSeal.
  - 6) Hardcast Coil-Tack.
- f. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct.
- 1) Fastener Pin Length: As required for thickness of insulation, and without projecting more than 1/8 inch into the airstream.
  - 2) Adhesive For Attachment of Mechanical Fasteners: Comply with the "Fire Hazard Classification" of duct liner system.
- H. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
  2. Surface Burning Characteristics: Sealants shall be ASTM E84 or UL 723 listed with a flame spread index not more than 25 and a smoke-developed index not more than 50.
  3. For Use with Flexible Ducts: UL labeled.
  4. The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics. Duct tape shall not be used as a sealant on any ducts.
  5. Joint and Seam Tape: 2 inches wide, glass-fiber-reinforced fabric.
  6. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with the tape to form a hard, durable, airtight seal.
  7. Solvent-Based Joint and Seam Sealant: One-part, non-sag, solvent-release-curing, polymerized butyl sealant complying with FS TT-S-001657, Type I; formulated with a minimum of 65 percent solids. Approved products: Design Polymerics DP 1090, Duro Dyne SGD, Fosters 32-14, or approved equal.
  8. Water-Based Joint and Seam Sealant: Non-Fibrated, UL 181 listed, rated to minimum SMACNA Pressure Class of  $\square$ 10 inches w.g and SMACNA Seal Class A. Sealant shall have a minimum service temperature range of 20 to 200 F and be freeze/thaw stable through 5 cycles. Approved products: Childers CP-146, Design Polymerics DP 1010, Ductmate Proseal, Duro Dyne Duroseal EDS-RS, Fosters 32-18, Hardcast Iron-Grip 601, Red Devil D-Seal and United McGill United Duct Seal WB.
  9. Water-Based Joint and Seam Sealant: Fiber reinforced, UL 181 listed, rated to minimum SMACNA Pressure Class of  $\square$ 10 inches w.g and SMACNA Seal Class A. Sealant shall have a minimum service temperature range of 20 to 200 F and be freeze/thaw stable through 5 cycles. Approved products: Childers CP-146, Design Polymerics DP 1030, Ductmate Fiberseal, Duro Dyne Duroseal EDS-RF, Fosters 32-17, Hardcast CCWI-181, Red Devil F-Seal 181 or United McGill Uni-Mastic.
  10. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
  11. Flanged Gasket Tapes: Butyl gasket shall be UL 181 classified. Gasket size shall be minimum 5/8 inch x 3/16 inch and have nominal 100 percent solid content. It shall be non-oxidizing, non-skinning and have a service temperature of -25 to 180 F. Approved Products: Design Polymerics DP 1040, Ductmate 440, and Hardcast 1104.
- I. Fire Stopping
1. Fire-Resistant Sealant: Two-part, foamed-in-place, fire-stopping silicone sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
  2. Fire-Resistant Sealant: One-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical

assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

3. Products: Subject to compliance with requirements, provide one of the following:
    - a. "3M Fire Stop Foam"; 3M Corp.
    - b. "SPECSEAL Pensil 200 Silicone Foam"; Specify Technology, Inc.
    - c. 3M Fire Stop Sealant"; 3M Corp.
    - d. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
    - e. "Fyre Putty"; Standard Oil Engineered Materials Co.
    - f. "FS-ONE", Hilti, Inc.
- J. Hangers and Supports
1. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
  2. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
    - a. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
    - b. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
    - c. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
    - d. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
    - e. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
  3. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 4 inches thick.
  4. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.
    - a. Hangers Installed In Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
    - b. Straps and Rod Sizes: Conform with SMACNA HVAC Duct Construction Standards, 2005 Edition, for sheet steel width and gauge and steel rod diameters.
  5. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
  6. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36.
    - a. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.
    - b. For stainless steel ducts, provide stainless steel support materials.
    - c. For aluminum ducts, provide aluminum support materials, except where materials are electrolytically separated from ductwork.
  7. Pre-engineered roof duct supports:
    - a. Manufacturers:
      - 1) Cooper B-Line, Inc.
      - 2) Elite Components.
      - 3) ERICO/Caddy.
      - 4) Ferguson/FNW.
      - 5) Miro.
      - 6) PHD Manufacturing.
      - 7) PHP Systems/Design.
      - 8) Roof Top Blox.
      - 9) Unistrut, a brand of Atkore International Inc.
      - 10) Zsi Foster.
    - b. General: Pre-engineered devices with embedded duct support fixtures as specified.
    - c. Pedestals: Steel pedestals with thermoplastic or rubber base with the following dimensions:
      - 1) Up to 12 inch strut length support: 18 inch x 18 inch.
      - 2) Up to 16 inch strut length support: 24 inch x 18 inch.
      - 3) Up to 24 inch strut length support: 30 inch x 18 inch.
      - 4) Thickness: Minimum 3/16 inch thick.
    - d. Block Bases: Closed-cell polyethylene blocks with the following dimensions.
      - 1) Length: Nominal 10 inch, 12 inch, 16 inch, or 24 inch

- 2) Width: Nominal 4 inches.
- e. Attachment/Support Fixtures: As recommended by manufacturer, with straps or crossbar over top of duct to prevent movement.
- f. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- g. Pre-Engineered Duct Support Rails:
  - 1) Manufacturers:
    - a) AES Industries.
    - b) Custom Curb, Inc.
    - c) Pate Company.
    - d) Thybar.
  - 2) Construction:
    - a) Base plate designed to be attached to building structure, with fully mitered raised cant and step to match roof insulation thickness.
    - b) Welded, minimum 18 gauge galvanized steel shell, internally reinforced to load bearing factors of equipment being supported.
    - c) Factory installed treated wood nailer.
    - d) 4 inch, minimum 18 gauge nailer jacket with counterflashing where equipment will not fully cover the support.
- 8. Wire Rope Hanging Systems:
  - a. General: Wire rope hanger system shall have a minimum 5 to 1 safety factor based upon the applied working load being supported.
  - b. Source Limitations: Furnish associated fittings, accessories, and hardware produced by a single manufacturer.
  - c. Wire Rope: Zinc coated or galvanized steel, with wire thread type as required to support the applied working load being supported. Provide same size wire for all applications based on worst case loading.
  - d. Cable Lock: Cast zinc housing with steel spring with wedge grip, selected to meet the vertical load applied to the hanging system and wire thread. Do not exceed the working load limit.
  - e. Accessories: Hanger attachments and structural attachments shall be compatible with wire rope hanger system and shall be by the same manufacturer as the wire rope hanger system.
  - f. Manufacturers:
    - 1) ASC Engineered Solutions.
    - 2) Ductmate Industries, Inc; Clutcher Cable Hanging System.
    - 3) Duro Dyne.
    - 4) Gripple.
- K. Reinforcement Shapes and Plates: Unless otherwise indicated, provide galvanized steel reinforcing where installed on galvanized sheet metal ducts. For aluminum and stainless steel ducts provide reinforcing of compatible materials.
- L. Tie Rods: Same material as the duct, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

### 2.3 DUCTWORK FABRICATION

- A. Fabricate and support duct in accordance with latest edition of SMACNA (DCS).
- B. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
  - 1. Fabricate rectangular ductwork of minimum 26 gauge sheet metal.
  - 2. Fabricate ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
- C. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

- D. Field Painted Ductwork: Provide mill phosphatized finish on exposed surfaces of rectangular ductwork and duct fittings to be field painted.
- E. Exterior Ductwork: Ductwork installed exterior to the building without weather-proof jacket or cladding shall be minimum #18 gauge with longitudinal and transverse joints welded or sealed airtight as specified under Paragraph "Seam and Joint Sealing".
1. Lined Ductwork: Where exterior ductwork is specified on the drawings to be provided with interior lining for thermal or sound performance requirements, seal the longitudinal and transverse joints with sealant rated for exterior exposure.
- F. Cross breaking or Cross Beading: Cross break or bead duct sides that are 19 inches and larger and are 20 gauge or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 2-9, unless they are lined or are externally insulated.
- G. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 2005 Edition, Figures 4-1 through 4-8. Unless otherwise noted on drawings, provide prefabricated 45 degree, high efficiency, rectangular/round branch duct takeoff fittings with manual balancing damper, 3/8 inch square shaft, U-bolt, nylon bushings, locking quadrant, and 2 inch insulation build-out for branch duct connections and take-offs to individual diffusers, registers and grilles. 45 degree, high efficiency, rectangular/round branch duct takeoff fittings shall be Flexmaster STO with model BO3 damper or equal.
- H. Provide radius elbows, turns, and offsets with a minimum centerline radius of 1-1/2 times the duct width. Where space does not permit full radius elbows, provide short radius elbows with a minimum of two continuous splitter vanes. Vanes shall be the entire length of the bend. The use of square throat, radius heel elbows is prohibited. Remove and replace all installed elbows of this type with an approved elbow at no additional cost to the owner.
- I. Provide mitered elbows where space does not permit radius elbows, where shown on the drawings, or at the option of the contractor with the engineer's approval. The contractor shall obtain approval to substitute mitered elbows in lieu of radius elbows prior to fitting fabrication. Mitered elbows less than 45 degrees shall not require turning vanes. Mitered elbows 45-degrees and greater shall have single thickness turning vanes of same material and gauge as ductwork, rigidly fastened with guide strips in ductwork. Vanes for mitered elbows shall be provided in all supply and exhaust ductwork and in return and outside air ductwork that has an air velocity exceeding 1000 fpm. Do not install vanes in grease ductwork. Refer to Section "Ductwork Accessories" for turning vane construction and mounting.
- J. Provide full radius elbows for ductwork installed in noise critical spaces. Refer to Section "Basic Mechanical Materials and Methods" for noise critical spaces. Where space does not permit the installation of radius elbows, provide mitered elbows with sound attenuating, acoustical turning vanes. Refer to Section "Ductwork Accessories" for acoustical turning vanes.
- K. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- L. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.
- M. Round and Flat Oval Duct Fabrication
1. General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given sized of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet.
    - a. Fabricate round and flat oval ductwork of minimum 26 gauge sheet metal.

- N. Round Ducts: Fabricate round supply ducts using seam types identified in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 3-2, RL-1, RL-4, or RL-5 except where diameters exceed 72 inches. Seam Types RL-2 or RL-3 may be used for ducts smaller than 72 inches in diameter if spot-welded on 1-inch intervals. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams. Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Table 3-5 through 3-13 for galvanized steel gauges. For round duct with static pressure classification of 2 inches water gauge or lower, round supply ducts may be fabricated using snaplock seam types identified in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 3-2, RL-6A, RL-6B, RL-7 or RL-8.
- O. Flat Oval Ducts: Fabricate flat oval supply ducts with standard spiral lockseams (without intermediate ribs) or with butt-welded longitudinal seams in gauges listed in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Table 3-15.
- P. Round and Flat Oval Fittings Fabrication
1. 90-Degree Tees and Laterals and Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figures 3-5, 3-6 and 3-7 and with metal thickness specified for longitudinal seam straight duct.
  2. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.
  3. Elbows: Unless elbow construction type is indicated, provide elbows meeting the following requirements:
    - a. Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate the bend radius of die-formed, gored, and pleated elbows 1.5 times the elbow diameter.
      - 1) Elbows in Round Duct: Provide full radius elbows.
      - 2) Elbows in Flat Oval Duct: Provide full radius elbows. Where space limits the installation of full radius elbows, short radius elbows with a minimum of two continuous splitter vanes shall be installed. Vane length shall be the entire length of the bend or 36 inches whichever is greater.
      - 3) The use of square throat, radius heel elbows is prohibited. Remove and replace all installed elbows of this type with an approved elbow at no additional cost to the owner.
      - 4) Provide full radius elbows for ductwork installed in noise critical spaces or where shown on the drawings. Refer to Section "Basic Mechanical Materials and Methods" for noise critical spaces.
    - b. Mitered Elbows: Fabricate mitered elbows with welded construction in gauges specified below.
      - 1) Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Table 3-1.
      - 2) Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from minus 2 inches to plus 2 inches:
        - a) 3 to 26 inches: 24 gauge.
        - b) 27 to 36 inches: 22 gauge.
        - c) 37 to 50 inches: 20 gauge.
        - d) 52 to 60 inches: 18 gauge.
        - e) 62 to 84 inches: 16 gauge.
      - 3) Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from 2 inches to 10 inches:
        - a) 3 to 14 inches: 24 gauge.
        - b) 15 to 26 inches: 22 gauge.
        - c) 27 to 50 inches: 20 gauge.
        - d) 52 to 60 inches: 18 gauge.
        - e) 62 to 84 inches: 16 gauge.
      - 4) Flat Oval Mitered Elbows: Solid welded and with the same metal thickness as longitudinal seam flat oval duct.



- 5) 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material handling classes A and B; and only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with a single-thickness turning vane.
  - c. Round Elbows - 8 Inches and Smaller: Die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 3-1/2- and 4-1/2-inch) elbows with gored construction.
  - d. Round Elbows - 9 Through 14 Inches: Gored or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a mitered elbow. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 9-1/2- and 10-1/2-inch) elbows with gored construction.
  - e. Round Elbows - Larger Than 14 Inches and All Flat Oval Elbows: Gored elbows, except where space restrictions require a mitered elbow.
  - f. Die-Formed Elbows for Sizes Through 8 Inches and All Pressures: 20 gauge with 2-piece welded construction.
  - g. Round Gored Elbows Gauges: Same as for non-elbow fittings specified above.
  - h. Flat Oval Elbows Gauges: Same as longitudinal seam flat oval duct.
  - i. Pleated Elbows Sizes Through 14 Inches and Pressures Through 10 Inches: 26 gauge.
- Q. Shop Application of Liner in Rectangular Ducts
- 1. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.
  - 2. Apply a coat of adhesive to liner facing in direction of airflow not receiving metal nosing.
  - 3. Butt transverse joints without gaps and coat joint with adhesive.
  - 4. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.
  - 5. Longitudinal joints in rectangular ducts shall not occur except at corners of ducts, unless the size of the duct and standard liner product dimensions make longitudinal joints necessary.
    - a. Apply an adhesive coating on longitudinal seams in ducts exceeding 2,500 FPM air velocity.
  - 6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
  - 7. Secure transversely oriented liner edges facing the airstream with metal nosings that are either channel or "Z" profile or are integrally formed from the duct wall at the following locations:
    - a. Fan discharge.
    - b. Intervals of lined duct preceding unlined duct.
    - c. Upstream edges of transverse joints in ducts where duct velocity is greater than 2,500 FPM.
  - 8. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to the duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire damper sleeve through fire separation.

## 2.4 MANUFACTURED DUCTWORK AND FITTINGS

- A. General: At the Contractor's option, factory-manufactured ductwork can be provided instead of fabricated ductwork for round and oval ductwork. The round duct system shall consist of fittings that are factory fitted with a sealing gasket and spiral duct which, when installed according to the

manufacturer's instructions, will seal the duct joints without the use of duct sealer. The oval duct system shall be sealed with duct sealer as specified.

1. Ducts shall be calibrated to manufacturer's published dimensional tolerance standard.
2. All duct 14" diameter and larger shall be corrugated for added strength and rigidity.
3. Spiral seam slippage shall be prevented by means of a flat seam and a mechanically formed indentation evenly spaced along the spiral seam.
4. Ducts shall be constructed using spiral lock seam sheet metal construction.
5. Ductwork to be installed in exposed locations shall have the surface prepared in the factory for field painting.

B. Duct Construction

1. Unless otherwise noted, all duct and fittings shall be constructed from galvanized steel in accordance with SMACNA's Duct Construction Standards for +10" water gauge pressure with minimum wall thickness as shown in the following tables.
2. Duct shall be calibrated to manufacturer's published dimensional tolerance standard.
3. Ducts shall be constructed using spiral lock seam sheet metal construction.
4. Ductwork to be installed in exposed locations shall be factory-prepared for field painting, i.e. mill-phosphatized.

Single Wall Round Duct:

Diameter (Inches)	Galvanized Spiral Duct (ga)	Galvanized Fittings (ga)
3-14	28	24
15-24	26	24
26-42	24	22
42-60	22	20

Oval Duct:

Major Axis (Inches)	Galvanized Spiral Duct (ga)	Galvanized Fittings (ga)
3-24	24	20
25-38	22	20
37-48	22	18
49-60	20	18
61-70	20	16
71 and large	18	16

5. .

C. Fittings:

1. All fitting ends for round duct and transitions and divided flow fittings smaller than 24" diameter that convert oval duct to round duct shall come factory equipped with a double lipped, U-profile, EPDM rubber gasket. Gasket shall be manufactured to gauge and flexibility so as to ensure that system will meet all of the performance criteria set forth in the manufacturer's literature. Gasket shall be classified by Underwriter's Laboratories to conform to ASTM E84-91a and NFPA 90A flame spread and smoke developed ratings of 25/50.
2. All fittings shall be calibrated to manufacturer's published dimensional tolerance standard and associated spiral duct.
3. All fitting ends from 5" to 60" diameter shall have rolled over edges for added strength and rigidity.
4. All elbows from 5" to 12" diameter shall be 2 piece die stamped and continuously stitch welded. All elbows 14" diameter and larger shall be standing seam gorelock construction and internally sealed.

5. The radius of all 90° and 45° elbows shall be 1.5 times the elbow diameter, unless otherwise noted on the contract documents to be 1.0. The radius of all 15°, 30° and 60° elbows shall be minimum 1.0 times the elbow diameter.
  6. All fittings that are of either spot welded or button punched construction shall be internally sealed. When contract documents require divided flow fittings, only full body fittings will be accepted. The use of duct taps is unacceptable except for retrofit installations.
  7. All volume dampers shall be Lindab Safe type DRU, DSU or DTU or equal by an acceptable manufacturer. Damper shall be fitting sized to slip into spiral duct. Damper shall have the following features:
    - a. Locking quadrant with blade position indicator.
    - b. 2" sheet metal insulation stand-off.
    - c. Integral shaft/blade assembly.
    - d. Shaft mounted, load bearing bushings.
    - e. Gasketed shaft penetrations to minimize leakage.
- D. Manufacturers:
1. Hercules Industries.
  2. Hranec Corporation.
  3. Lewis & Lambert.
  4. Lindab Safe.
  5. Linx Industries, Inc.
  6. Semco.

## 2.5 CONCENTRIC DUCT FOR GREASE EXHAUST

- A. General: At Contractors option, in lieu of welded carbon or stainless steel grease exhaust duct, a pre-fabricated concentric duct package may be used subject to local code authority approval. Provide fire rating and clearance to combustibles listing as applicable for the installation.
- B. Code Compliance: Material and installation shall comply with UL 1978, UL 2221, ASTM E814, and NFPA 96. Zero clearance applications shall also comply with BOCA ER 96-37 or ICBO ER 5301 Zero Clearance to Combustibles Report.
- C. Product Description:
1. Grease duct shall be factory prefabricated, double wall type, listed for venting of grease laden air from Type 1 kitchen hoods serving commercial cooking appliances.
  2. Material and installation shall be rated for continuous operation at 500 F and intermittent operation at 2000 F.
  3. All grease duct system components shall be by manufacturer to maintain approval agency ratings including supports, guides, fittings, cleanouts, and expansion joints.
  4. Grease duct system shall meet ASTM E119 2-hour fire resistance rating and 3-hour fire engulfment rating and ASTM E814 3-hour Fire Stop Test.
  5. Grease duct system shall be SBCCI tested as an alternate to a 2-hour fire rated shaft and SBCCI classified as a 2-hour fire rated enclosure.
  6. The grease duct system shall be constructed of inner and outer walls with ceramic fiber insulation between the walls.
  7. The inner wall shall be constructed of stainless steel, minimum 0.035 inch thickness.
  8. The outer wall shall be constructed of aluminized steel or Type 430, Type 304, or 316 stainless steel, minimum 0.024 inch thickness. Provide aluminized steel if duct is exposed and will be field painted.
  9. The insulation shall be minimum 3-inch up to 24 inch duct diameter and 4-inch for greater than 24 inch duct diameter thickness soluble ceramic fiber.
  10. The grease duct assembly shall be rated for zero clearance to combustibles.
- D. Manufacturers:
1. Ampco.
  2. CaptiveAire

3. DuraVent Commercial.
4. Enervex.
5. Metal-Fab G.
6. Schebler Chimney Systems.
7. Security Chimneys.
8. Selkirk ZeroClear.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install products in accordance with manufacturer's instructions.
- C. Install ducts with the fewest possible joints.
- D. Seal duct joints with the appropriate sealing material.
- E. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.
- F. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
- G. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.
- J. Install insulated ducts with 1-inch clearance outside of insulation.
- K. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.
- L. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- M. Exposed Ductwork: Exposed ductwork shall be free of defects, dents or blemished surfaces to provide a smooth, finished appearance. Any damaged material shall be replaced with new material. Ductwork that is to be field painted shall have surfaces wiped clean of lubricant, dirt, or fil prior to priming and painting. Apply primer and paint of type as recommended by paint manufacturer for duct material and finish.
- N. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- O. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1-1/2 inches.
- P. Acoustical Barrier Penetrations: Where a duct passes through a wall, ceiling or floor slab of a noise critical space, provide a clear annular space of 1-inch between the duct and the structure. Refer to Section "Common Work Results for HVAC" for noise critical spaces. The Contractor shall check the clearance and, if clearance is acceptable, shall install the duct and pack the voids full depth with mineral fiber batt insulation. Contractor shall caulk both ends with a non-aging, non-hardening sealant backed by a polyethylene foam rod or permanently flexible firestop

material. Where there is insufficient clearance space, Contractor shall place a short stub duct in the wall, pack and caulk around it and then attach the inlet and outlet ducts to each end.

- Q. Cover ducts openings during construction with duct caps or three-mil plastic to protect inside of (installed and delivered) ductwork from exposure to dust, dirt, paint and moisture. Do not use duct tape on ducts that will be exposed or painted.
- R. Duct Liner Installation
1. Fiberglass Duct Liner:
    - a. Attach fiberglass duct liner using fasteners that do not damage the liner when applied as recommended by the manufacturer, that do not cause leakage in the duct, and will indefinitely sustain a 50-pound tensile dead load test perpendicular to the duct wall.
  2. Flexible Elastomeric Duct Liner:
    - a. Install liner in accordance with the manufacturer's installation instructions or ASTM C 1710.
    - b. Attach flexible elastomeric duct liner to clean, oil-free sheet metal surfaces with adhesive as recommended by the liner manufacturer.
    - c. Seal all longitudinal seams and end joints with manufacturer's recommended adhesive and install compression joints in accordance with manufacturer's instructions to eliminate any openings in insulation that would allow passage of air to duct surface being insulated.
- S. Kitchen Hood Exhaust
1. Provide for thermal expansion of ductwork through 2,000°F temperature range.
  2. Install without dips or traps that may collect residues, except where traps have continuous or automatic residue removal.
  3. Horizontal Ducts:
    - a. Provide at least one opening that is minimum size of 20 inches by 20 inches for personnel entry. Where an opening of this size is not possible, provide access openings at each change in direction and at 12-foot intervals. Locate openings on sides of duct 1-1/2 inches minimum from bottom, and fit with grease-tight covers of same material as duct. Support systems for ducts 24 inch and larger in any dimension shall be designed for the weight of the duct plus 800 pounds at any point in the duct system.
    - b. Slope horizontal ductwork serving a Type I hood back toward the hood or local grease reservoir a minimum of 1/4 inch per foot. Horizontal ducts that exceed 75 feet in length shall be sloped not less than 1 inch per foot.
  4. Vertical Ducts:
    - a. For ducts larger than 24 inches by 24 inches, provide a 20 inch by 20 inch access opening for personnel entry at the top of the vertical riser.
    - b. For ducts smaller than 24 inches by 24 inches, provide an access opening at each floor level in a location that is accessible and not higher than 12 feet above finished floor.
    - c. Supports for ducts large enough for personnel entry shall be designed for the weight of the duct plus 800 lbs at any point in the duct system.
  5. Provide transition at connection to fan with opening size equal to or greater than the venturi opening of the fan inlet. Provide gasket at flanged connection to fan rated for 1500 F and grease applications.
  6. Do not penetrate fire-rated assemblies without providing shaft, field-applied or factory-built enclosure.
- T. Dishwasher Exhaust Duct Installations
1. Install dishwasher exhaust duct systems in accordance with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 10-2.
  2. Slope horizontal ductwork back towards dishwasher hood a minimum of 1/4" per foot. Where distance does not allow continuous slope in ductwork, provide low point drains with the following:

- a. Drip leg with 3/4 inch plenum rated drain tubing routed to discharge at code approved location.
  - b. Pigtail trap or U-trap sized for system pressure.
- U. Dryer Vent Ducts
  1. Install dryer vent exhaust ducts in accordance with dryer manufacturer's installation instructions.
  2. Install dryer vent ducts without kinks. Install duct joints with overlap, with the male end extending in the direction of airflow. Make connections with metal clamps adjustable using phillips/hex head screws. Do not penetrate duct with sheet metal screws.
  3. Connect individual dryer vents into main header using lateral, 45 degree tees to minimize pressure drop.
  4. Install vertical risers with a means for cleanout.
  5. Install a backdraft damper at termination of the dryer vent duct.
- V. Natatorium, Hydrotherapy, Swimming Pool, Pool Equipment Ductwork
  1. Seal above ground ductwork with silicone sealant to provide watertight joint.
  2. Slope above ground horizontal exhaust ductwork down towards air devices at a minimum of 1/4 inch per foot. Where distance does not allow continuous slope in ductwork, provide low point drains with the following:
    - a. Drip leg with 3/4 inch plenum rated drain tubing routed to discharge at code approved location.
    - b. Pigtail trap or U-trap sized for system pressure.
- W. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- X. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- Y. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
- Z. Seam and Joint Sealing
  1. General: Seal duct seams and joints as follows:
    - a. All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed to meet SMACNA Seal Class A.
    - b. Seal class shall apply to all supply, return, outdoor air, and exhaust ductwork, regardless if the duct is positively or negatively pressurized. Transfer air ducts and sound boots do not need to be sealed.
  2. Seal externally insulated ducts prior to insulation installation.
  3. Ductwork installed exterior to the building without weather-proof jacket or cladding shall have longitudinal and transverse joints welded or sealed airtight with weatherproof heavy liquid sealant applied according to manufacturer's instructions.
    - a. Lined Ductwork: Where exterior ductwork is specified on the drawings to be provided with interior lining for thermal or sound performance requirements, seal the longitudinal and transverse joints with sealant rated for exterior exposure.
    - b. Duct Sealing:
      - 1) Seal air distribution system from the inside using automated aerosolized sealant injection.
      - 2) Repair all injection and test holes in existing ductwork sealed tight as per SMACNA standards.
- AA. Hanging and Supporting
  1. Install rigid round, rectangular, and flat oval metal duct with support systems per SMACNA standards.

2. The use of wire rope hanging systems is an acceptable alternate hanging method when installed in strict accordance with manufacturer's instructions. Wire rope hanger spacing shall not exceed 8 feet. Supported load shall not exceed manufacturer's recommended load rating.
    - a. Where approved by local code authority, the loop system may be swaged directly on to a seismic approved bracket or appropriate end fixing.
  3. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
  4. Support vertical ducts at a maximum interval of 16 feet and at each floor.
  5. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated. Hangers and supports shall be fastened to building joists or beams. Do not attach hangers and supports to the above floor slab or roof with sheet metal screws.
  6. Install concrete insert prior to placing concrete.
  7. Install powder actuated concrete fasteners after concrete is placed and completely cured.
  8. Provide double nuts and lock washers on threaded rod supports.
  9. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  10. Installation of Pre-Engineered Roof Duct Supports:
    - a. Install pre-engineered roof duct supports to rest on the roofing membrane without attachment to the roof structure or penetration through the roofing assembly.
    - b. Install pre-engineered roof duct supports anchored to the roof structure.
      - 1) Install supports to meet the specified design criteria.
        - a) Building Design Risk Category: III.
        - b) Design Wind Speed: 169mph.
      - 2) Coordinate with the pre-engineered roof duct support manufacturer to anchor the duct supports directly to the roof structure in accordance with the manufacturer's installation instructions or provide intermediate duct supports engineered to meet the design criteria.
      - 3) Submit design and installation requirements as a Deferred Submittal.
      - 4) Pre-Engineered Duct Support Rails: Provide rigid backing material (e.g., insulation, wood, etc.) to maintain cant slope. Install supports to maintain continuous insulation on roof.
- BB. Penetrations
1. Fire Barrier Penetrations: Where ducts pass through fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity.
  2. Exterior Wall Penetrations: Seal duct penetrations through exterior wall constructions with sleeves, packing, and sealant. Refer to Division 23 Section "Basic Piping Materials and Methods" for additional information.
  3. Underground Exterior Wall Penetrations: Seal duct penetrations through underground exterior walls with sleeves, packing, and sealant. Refer to Division 23 Section "Basic Piping Materials and Methods" for additional information.
  4. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of No-Fire Rated Walls and Concrete Slab on Grade Penetrations: Seal ducts that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 23 Section "Basic Piping Materials and Methods" for special sealers and materials.
- CC. Connections
1. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 23 Section "Air Duct Accessories."
  2. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards".
  3. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards". Where a 90-degree elbow is required at the connection to air devices, provide

a rigid duct elbow or, at Contractor's option, a flexible elbow assembly as specified in Division 23 Section "Air Duct Accessories."

4. Fan Connections: Comply with SMACNA "HVAC Duct Construction Standards".

### 3.2 FIELD QUALITY CONTROL

- A. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage.
- B. General Duct Systems: Perform leakage tests on the duct systems listed below in accordance with ASHRAE and SMACNA standards.
  1. Disassemble, reassemble, and seal segments of the systems as required to accommodate leakage testing, and as required for compliance with test requirements.
  2. Conduct tests at static pressures equal to the maximum design pressure of the system or the section being tested. If pressure classifications are not indicated, test entire system at the maximum system design pressure. Do not pressurize systems above the maximum design operating pressure. Give 7 days' advanced notice for testing. Submit a letter report to the Owner and Engineer summarizing the test procedures followed, systems tested and the results of the leakage tests.
  3. Determine leakage from entire system or section of the system by relating leakage to the surface area of the test section.
  4. Maximum Allowable Leakage: As described in ASHRAE 2005 Handbook, "Fundamentals" Volume, Chapter 35, Table 9 and Figure 13. Comply with requirements for leakage classification 3 for round and flat oval ducts, leakage classification 12 for rectangular ducts in pressure classifications less than and equal to 2 inches water gauge (both positive and negative pressures), and leakage classification 6 for pressure classifications greater than 2 inches water gauge and less than and equal to 10 inches water gauge.
  5. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage.
  6. Leakage Test: Perform volumetric measurements and adjust air systems as described in Testing, Adjusting and Balancing chapter of ASHRAE "HVAC Applications" Volume, Duct Design chapter of ASHRAE "Fundamentals" Volume, and Division 23 Section "Testing, Adjusting and Balancing for HVAC."
- C. Ductwork with Pressure Rating > 3" W.C.: Ducts and plenums shall be leak tested in accordance with SMACNA HVAC Air Duct Leakage Test Manual to prove they meet leakage classification less than or equal to 6. Submit test reports to the Engineer of Record demonstrating that at least 25 percent of the installed duct area has been tested and pass this test.
- D. Grease Duct Leakage Test: All portions of grease duct systems shall be tested for leakage in accordance with Chapter 5, Section 506 of the locally adopted IMC. Leakage tests shall be by light or other equivalent test methods as approved by the local code official to verify that all joints are liquid tight. Tests shall be performed in the presence of the local code official. Any joints found defective shall be repaired and retested until satisfactory results are obtained. The contractor shall submit a copy of the grease duct leakage test report to the Architect and Engineer complete with the approval signature of the local code official.
- E. Smoke Control Duct Leakage Test: All portions of smoke control duct systems shall be tested for leakage in accordance with Chapter 5, Section 513 of the locally adopted IMC. Ducts shall be leak tested to 1.5 times the maximum design pressure. Measured leakage shall not exceed 5 percent of design air flow. Test shall be as approved by the local code official to verify that all joints are liquid tight. Tests shall be performed in the presence of the local code official. Any joints found defective shall be repaired and retested until satisfactory results are obtained. The contractor shall submit a copy of the smoke control duct leakage test report to the Architect and Engineer complete with the approval signature of the local code official.



**3.3 ADJUSTING STARTUP**

- A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 23 Section "Testing, Adjusting and Balancing for HVAC" for requirements and procedures for adjusting and balancing air systems.
- B. Remove temporary protection devices over ductwork prior to starting equipment and turning the system over to the owner.
- C. If permanent HVAC equipment is used during the construction period, provide temporary filters at all openings in the ductwork and at inside equipment to protect the system from dust, dirt, paint, and moisture. Replace and maintain filters when needed, but not less than every month. On the day of substantial completion, clean the duct system and provide a new set of filters in the HVAC unit.
  - 1. Refer to Division 23 Section "Particulate Air Filtration" for filter requirements.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 23 33 00 - AIR DUCT ACCESSORIES****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Turning vanes.
- B. Backdraft dampers.
- C. Combination fire and smoke dampers.
- D. Duct access doors.
- E. Duct hardware.
- F. Fire dampers.
- G. Flexible duct connectors.
- H. Smoke dampers.
- I. Volume control dampers.
- J. Duct opening closure film.
- K. Cable operated damper systems.
- L. Fire rated duct wrap.
- M. Flexible ductwork.
- N. Flexible elbow assembly.
- O. Duct silencers.

**1.2 SUBMITTALS**

- A. Product Data: Provide for each type of ductwork accessory the following:
  - 1. Electrical characteristics.
  - 2. Connection requirements.
  - 3. Dimensions.
  - 4. Capacities.
  - 5. Pressure drops,
  - 6. Leakage rates.
  - 7. Materials of construction.
- B. Shop Drawings: Indicate for shop fabricated assemblies the following:
  - 1. Interfacing requirements with ductwork.
  - 2. Method of fastening or support.
  - 3. Methods of assembly of components.
- C. Performance Data: Submit performance data for duct silencers including insertion loss performance in octave bands from 63 Hz to 8,000 Hz and pressure drop at specified airflow.
- D. Project Record Drawings: Record actual locations of access doors and test holes.
- E. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual.

**1.3 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. SMACNA Compliance: Comply with applicable portions of SMACNA (DCS) "HVAC Duct Construction Standards Metal and Flexible".
- C. UL Compliance:
  - 1. Fire Dampers: Construct, test, and label fire dampers in accordance with current edition of UL Standard 555 Standard for Fire Dampers.
  - 2. Smoke Dampers: Construct, test, and label smoke dampers in accordance with current edition of UL Standard 555S Standard for Smoke Dampers.
  - 3. Flexible Ductwork: Construct flexible ductwork in compliance with UL Standard 181 Factory-Made Air Ducts and Connections.
  - 4. Duct Tape: Label in accordance with UL Standard 181B and marked 181B-FX.
  - 5. Duct Clamps: Label in accordance with UL Standard 181B and marked 181B-C.
  - 6. Fire Rated Duct Wrap: Meet the fire protection requirements defined by UL Standard 1479 Fire Tests of Through-Penetration Firestops.
  - 7. Grease Exhaust Duct Wrap: Meet the fire protection requirements defined by UL Standard 1479 Fire Tests of Through-Penetration Firestops.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated
- E. NFPA Compliance:
  - 1. Comply with applicable provisions of NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems and NFPA 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems pertaining to installation of ductwork accessories.
  - 2. Comply with NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations for fire-rated grease exhaust ducts.
- F. ASTM Compliance: Products shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 "Standard Test Method for Surface Burning Characteristics of Building Materials" (NFPA 255) method.
  - 1. Duct silencers shall be tested for performance in accordance with ASTM E477 "Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers."
  - 2. Grease exhaust duct wrap shall be tested for performance in accordance with ASTM E 2336 "Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems" and ASTM E814 "Standard Test Methods of Fire Resistance of Through-Penetration Fire Stops".
  - 3. Fire rated duct wrap shall be tested in accordance with ASTM E814 "Standard Test Methods of Fire Resistance of Through-Penetration Fire Stops".

**1.4 DELIVERY STORAGE AND HANDLING**

- A. Protect ductwork accessories during shipping and storage from dirt, debris and moisture damage.
- B. Protect dampers from damage to operating linkages and blades.

**1.5 SPARE PARTS**

- A. Extra Fusible Links: One link for every 10 installed of each type, size and temperature range. Obtain receipt.

**PART 2 - PRODUCTS****2.1 TURNING VANES**

- A. Manufacturer:
1. Aero Dyne Co.
  2. Anemostat Products Div.; Dynamics Corp. of America.
  3. Ductmate Industries.
  4. Duro Dyne Corp.
  5. Elgen Manufacturing Co., Inc.
  6. Hart & Cooley Mfg. Co.
  7. Register & Grille Mfg. Co., Inc
  8. Sheet Metal Connectors, Inc.
- B. Manufactured Turning Vanes: Provide turning vanes and runners fabricated from galvanized sheet metal, lock-forming quality, ASTM A 653, minimum Coating Designation G 60, of the same gauge thickness or greater as the ductwork in which they are installed.
1. Vanes shall be rigidly fastened with guide strips to minimize noise and vibration.
  2. Vanes in ductwork over 30" deep shall be installed in multiple sections with vanes not over 30" long and shall be rigidly fastened.
  3. Turning vanes shall be constructed per SMACNA Duct Construction Standards Metal and Flexible – 2005 Edition, Figure 4-3 and set into side strips suitable for mounting in ductwork.
- C. Acoustical Turning Vanes: Provide acoustical turning vanes constructed of airfoil shaped aluminum extrusion with perforated faces and fiberglass fill in systems serving noise critical spaces. Refer to Section "Common Work Results for HVAC" for noise critical spaces.

**2.2 BACKDRAFT DAMPERS**

- A. Manufacturers:
1. Air Balance, Inc.
  2. Arrow United Industries.
  3. Cesco
  4. Greenheck
  5. Louvers & Dampers, Inc.
  6. Nailor Industries, Inc.
  7. Pottorff
  8. Ruskin Mfg. Co.
  9. TAMCO
  10. Vent Products
- B. Backdraft Dampers: Provide dampers with parallel blades, counterbalanced and factory-set to open at indicated static pressure. Provide adjustment device to permit setting for varying differential static pressure
1. Construct frames of minimum 16 gauge galvanized steel or 10 gauge aluminum.
  2. Construct blades of minimum 16 gauge aluminum.
  3. Provide minimum 1/2" diameter, corrosion-resistant bearings and 1/2" diameter, galvanized or stainless steel axles.
  4. Mechanically lock blade edge seals into blade edge. Provide neoprene seals for round dampers and silicone or vinyl seals for rectangular dampers.

**2.3 COMBINATION FIRE AND SMOKE DAMPERS**

- A. Manufacturers:
1. Air Balance, Inc.
  2. Cesco Products.
  3. Greenheck

4. Louvers & Dampers, Inc.
  5. Nailor Industries, Inc.
  6. Pottorff
  7. Prefco Products, Inc.
  8. Ruskin Mfg. Co.
- B. General: Provide combination fire and smoke dampers at locations indicated on the drawings. Damper ratings shall be as required to maintain the fire and/or smoke ratings noted on the architectural drawings. Provide duct access door for inspection and service to each fire and smoke damper and fusible link as required. Provide sleeves of length as required to meet the installed location. Damper assemblies shall be provided as a single unit from the manufacturer.
- C. Fabricate dampers in accordance with NFPA 90A, UL555 (current edition) classified fire damper of rating required for location installed, UL555S (current edition) classified smoke damper for leakage class II and rated for dual directional airflow.
- D. Fire/smoke dampers shall be rated for closure in ducts up to minimum velocity of 2,000 fpm and static pressure of 4" w.g.
- E. Multiple Blade Dampers:
1. Frame: Minimum 16-ga galvanized steel. Construct casings of 16 gauge stainless steel where installed in corrosive or moisture laden airstreams or where noted on the drawings.
  2. Blades: Minimum 22 gauge thickness with airfoil or longitudinal grooved shape for airflow velocities up to 2,000 fpm and airfoil shape for airflow velocities greater than 2,000 fpm.
  3. Bearings: Self-lubricating, turning in extruded hole in the frame.
  4. Linkage: Plated steel axles, linkage concealed in frame, 1/2" actuator shaft.
  5. Seals: Flexible, stainless steel jamb seals, silicone rubber blade seals with galvanized steel mechanical locked in to the blade edge and stainless steel spring loaded leakage seals in sides of casing. Provide stainless steel spring loaded leakage seals in sides of casing, and the following additional features:
    - a. Open-closed indication switch.
    - b. Temperature Limited Override.
    - c. Test Switch.
    - d. .
- F. Operators:
1. UL listed and labeled.
  2. Spring return open/fail closed operation.
  3. Two-position or modulating as required for the installation.
  4. Electric type suitable for 120 Volts, single phase, 60 Hz.
  5. Factory installed on dampers.
  6. All operators shall open in between 7 and 15 seconds and close in between 7 and 15 seconds after alarm or smoke detection has occurred.
  7. Rated for a minimum of 20,000 cycles of operation.
  8. Provide automatic reset of damper upon cessation of detector (test or actual smoke detection), and normalization of duct air temperature.
- G. Electro Thermal Link: Provide resettable temperature device rated at 160 to 165 degrees F (71 to 74 degrees C) unless otherwise indicated.
- H. Smoke Activation:
1. Provide terminal block for connection to the building fire alarm system.
- I. Accessories:
- a. Open-closed indication switch.
  - b. Temperature Limited Override.
  - c. Test Switch.
  - d. Integral end switch.

**2.4 DUCT ACCESS DOORS**

- A. Manufacturers:
1. Air Balance Inc.
  2. Ductmate Industries.
  3. Duro Dyne Corp.
  4. Greenheck.
  5. Register & Grille Mfg. Co., Inc.
  6. Ruskin Mfg. Co.
  7. Ventifabrics, Inc.
  8. Vent Products.
  9. Zurn Industries, Inc.; Air Systems Div.
- B. Provide, where indicated on the drawings or where specified in Part 3 of this section, duct access doors of size allowable by duct dimensions with, unless otherwise noted on the drawings, minimum size of 10" by 10" and maximum size of 24" by 24". Fabricate in accordance with SMACNA (DCS) and as indicated. Label access doors for fire and smoke dampers as specified in Part 3.
- C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. Construct of same or greater gauge as ductwork served. For insulated ductwork, install minimum 1 inch thick insulation with sheet metal cover. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct.
1. 12 inches square or less: Provide one size hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors. Provide removable section of duct where duct size is too small for a 10" by 10" access door.
  2. Larger than 12 inches square: Provide two hinges and two handle-type latches.

**2.5 DUCT HARDWARE**

- A. Manufacturers:
1. Ductmate Industries.
  2. Elgen Manufacturing Co., Inc.
  3. Ventfabrics, Inc.
  4. Young Regulator Co.
- B. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated.
1. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
  2. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.
- C. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

**2.6 FIRE DAMPERS**

- A. Manufacturers:
1. Air Balance, Inc.
  2. Cesco Products.
  3. Greenheck
  4. Louvers & Dampers, Inc.
  5. Nailor Industries, Inc.
  6. Pottorff
  7. Prefco Products, Inc.
  8. Ruskin Mfg. Co.

- B. General: Provide fire dampers at locations indicated on the drawings. Damper ratings shall be as required to maintain the fire ratings noted on the architectural drawings. Provide duct access door for inspection and service to each fire damper and fusible link as required. Provide sleeves of length as required to meet the installed location.
- C. Fabricate in accordance with NFPA 90A and UL 555 and as indicated.
- D. Fire dampers shall be dynamic-rated for closure under pressure.
- E. Provide positive lock in closed position.
- F. Ceiling Radiation Dampers
  - 1. General: Conform to UL 555C or tested in accordance with UL 263.
  - 2. Casing: Galvanized steel frame in gauges as required to maintain applicable UL classification.
  - 3. Damper Blades: Galvanized steel with UL classified thermal insulation as required to meet UL criteria and fire and smoke ratings noted on the architectural drawings.
  - 4. Fusible link: Integral to device, rated at 165 degrees F.
  - 5. Accessories: Provide as required for the installation:
    - a. Volume Controller: Manually adjustable volume controller integral to the assembly used to regulate airflow through the damper for testing and balancing.
    - b. Boot Fitting: Factory provided elbow, end or straight type. Include field provided collar, flanged recess, or ceramic thermal blanket.
    - c. Box Fitting: Factory provided 26 gauge with field provided collar, flanged recess, or ceramic thermal blanket.
- G. Horizontal Dampers: Minimum 22 gauge galvanized steel frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket. Construct casings of 20 gauge stainless steel where installed in corrosive or moisture laden airstreams or where noted on the drawings.
- H. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream. Construct frames of 20-gauge stainless steel where installed in corrosive or moisture laden airstreams or where noted on the drawings.
- I. Multiple Blade Dampers: Minimum 16 gauge, galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock. Construct frames of 20-gauge stainless steel where installed in corrosive or moisture laden airstreams or where noted on the drawings
- J. Fusible links: UL 33 rated at 160 to 165 degrees F unless otherwise indicated.
- K. Accessories:
  - 1. Open-closed indication switch.

## 2.7 FLEXIBLE DUCT CONNECTORS

- A. Manufacturers:
  - 1. Carlisle HVAC Products.
  - 2. Ductmate Industries.
  - 3. Duro Dyne Corp.
  - 4. Elgen Manufacturing Co., Inc.
  - 5. Ventfabrics, Inc.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated. Flexible connectors shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.



- C. Flexible Duct Connections: Fabric crimped into metal edging strip. Provide metal compatible with connected ducts. Factory fabricated. Flame-retardant or noncombustible fabrics compliant with NFPA 701.
  - 1. Indoor Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric compliant with NFPA 90A.
    - a. Minimum Weight: 26 oz./sq. yd.
    - b. Minimum Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
    - c. Service Temperature: Minus 40 to plus 200 deg F.
  - 2. Outdoor Fabric: UL listed fire-retardant woven glass fiber fabric coated with weatherproof, synthetic rubber resistant to UV rays and ozone compliant with NFPA 90A.
    - a. Minimum Weight: 24 oz./sq. yd.
    - b. Minimum Tensile Strength: 225 lbf/inch in the warp and 300 lbf/inch in the filling.
    - c. Service Temperature: Minus 40 to plus 250 deg F.
  - 3. Metal: Factory fabricated with a fabric strip minimum 3-1/2 inches wide attached to two strips of minimum 24 gauge galvanized sheet steel or 0.032-inch- thick aluminum.
- D. Maximum Installed Length: 14 inch.
- E. Coatings and Adhesives: Comply with UL 181, Class 1.

## 2.8 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide fire and smoke dampers of one of the following:
  - 1. Air Balance, Inc.
  - 2. Cesco Products.
  - 3. Greenheck
  - 4. Louvers & Dampers, Inc.
  - 5. Nailor Industries, Inc.
  - 6. Pottorff
  - 7. Prefco Products, Inc.
  - 8. Ruskin Mfg. Co.
- B. General: Provide smoke dampers at locations indicated on the drawings. Damper ratings shall be as required to maintain the smoke ratings noted on the architectural drawings. Provide duct access door for inspection and service to each smoke damper as required. Provide sleeves of length as required to meet the installed location. Damper assemblies shall be provided as a single unit from the manufacturer.
- C. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.
- D. Dampers:
  - 1. UL555S (current edition) leakage class II, rated for dual directional airflow.
  - 2. Rated for a minimum velocity of 2,000 fpm and pressure of 4" w.g.
  - 3. Blades: Minimum 22 gauge thickness with airfoil or longitudinal grooved shape for airflow velocities up to 2,000 fpm and airfoil shape for airflow velocities greater than 2,000 fpm.
- E. Casings:
  - 1. Minimum 16-ga galvanized steel.
  - 2. Minimum 16 gauge stainless steel where installed in corrosive or moisture laden airstreams or where noted on the drawings.
- F. Bearings: Self-lubricating, turning in extruded hole in the frame.
- G. Seals:
  - 1. Jamb seals made of flexible, stainless steel.
  - 2. Blade edge seals: silicone rubber mechanically locked in to the blade edge.
  - 3. Stainless steel spring loaded leakage seals in sides of casing,
- H. Linkage: Concealed in the frame.

- I. Smoke Activation:
  - 1. Provide terminal block for connection to the building fire alarm system.
- J. Operators:
  - 1. UL listed and labeled.
  - 2. Spring return, fail closed.
  - 3. Electric type 120 Volts, single phase, 60 Hz.
  - 4. Factory installed on dampers.
  - 5. Designed to close and/or open damper between 7 and 15 seconds after alarm or smoke detection has occurred.
  - 6. Two-position or modulating as required for the installation.
  - 7. Rated for a minimum of 20,000 cycles of operation.
  - 8. Operator mounted outside or inside air stream.
  - 9. Automatic reset of damper upon cessation of detector (test or actual smoke detection), and normalization of duct air temperature.
- K. Accessories:
  - a. Blade Material: Match casing material.
  - b. Open closed indication switches.
  - c. Test switch.
  - d. Provide with integral end switch.

## 2.9 VOLUME CONTROL DAMPERS

- A. Manufacturers:
  - 1. Air Balance, Inc.
  - 2. Arrow United Industries
  - 3. Cesco
  - 4. Greenheck
  - 5. Louvers & Dampers, Inc.
  - 6. Nailor Industries, Inc.
  - 7. Pottorff
  - 8. Rossi Air Flow
  - 9. Ruskin Mfg. Co.
  - 10. TAMCO
  - 11. Vent Products
- B. Fabricate dampers in accordance with SMACNA (DCS) and as indicated. Construct using galvanized steel for standard air systems, aluminum for wet or natatorium environments and stainless steel for corrosive environments.
- C. Single Blade Dampers:
  - 1. Fabricate for duct sizes up to 12 x 36 inch.
  - 2. Blade: 20 gauge, 0.04 inch, minimum.
- D. Multi-Blade Damper: Fabricate of parallel or opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
  - 1. Blade: 18 gauge, 0.0478 inch, minimum.
- E. Bearings: Corrosion resistant, molded synthetic.
- F. Axles: Positively lock into the damper blade.
- G. Blade Seals: Where used for shutoff duty, provide Neoprene seals for round dampers and silicone for rectangular dampers.
- H. Quadrants:
  - 1. Provide locking, indicating quadrant regulators.

2. On insulated ducts, provide extended shafts and mount regulator on standoff bracket, base or adapter.
3. Where rod lengths exceed 48 inches, provide regulator at both ends.

#### **2.10 DUCT OPENING CLOSURE FILM**

- A. Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
- B. Thickness: 2 mils.
- C. High tack water-based adhesive.
- D. UV stable.
- E. Elongation Before Break: 325 percent, minimum.

#### **2.11 CABLE OPERATED DAMPER SYSTEMS**

- A. Manufacturer:
  1. DuroDyne, DuroZone.
  2. Metropolitan Air Technology, Inc. (Reference model number for round damper is RT-250 and for rectangular damper is RT-200).
  3. Young Regulator Co. (Reference model number is 270).
- B. General: Where access to dampers through a hard ceiling is required, provide a concealed, remote cable-operated, butterfly-type volume damper assembly with external worm gear operator.
- C. Damper assembly shall include duct casing with rolled bead stiffeners, reinforced blade, self-lubricating bearing, and remote operator mounting plate.
- D. Adjustable through the diffuser frame with standard 1/4 inch nut-driver or flat screwdriver.
- E. Cable assembly shall attach to damper as a single piece with no linkage adjustment required.
- F. Positive, direct, two-way damper control with no sleeves, springs or screw adjustments to come loose after installation.
- G. Cable length as required to span the distance from the damper to the remote operator location.
- H. Where approved by Architect, a ceiling cup with cover plate can be used for access to cable operator.

#### **2.12 FIRE RATED DUCT WRAP**

- A. Manufacturers:
  1. 3M.
  2. Pyroscat
  3. Thermal Ceramics
  4. Unifrax Corporation
- B. Grease Exhaust Ducts:
  1. Reference manufacturer and model number is Unifrax FyreWrap Elite 1.5.
  2. Minimum two-hour rated duct wrap insulation for Type I hood grease exhaust duct applications.
  3. Two layers of 1-1/2 inch thick.
  4. Density: Minimum 6 lb. per cubic foot.
  5. Zero clearance to combustibles.
  6. Flexible wrap enclosure rated for minimum 2000 F.
  7. Material: Non-mineral wool, passive, low bio-persistent fiber totally encapsulated with aluminum foil reinforced with scrim. UL Listed in accordance with ASTM E2336.

8. Attachments:
    - a. Ducts smaller than 24" by 24" in size, provide stainless steel bands at insulation seams and on maximum 12 inch centers to hold the outer layer of the blanket enclosure in place.
    - b. Ducts larger than 24" by 24" in size, provide pins to hold the outer layer in place.
  9. Insulation shall be tested for intended use in accordance with all applicable codes and shall be approved by the local code official.
  10. Provide factory-built access doors by same manufacturer as fabricated for use specifically with the insulation system.
- C. Dryer Vent Exhaust Ducts in Plenums:
1. Reference manufacturer and model number is Unifrax FyreWrap DPS.
  2. One-hour rated duct wrap insulation specifically designed as a means to separate dryer vent exhaust ducts from an air plenum by preventing flame propagation and smoke development in the plenum area.
  3. This system may be used as an alternative to a gypsum enclosure where allowed by the AHJ.
  4. 1-1/2 inch thick wrap.
  5. Density: Minimum 6 lb. per cubic foot.
  6. Zero clearance to combustibles.
  7. Flexible wrap enclosure rated for minimum 2000 F.
  8. Material: Non-mineral wool, passive, low bio-persistent fiber totally encapsulated on all sides with aluminum foil reinforced with scrim. UL Listed in accordance with ISO 6944 and UL 1479, and as acceptable to the Authority Having Jurisdiction.
- D. General for HVAC Ducts:
1. Reference Manufacturer and Model Number is Unifrax FyreWrap Elite 1.5.
  2. Provide duct wrap insulation for HVAC ducts required to be in rated enclosure construction where dampers are restricted.
  3. One, two or three hour-rating as required for the installation.
  4. 1-1/2 inch thick wrap.
  5. Density: Minimum 6 lb. per cubic foot.
  6. Zero clearance to combustibles.
  7. Flexible wrap enclosure rated for minimum 2000 F.
  8. Applied in one or more layers to achieve the hourly rating requirement.
  9. Material: Non-mineral wool, passive, low bio-persistent fiber totally encapsulated on all sides with aluminum foil reinforced with scrim. UL Listed in accordance with ISO 6944 and UL 1479, and as acceptable to the Authority Having Jurisdiction.
- E. Access Doors:
1. Manufacturer and/or model number:
    - a. Ductmate Ultimate.
    - b. FlameGard.
    - c. Thermal Ceramics FastDoor XL.
    - d. Or Equal.
  2. Duct access door to be tested and listed in accordance with UL1978.
  3. Gaskets: Liquid tight and minimum 1500F rated.
  4. Duct access to be provided with 2-hour and zero clearance insulation cover tested and UL Listed per ASTM E2336 by same manufacturer and as fabricated for use specifically with the insulation system.

## 2.13 FLEXIBLE DUCTWORK

- A. Manufacturers:
1. ATCO Rubber Products.
  2. Flexmaster.
  3. JPL (J.P. Lamborn Co)

4. Thermaflex.
- B. Construction: Provide flexible ductwork conforming to UL 181-Class I, NFPA 90A and NFPA 90B and as follows. Duct types of manufacturers are indicated for reference in regard to required quality of construction and materials.
- C. Insulated Flexible Ductwork: Provide duct fabric of ply-vinyl film, polyethylene film or multiple layers of aluminum laminate supported by helically wound spring steel wire. Wrap fabric with fiberglass insulation and provide fire retardant polyethylene or reinforced metalized protective vapor barrier as specified herein.
1. Duct pressure class up to and including 6" w.g.
    - a. Fire retardant polyethylene vapor barrier
      - 1) ATCO 80 Series
      - 2) Flexmaster Type 5B
      - 3) JPL Type PR Series
      - 4) Thermaflex Type G-KM
    - b. Reinforced metalized vapor barrier
      - 1) ATCO 30 Series
      - 2) Flexmaster Type 5M
      - 3) JPL Type MHP Series
      - 4) Thermaflex Type M-KE
  2. High pressure (duct pressure class over 6" w.g.)
    - a. Fire retardant polyethylene vapor barrier
      - 1) Flexmaster Type 3B
    - b. Reinforced metalized vapor barrier
      - 1) ATCO OmniAir 1200
      - 2) JPL Type FHP-25
      - 3) Flexmaster Type 3M
      - 4) Thermaflex Type M-KC
  3. Flexible ductwork shall have CPE liner with steel wire helix mechanically locked or permanently bonded to the liner.
  4. Provide acoustical, fiberglass insulated duct with minimum R-value of R-6.0.

#### **2.14 FLEXIBLE ELBOW ASSEMBLY**

- A. Manufacturers:
1. Build Right Products, FlexRight Elbow.
  2. Flexible Technologies, Inc., FlexFlow Elbow.
  3. Titus, FlexRight.
- B. General: At Contractors option, in lieu of rigid sheet metal elbows at connections to air inlets and outlets in concealed spaces, provide flexible elbow assembly to air devices requiring a 90 degree elbow connection.
- C. Flexible elbow assembly shall be constructed of durable composite material and UL listed for use in return air plenums with a turning radius of not less than 3 inches.

#### **2.15 DUCT SILENCERS**

- A. Manufacturer: Subject to compliance with requirements, provide duct silencers of one of the following:
1. BRD Noise and Vibration Control
  2. Commercial Acoustics, Div. of Metal Form Manufacturing
  3. Dynasonics
  4. Industrial Acoustics (IAC)
  5. Price Industries
  6. Ruskin Company

7. SEMCO Inc.
  8. United Sheet Metal
  9. VAW Systems Ltd.
  10. Vibro-Acoustics
- B. Description: Duct section with sheet metal outer casing, sound absorbing fill material, and inner casing of perforated sheet metal; incorporating interior baffles of similar construction. Fabricate in accordance with SMACNA (DCS).
- C. General Requirements:
1. Casing, sealants, adhesives, accessory materials, and packing materials to comply with ASTM E84.
  2. Airstream surfaces installed in a return air plenum to comply with requirements in ASHRAE Std 62.1.
  3. Factory-fabricated, field-installed products.
  4. Provide internal support rods at locations as required to provide uniform support and to prevent the fan airflow from twisting the internal core.
  5. Provide end connections compatible with the location being installed.
- D. Geometry: Provide the following geometries as specified on the drawings.
1. Circular straight with center bodies or pods.
  2. Circular elbows with splitters or baffles.
  3. Rectangular straight with splitters or baffles.
  4. Rectangular elbows with splitters or baffles.
  5. Specialty or custom geometry.
- E. Configuration:
1. Rectangular: Provide lined splitters with radiused nose and contour tails.
  2. Tubular: Provide inner casing and liner and the option specified below as required to meet the scheduled silencer on the drawings:
    - a. Without center body.
    - b. With absorptive aerodynamically shaped center body with nose cone and truncated tail cone.
    - c. With absorptive splitters with radiused nose and contoured tails.
- F. Materials:
1. Outer Casing: Minimum 22 gauge thick galvanized steel stiffened as required. Provide seams of the following:
    - a. Mastic filled lock formed.
    - b. Welded.
  2. Inner casing and splitters: Minimum 22 gauge thick perforated galvanized steel.
  3. Sound absorbing media: Media shall be incombustible, mildew resistant and vermin proof.
    - a. Acoustic quality, glass fiber insulation packed to minimum 5 percent compression.
    - b. Acoustic quality mineral wool.
  4. Fill Liner: Bonded glass fiber matting or mylar film designed to protect media from erosion.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION**

- A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

**3.2 INSTALLATION OF DUCTWORK ACCESSORIES**

- A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Provide turning vanes, of same gauge as ductwork, rigidly fastened with guide strips in ductwork having an offset of 45 degrees or more. Provide vanes in all supply and exhaust ductwork and in return and outside air ductwork that has an air velocity exceeding 1000 fpm. Do not install vanes in grease or dryer exhaust ductwork.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Provide combination fire and smoke dampers, fire dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction.
1. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
  2. Coordinate all smoke and fire/smoke damper installation, wiring, and checkout to ensure that the dampers function properly and that they respond to the proper fire alarm system signal.
  3. Install ceiling radiation dampers per manufacturer's instructions. Support damper assembly from structure.
  4. Demonstrate re-setting of fire and fire/smoke dampers to Owner's representative.
- E. Provide duct access doors to maintain and/or clean components internal to ductwork including, but not limited to, coils, airflow stations, motorized and backdraft dampers, humidifiers, etc, Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.
1. Provide duct access door(s) as scheduled below, at each fire and smoke damper within 12 inches of the device to allow for testing and maintenance. Label each door (with minimum 1" lettering) indicating which damper type is served. Door shall be capable of being fully opened or provide removable door.
 

DUCT ACCESS DOOR SCHEDULE		
Duct Width/Depth	Door Size	Quantity
10" TO 12"	10 X 10	1
14" TO 18"	12 X 12	1
20" TO 36"	14 X 14	1
38" TO 54"	18 X 18	1
56" TO 72"	18 X 18	2 (1 EACH END)
74" TO 96"	20 X 20	2 (1 EACH END)
  2. Provide duct access doors for cleaning kitchen exhaust ducts in accordance with NFPA 96. Review locations prior to fabrication.
- F. Provide flexible duct connections wherever ductwork connects to vibrating equipment and when transitioning between two different metallic duct materials (e.g., aluminum to galvanized steel). Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibration of connected equipment.
1. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
  2. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- G. Provide volume control dampers at branch takeoffs from main ducts. Unless otherwise noted on drawings, provide prefabricated 45 degree, high efficiency, rectangular/round branch duct takeoff fittings with manual volume control damper and locking quadrant for branch duct connections and take-offs to individual diffusers, registers and grilles.

- H. Install constant airflow regulators square and free from racking. Do not compress or stretch damper frame into duct or opening. Handle damper using frame or sleeve.
- I. Provide cable operated volume dampers with remote operators where access to dampers through a hard ceiling is required.
  - 1. Support cable assembly to avoid bends and kinks in cable.
- J. Install grease exhaust and fire rated duct wrap in accordance with manufacturer's instructions to provide the fire rating of the material as tested per UL requirements. Joints at insulation seams, banding, pins, and fire stop systems shall be installed as per manufacturers UL Listing and manufacturers published installation instructions. Overlap seams, install stainless steel bands and/or pins to secure wrap to duct and fill annular spaces in floor and wall penetrations with UL rated forming materials and/or putty to maintain the integrity of the system.
- K. Install flexible ductwork in accordance with manufacturer's instructions. At a minimum, install two wraps of duct tape around the inner core connection and a metallic or non-metallic clamp over the tape and two wraps of duct tape or a clamp over the outer jacket.
  - 1. Flexible ductwork runs shall not exceed 5 feet in length. Utilize the minimum length of duct to make the connections.
  - 2. Install flexible ductwork straight as possible avoiding tight turns with a maximum of one 90 degree bend in any length. Install flexible ductwork fully extended minimizing compression.
  - 3. Provide continuous length with no intermediate joints.
  - 4. Support flexible ductwork from structure and not from ceiling tile, light fixtures or air terminals. Support for maximum sag of 1/2-inch per foot.
  - 5. Avoid incidental contact with metal fixtures, water lines, pipes, or conduit.
  - 6. Support straps/saddles shall be minimum 1-1/4" wide. Use of wire hanging systems shall utilize strap and connect wire to strap.
    - a. Factory installed suspension systems are acceptable
  - 7. Do not crimp flexible ductwork against joist or truss members, pipes, conduits, etc.
  - 8. Install flexible ductwork with bend radius at the center line equal to or greater than one duct diameter.
    - a. Support bends approximately one duct diameter on both sides of bends.
  - 9. Connect flexible ductwork to sheet metal ductwork and air devices with at least 1" overlap.
- L. Provide rigid duct elbow or flexible elbow assembly where a 90 degree elbow is required at connection to air devices.
- M. Install duct silencers at locations indicated on the drawings with straight sections of upstream and downstream ductwork as recommended by the manufacturer.
  - 1. If the silencer is installed in a location exposed to water or weather, the fill shall be completely encapsulated in mylar bagging. The mylar bagging shall not degrade the acoustical performance of the silencer.
- N. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

### 3.3 FIELD QUALITY CONTROL

- A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.
- B. After start-up, final corrections and balancing of systems, test duct silencers by taking octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and other critical locations, as directed. Refer to Division 23 Section "Testing, Adjusting and Balancing of HVAC" for additional requirements.
  - 1. Provide one-third octave band measurements of artificial sound sources in areas indicated as having critical requirements.
  - 2. Submit complete report of test results including sound curves.



**3.4 ADJUSTING AND CLEANING**

- A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.
- B. Label access doors in accordance with Division-23 section "Identification for HVAC Piping and Equipment".
- C. Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting, and Balancing for HVAC".
- D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 23 34 23 - HVAC POWER VENTILATORS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Roof ventilators.
- B. Upblast roof exhausters.
- C. Roof intake fans.
- D. Inline centrifugal fans.
- E. Kitchen hood exhausters.
- F. Utility vent set.

**1.2 SUBMITTALS**

- A. General: Submit data in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements. Include the following:
  - 1. For fans with factory-furnished starters or variable frequency drives, include short circuit current ratings.
  - 2. Materials gages and finishes, including color charts.
  - 3. Dampers, including housings, linkages, and operators.
- C. Shop Drawings: Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.
- D. Wiring Diagrams: Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.
- E. Maintenance Data: Include instructions for lubrication, motor and drive replacement and spare parts list.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Fan Belts: One set for each individual fan.

**1.3 QUALITY ASSURANCE**

- A. AMCA Compliance: Provide products that meet AMCA certified performance and sound ratings and are licensed to use the AMCA Seal.
- B. UL Compliance: Fans and fan motors shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators."
- C. Kitchen Hood Exhaust Fans: Kitchen hood exhaust fans and components shall comply with requirements of UL 762 "Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances and NFPA 96 "Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations".
- D. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

- E. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- F. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

#### 1.4 DELIVERY STORAGE AND HANDLING

- A. Protect motors, shafts, and bearings from weather and construction dust.

#### 1.5 FIELD CONDITIONS

- A. Permanent fans may not be used for ventilation during construction.

### PART 2 - PRODUCTS AND MATERIALS

#### 2.1 POWER VENTILATORS - GENERAL

- A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished; with indicated capacities and characteristics.
- B. Statically and Dynamically Balanced: Fans and shafts shall be statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.
  - 1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.
- C. Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210 "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating".
- D. Sound Ratings: Comply with AMCA 301 "Certified Ratings Program Product Rating Manual for Fan Sound Performance". Test fans in accordance with AMCA Standard 300 "Reverberant Room Method for Sound Testing of Fans".
- E. Fabrication: Comply with AMCA 99.
- F. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
  - 1. Service Factor: 1.4.
- G. Belts: Oil-resistant, non-sparking, and non-static.
  - 1. Fans used for smoke control applications shall have 1.5 times the number of belts required for the design duty with a minimum of two belts.
- H. Motors: Refer to Section "Common Motor Requirements for HVAC Equipment" for requirements.
- I. Motor and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with motors larger than 15 HP. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions.
  - 1. Belt Guards: Provide steel belt guards for motors mounted on the outside of the fan cabinet.
- J. Hazardous Duty: Provide fans with spark resistant construction and explosion proof motor where specified in the schedule.
- K. Factory Finish: The following finishes are required:
  - 1. Sheet Metal Parts: Prime coating prior to final assembly.
  - 2. Exterior Surfaces: Baked-enamel finish coat after assembly.

**2.2 ROOF VENTILATORS**

- A. Manufacturers:
1. Accurex.
  2. Acme Engrg. & Mfg. Corp.
  3. CaptiveAire
  4. Carnes Company, Inc.
  5. Cook (Loren) Co.
  6. Greenheck Fan Corp.
  7. Hartzell Fan, Inc.
  8. PennBarry.
  9. Twin City Fan Company.
- B. Fan Unit: Belt-driven or direct-drive as indicated, centrifugal or axial fan, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
- D. Roof Curbs: Refer to Section "Hangers and Supports for HVAC" for pre-engineered roof equipment supports .
- E. Fan Wheel: Aluminum hub and wheel.
- F. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:
1. Pulleys: Cast-iron, adjustable-pitch.
  2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
  3. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
  4. For centrifugal fans, fan and motor shall be isolated from exhaust air stream.
- G. Accessories: Provide the following items as indicated:
1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
  2. Bird Screens: Maximum 1/2-inch mesh, 16-gage, aluminum or brass wire.
  3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base, fan set to close when fan stops.
  4. Dampers: Motor-operated, parallel-blade, volume control dampers mounted in curb base.
    - a. Blades: Die-formed sheet aluminum.
    - b. Frame: Extruded aluminum, with waterproof, felt blade seals.
    - c. Linkage: Nonferrous metals, connecting blades to counter weight or operator.
    - d. Operators: Manufacturer's standard electric actuator.
    - e. Operators: Manufacturer's standard pneumatic actuator.

**2.3 UPBLAST ROOF EXHAUSTERS**

- A. Manufacturers:
1. Accurex.
  2. Acme Engrg. & Mfg. Corp.
  3. CaptiveAire
  4. Carnes Company, Inc.
  5. Cook (Loren) Co.
  6. Greenheck Fan Corp.
  7. Hartzell Fan, Inc.
  8. PennBarry.
  9. Twin City Fan Company
- B. General Description: Belt-driven or direct-drive as indicated, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

- C. Fan Wheel:
  - 1. Type: Non-overloading centrifugal, propeller or axial blades as scheduled
  - 2. Material: Aluminum ,
- D. Housing:
  - 1. Construct of heavy-gage aluminum including curb cap, windband and motor compartment..
  - 2. Rigid internal support structure.
  - 3. One-piece fabricated or fully welded curb-cap to windband for leak proof construction.
  - 4. Wind Band and Base: Reinforced and braced aluminum, containing aluminum butterfly dampers and rain trough, motor and drive assembly, and fan wheel.
    - a. Dampers Rods: Steel with bronze or nylon bearings.
  - 5. Provide breather tube for fresh air motor cooling and wiring.
- E. Shafts and Bearings:
  - 1. Fan Shaft:
    - a. Ground and polished steel with anti-corrosive coating.
    - b. First critical speed at least 25 percent over maximum cataloged operating speed.
  - 2. Bearings
    - a. Permanently sealed or pillow block type.
    - b. Minimum L10 life in excess of 50,000 hours.
- F. Drive Assembly: Resiliently mounted to the housing, with the following features:
  - 1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
  - 2. Belts: Static free and oil resistant.
  - 3. Pulleys: Cast-iron, adjustable-pitch, keyed and securely attached to the wheel and motor shafts..
- G. Roof Curbs: Refer to Section "Hangers and Supports for HVAC" for pre-engineered roof equipment supports.
- H. Drain Trough: Provides single point drainage for water or other residue.
- I. Accessories: Provide the following items as indicated:
  - 1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
  - 2. Bird Screens: Maximum 1/2-inch mesh, 16-gage aluminum or brass wire.
  - 3. Dampers: Counter-balanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
  - 4. Dampers: Motor-operated, parallel-blade, volume control dampers mounted in curb base.
    - a. Blades: Die-formed sheet aluminum.
    - b. Frame: Extruded aluminum, with waterproof, felt blade bumpers.
    - c. Linkage: Nonferrous metals.
    - d. Operators: Manufacturer's standard electric actuator.
    - e. Operators: Manufacturer's standard pneumatic actuator.

## 2.4 ROOF INTAKE FANS

- A. Manufacturers:
  - 1. Acme Engrg. & Mfg. Corp.
  - 2. Carnes Company, Inc.
  - 3. Cook (Loren) Co.
  - 4. Greenheck Fan Corp.
  - 5. Hartzell Fan, Inc.
  - 6. PennBarry.
  - 7. Twin City Fan Company
- B. Fan Unit: Adjustable belt or direct-driven centrifugal fan with resiliently-mounted induction motor.
- C. Housing: Provide housing of one of the following:

1. Galvanized steel, four sided, hood style housing.
  2. Heavy gauge extruded aluminum, louvered penthouse.
  3. Powder-coated steel weatherproof cabinet with side intake hood, and removable service panels.
- D. Sheaves: Constructed of cast iron or heavy gauge steel, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning prelubricated ball bearings.
- E. Filters: Provide washable aluminum filters of thickness and MERV rating as scheduled.
- F. Roof Curbs: Refer to Section "Hangers and Supports for HVAC" for pre-engineered roof equipment supports.
- G. Accessories: Provide the following items as indicated:
1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
  2. Bird Screens: Maximum 1/2-inch mesh, 16-gage aluminum or brass wire.
  3. Dampers: Counter-balanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
  4. Dampers: Motor-operated, parallel-blade, volume control dampers mounted in curb base.
    - a. Blades: Die-formed sheet aluminum.
    - b. Frame: Extruded aluminum, with waterproof, felt blade bumpers.
    - c. Linkage: Nonferrous metals.
    - d. Operators: Manufacturer's standard electric actuator.
  5. Curb Extensions: Aluminum or galvanized steel as required to raise the inlet above the roof surface to avoid entry of snow.

## 2.5 INLINE CENTRIFUGAL FANS

- A. Manufacturers:
1. Acme Engrg. & Mfg. Corp.
  2. CaptiveAire
  3. Carnes Company, Inc.
  4. Cook (Loren) Co.
  5. Greenheck Fan Corp.
  6. PennBarry.
  7. Twin City Fan Company
- B. Fan Unit: Inline, belt or direct driven, centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, drive assembly, motor and disconnect switch, mounting brackets, and accessories.
- C. Housing: Galvanized steel or split, spun-aluminum housing, with straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- D. Wheel: Aluminum, forward curved, backward inclined or airfoil blades welded to aluminum hub.
- E. Direct-Drive Units: Motor encased in housing out of air stream, factory-wired to disconnect located on outside of fan housing.
- F. Belt-Drive Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing. Provide self-aligning pre-lubricated ball bearings.
- G. Accessories: Provide the following accessories as indicated:
1. Volume Control Damper: Manual operated with quadrant lock, located in fan outlet.
  2. Companion Flanges: For inlet and outlet duct connections.
  3. Fan Guards: Expanded metal in removable frame.

4. Speed Control: Variable speed switch with on-off control and speed control for 100 to 50 percent of fan air delivery.

## 2.6 KITCHEN HOOD UPBLAST EXHAUSTERS

- A. Manufacturers:
  1. Accurex.
  2. CaptiveAire
  3. Carnes Company, Inc.
  4. Cook (Loren) Co.
  5. Greenheck Fan Corp.
  6. PennBarry.
  7. Twin City Fan Company
- B. Fan Unit: Belt-driven or direct-drive as indicated, centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Housing:
  1. Construct of heavy-gage, removable, spun-aluminum including curb cap, windband and motor compartment.
  2. Rigid internal support structure.
  3. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
  4. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.
  5. Provide breather tube for fresh air motor cooling and wiring.
- D. Fan Wheel: Aluminum hub and blades.
- E. Shafts and Bearings:
  1. Fan Shaft:
    - a. Ground and polished steel with anti-corrosive coating.
    - b. First critical speed at least 25 percent over maximum cataloged operating speed.
  2. Bearings
    - a. Permanently sealed or pillow block type.
    - b. Minimum L10 life in excess of 50,000 hours.
- F. Drive Assembly: Resiliently mounted to the housing, with the following features:
  1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
  2. Belts: Static free and oil resistant.
  3. Pulleys: Cast-iron, adjustable-pitch, keyed and securely attached to the wheel and motor shafts..
- G. Grease Exhaust: Exhaust fans serving Type I kitchen exhaust hoods shall discharge a minimum of 40" above the roof surface, shall have hinged access, shall have access opening on curvature of outer housing for blade inspection and cleaning, and shall be installed in accordance with NFPA 96 and local codes.
- H. Roof Curbs: Refer to Section "Hangers and Supports for HVAC" for pre-engineered roof equipment supports
- I. Drain Trough: Grease drain trough shall be filled with replaceable, absorbent material or replaceable cup with absorbent material and cap which absorbs grease and rejects water.
- J. Accessories: Provide the following items as indicated:
  1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
  2. Clean Out Port: Removable grease repellent compression rubber plug allows access for cleaning wheel through windband.
  3. Roof Curb Extension: Vented curb extension where required for compliance with minimum clearances required by NFPA 96.
  4. Hinge Kit:



- a. Aluminum hinges.
  - b. Hinges and restraint cables mounted to base (sleeve).
  - c. Allows fan to tilt away for access to wheel and ductwork for inspection and cleaning.
5. Heat Baffle: Prevents heat from radiating into motor compartment.

## 2.7 UTILITY VENT SET

- A. Manufacturers:
1. Accurex.
  2. Acme Engrg. & Mfg. Corp.
  3. Bayley Fan Group.
  4. CaptiveAire
  5. Carnes Company, Inc.
  6. Chicago Blower Corp.
  7. Cook (Loren) Co.
  8. Greenheck Fan Corp.
  9. Hartzell Fan, Inc.
  10. PennBarry.
  11. Trane Co.
  12. Twin City Fan Company
- B. Fan Unit: Belt-or direct-drive, centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.
- C. Housings: Fabricated of heavy-gage galvanized steel or aluminum material with side sheets fastened to scroll sheets by means of welding or deep lock seam.
1. Inlet: Round duct collar.
  2. Discharge: Slip-joint duct connection.
  3. Housings Discharge Arrangement: Adjustable to 8 standard positions.
- D. Fan Wheels: Single-width, single-inlet, welded to cast-iron or cast-steel hub and spun steel inlet cone, with hub keyed to the shaft.
1. Blade Materials: Steel or aluminum.
  2. Blade Type: Forward-curved, backward-curved or airfoil, die-formed.
- E. Shafts and Bearings:
1. Fan Shaft:
    - a. Ground and polished steel with anti-corrosive coating.
    - b. First critical speed at least 25 percent over maximum cataloged operating speed.
  2. Bearings
    - a. Permanently sealed or pillow block type.
    - b. Minimum L10 life in excess of 50,000 hours.
- F. Drive Assembly: Resiliently mounted to the housing, with the following features:
1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
  2. Belts: Static free and oil resistant.
  3. Pulleys: Cast-iron, adjustable-pitch, keyed and securely attached to the wheel and motor shafts..
- G. Grease Exhaust: Exhaust fans serving Type I kitchen exhaust hoods shall discharge a minimum of 40" above the roof surface, shall have access opening on curvature of outer housing for blade inspection and cleaning, and shall be installed in accordance with NFPA 96 and local codes.
1. Drain Connection: Provide drain connection with grease drain trough filled with replaceable, absorbent material or replaceable cup with absorbent material and cap which absorbs grease and rejects water.
- H. Accessories: Provide the following accessories where indicated:
1. Backdraft Dampers: Gravity-actuated with counterweight and interlocking aluminum blades and felt edges in steel frame installed on fan discharge.

2. Access Doors: Gasketed doors with latch-type handles.
3. Scroll Dampers: Single-blade damper installed at fan scroll top with adjustable linkage.
4. Spark-Resistant Construction: AMCA construction option A, B, or C as indicated.
5. Inlet Screens: Removable, heavy wire mesh.
6. Drain Connections: 3/4-inch, threaded coupling drain connection installed at lowest point of housing.
7. Weather Hoods: Weather-resistant with stamped vents over motor and drive compartment.

### **PART 3 - EXECUTION**

#### **3.1 SEQUENCING AND SCHEDULING**

- A. Coordinate the size and location of structural steel support members.

#### **3.2 INSTALLATION**

- A. Install fans level and plumb, in accordance with manufacturer's written instructions.
- B. Secure roof-mounted fans to pre-engineered roof equipment supports in accordance with the requirements specified in Section "Hangers and Supports for HVAC Piping and Equipment."
- C. Install vibration isolation for equipment as specified in Division 23 Section "Vibration Isolation for HVAC Piping and Equipment."
- D. Arrange installation to provide access space around fans for service and maintenance.

#### **3.3 ADJUSTING CLEANING AND PROTECTING**

- A. Adjust damper linkages for proper damper operation.
- B. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

#### **3.4 STARTUP**

- A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
  1. Remove shipping blocking and bracing.
  2. Verify fan assembly is secure on mountings and supporting devices and that connections for ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
  3. Perform cleaning and adjusting specified in this Section.
  4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
  5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
  6. Verify manual and automatic volume control and that fire and smoke dampers in connected ductwork systems are in the full-open position.
  7. Disable automatic temperature control operators.
- B. Starting procedures for fans:
  1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
    - a. Replace fan and motor pulleys as required to achieve design conditions.
  2. Measure and record motor electrical values for voltage and amperage.
  3. Shut unit down and reconnect automatic temperature control operators.

4. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for air-handling-system testing, adjusting, and balancing.

### **3.5 DEMONSTRATION**

- A. Demonstration Services: Train Owner's maintenance personnel on the following:
  1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
  2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Closeout Procedures" and Division 23 Section "General Mechanical Requirements."
- B. Schedule training with at least 7 days' advance notice.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 23 34 33 - AIR CURTAINS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Service window air curtains.
- B. Air curtains.
  - 1. Hot-water heating coils.

**1.2 SUBMITTALS**

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each unit.
- B. Shop Drawings: For air curtain units.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Operation and Maintenance Data: Manufacturer's printed instructions for operating and maintaining air curtain components.
- E. Warranty Documentation: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

**1.3 COORDINATION DRAWINGS**

- A. Submit plans and details drawn to scale and coordinated with penetrations of walls.

**1.4 QUALITY ASSURANCE**

- A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of air curtains that are similar to those indicated for this Project in material, design, and extent.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of air curtains and are based on the specific product indicated. Alternate manufacturers shall meet the design intent shown on the drawings. Refer to Division 1 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with AMCA 220, "Test Methods for Air Curtain Units," for airflow, outlet velocity, and power consumption.
- E. Comply with AHRI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils," for components, construction, and rating.
  - 1. Certify coils according to AHRI 410.

**1.5 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air curtains that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period (Water or Steam Heating Units): Two years.

## 1.6 EXTRA MATERIALS

- A. Furnish extra materials described below, before construction begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish one set of filters and fan belts for each unit.

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 AIR CURTAINS

- A. Manufacturers:
  - 1. Berner International Corp.
  - 2. Mars Air Products.
  - 3. Powered Aire, Inc.
- B. Frame: Minimum 16-gauge galvanized steel or aluminized steel base frame with welded construction.
- C. Housing Panel and Finish: Provide finish as scheduled on the plans.
  - 1. Galvanized steel.
  - 2. Aluminum.
  - 3. Stainless steel.
  - 4. Molded, high impact polyethylene.
- D. Mounting Brackets: Steel, for mounting as scheduled.
- E. Air Adjustment: Provide one of the following options to reduce air volume and outlet velocity to meet the installation requirements:
  - 1. Multi-speed motors with minimum of 3 speed adjustments.
  - 2. Intake louvers that are an integral part of the housing, mechanically field adjustable and capable of reducing air-outlet velocity by up to 60 percent.
- F. Discharge Nozzle: Integral part of the housing, containing adjustable air-directional vanes with 40-degree sweep front to back.
- G. Fans: Galvanized steel, painted steel, or aluminum, centrifugal, forward curved, double width, double inlet; statically and dynamically balanced.
  - 1. Fan Drives:
    - a. Direct drive.
    - b. Belt drive, equipped with belt guards and adjustable sheaves and pulleys for adjusting air-outlet velocity.
- H. Motors: Comply with Section "Common Motor Requirements for HVAC Equipment".
  - 1. Single speed, multispeed or variable speed.
  - 2. Resiliently mounted, continuous duty.
  - 3. Totally enclosed, air over.
  - 4. Explosion proof in hazard locations
  - 5. Integral thermal-overload protection.
  - 6. Bearings: Permanently sealed, lifetime, prelubricated, ball bearings.
  - 7. Disconnect: Internal power cord with plug and receptacle.
- I. Hot Water Heating Coils
  - 1. Description: Factory mounted, drainable coil.

2. Piping Connections: Threaded.
  3. Tubes: Copper, complying with ASTM B 75.
    - a. Tube Diameter: 0.625 inch.
  4. Fins: Maximum fin spacing 14 fins per inch.
    - a. Aluminum.
    - b. Copper.
  5. Fin and Tube Joint:
    - a. Mechanical bond.
    - b. Silver brazed.
  6. Headers:
    - a. Seamless copper tube with brazed joints.
    - b. Fabricated steel with brazed joints.
  7. Frames: Minimum 16 gauge galvanized-steel channel frame.
  8. Ratings: According to ASHRAE 33.
  9. Working-Pressure Ratings: 200 psig, 325 deg F.
  10. Source Quality Control: Test to 300 psig and to 200 psig underwater.
- J. Filters
1. Disposable Panel Filters: Factory-fabricated, viscous-coated, flat-panel-type, disposable air filters with glass-fiber media sprayed with nonflammable adhesive in cardboard or galvanized-steel frame.
  2. Washable Panel Filters: Removable, aluminum media, minimum 0.5" thick, aluminum or steel filter frame.
  3. Mounting Frames: Welded, galvanized steel with gaskets and fasteners and suitable for bolting together into built-up filter banks.
- K. Accessories: Provide the following accessories where required to meet the specified conditions on the drawings.
1. Built-In Thermostat: Line voltage, factory installed and wired to the junction box on air curtain.
  2. Field Installed Thermostat: Line voltage, factory furnished thermostat to be field wired to the junction box on the air curtain.
  3. Automatic Door Switch: Provide automatic door switch in door area to activate air curtain when door opens and to deactivate air curtain when door closes.
    - a. Provide plunger type at dock doors and back of house doors.
    - b. Provide magnetic type at public entrance doors.
  4. Time-Delay Relay: Factory installed and adjustable to allow air curtain to operate from 0.5 seconds to 10 hours.
  5. Motor-Control Panel: Complete with motor starter, 115-V ac transformer with primary and secondary fuses, and terminal strip.
    - a. Provide NEMA 250, Type 1 enclosure.
  6. Mounting Brackets: Provide mounting brackets and other mounting accessories as required to permit installation and functioning of air curtain to meet project installation.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and conditions where air curtains will be installed for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before air-curtain installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 COORDINATION**

- A. Coordinate layout and installation of air curtains and suspension system components with other construction, including light fixtures, fire-suppression-system components, and partition assemblies.
- B. Coordinate installation of wall penetrations and louvers.

**3.3 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install air curtains with clearance for equipment service and maintenance.
- C. Comply with requirements for hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

**3.4 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air curtain to allow service and maintenance.
- C.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Common Work Results for Electrical."

**3.5 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing air curtains completely, perform visual and mechanical check of individual components.
  - 2. After electrical circuitry has been energized, start unit to confirm motor rotation and unit operation. Certify compliance with test parameters.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Repair or replace malfunctioning units and retest as specified above.

**3.6 ADJUSTING**

- A. Adjust belt tension.
- B. Adjust motor and fan speed to achieve specified airflow.
- C. Adjust discharge louver and dampers to regulate airflow.
- D. Adjust air-directional vanes.

**3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air curtains on the following:
  - 1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
  - 2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Project Closeout" and Division 23 Section "General Mechanical Requirements."



- B. Schedule training with at least 7 days' advance notice.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 23 36 00 - AIR TERMINAL UNITS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Variable Air Volume Terminal Units
  - 1. Reheat

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical product data, including performance data for each size and type of air terminal furnished; certified sound power data for each unit; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, methods of assembly of components and electrical characteristics and connection requirements.
- C. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.
- D. Wiring Diagrams: Submit ladder-type wiring diagrams for electric power and control components, clearly indicating required field electrical connections.
- E. Nameplate Data: Nameplate data shall be submitted in a timely manner so as to allow proper coordination with the Electrical Contractor. Submittals that do not have nameplate data will be rejected.
- F. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.
- G. Project Record Documents: Record actual locations of units and locations of access doors required for access of valving.
- H. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include this data, product data, shop drawings, and maintenance data in maintenance manual; in accordance with requirements of Division 1.

**1.3 QUALITY ASSURANCE**

- A. ADC Compliance: Provide air terminals that have been tested and rated in accordance with ADC standards, and bear ADC Seal.
- B. AHRI Compliance:
  - 1. Provide air terminals that have been tested and rated in accordance with AHRI 880 "Performance Rating of Air Terminals" and bear AHRI certification seal.
  - 2. Provide air terminals that meet the scheduled sound performance in compliance with AHRI 885 "Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets".
- C. UL/ETL Compliance: Air terminal units shall be UL or ETL listed as a complete assembly. All electrical components shall be UL listed and installed in accordance with the National Electric Code.
- D. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.4 SPARE PARTS

- A. If HVAC equipment is used during construction, the contractor is fully responsible for it's cleaning just before substantial completion prior to testing and balancing.

### PART 2 - PRODUCTS

#### 2.1 VARIABLE AND CONSTANT AIR VOLUME TERMINAL UNITS

- A. Manufacturers:
  - 1. Carnes Co.
  - 2. Carrier Corp.; Sub. of United Technologies Corp.
  - 3. Environmental Technologies, Inc.
  - 4. Greenheck
  - 5. Johnson Controls, Inc.
  - 6. Krueger Mfg. Co.
  - 7. Metalaire.
  - 8. Nailor Industries, Inc.
  - 9. Price Industries.
  - 10. Tempmaster Corp.
  - 11. Titus Products Div.; Philips Industries, Inc.
  - 12. Trane (The) Co.
- B. Construction
  - 1. Casings: Construct of galvanized sheet metal of minimum 22 gauge thickness or die-cast aluminum of minimum 20 gauge thickness.
    - a. Assembled with longitudinal lock seam construction.
    - b. Construct casings such that when subjected to 0.5-in w.g. pressure for low pressure units, and 3.0-in w.g. pressure for high pressure units, total leakage does not exceed 2% of specified air flow capacity with outlets sealed and inlets wide open.
  - 2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes or rectangular where needed to meet airflow requirements.
  - 3. Unit Discharge: Rectangular, with slip-and-drive connections.
  - 4. Acceptable Liners:
    - a. Linings: Line inside surfaces of casings with fiberglass, lining material to provide acoustic performance, thermal insulation, and to prevent condensation on outside surfaces of casing. Provide minimum thickness of 1/2". Secure lining to prevent delamination, sagging, or settling.
  - 5. Access: Provide removable panels in casings to permit access to air dampers, fans and other parts requiring service, adjusting, or maintenance.
    - a. Provide airtight gasket and quarter-turn latches.
  - 6. Provide hanger brackets for attachment of supports.
- C. Sound Attenuator
  - 1. Provide if required to meet scheduled acoustical performance requirements.
  - 2. Construction to consist of a continuous extension of the casing and liner as required to achieve required attenuation.
  - 3. At 2000 fpm inlet velocity, the additional differential pressure drop with attenuator not to exceed 0.2 inch wg.
  - 4. All sound data shall be compiled in an independent ADC certified laboratory and in accordance with the latest version of AHRI 880. All units shall be AHRI certified and bear the AHRI certification label.

- D. Primary Air Damper Assembly
1. Heavy-gauge, galvanized steel or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
  2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
  3. Incorporate low leak damper blades for tight airflow shutoff.
    - a. Air Leakage Past Closed Damper: Maximum two percent of unit maximum airflow at 3 inch wg inlet static pressure, tested in accordance with ASHRAE Std 130.
- E. Hot Water Heating Coil:
1. Seamless copper tubes, mechanically expanded into aluminum or aluminum-plated fins.
  2. Include low-leakage access door for coil inspection and cleaning.
  3. Coil leak tested to minimum 200 psig.
  4. Base performance data on tests run in accordance with AHRI 410.
- F. Electrical Requirements:
1. Single-point power connection.
  2. Equipment wiring to comply with requirements of NFPA 70.
  3. All electrical components shall be UL or ETL listed or recognized and installed in accordance with the National Electrical Code.
  4. All electrical components shall be mounted in a control box.
  5. The entire assembly shall be UL or ETL listed (cETL in Canada) and so labeled.
- G. Control Transformers: Factory supplied and mounted for electric and electronic control applications.
- H. Controls: Provide controls accurate to 1.5 degrees F and adjustable from 65 degrees F to 85 degrees F. Provide air flow measurement station at terminal unit inlet. Provide control type as indicated below.
1. DDC (Direct Digital Control): Provide direct digital controls, compatible with direct digital control system specified in other Division 23 sections.
    - a. The unit level controller to include the following:
      - 1) 24 VAC power terminal or RJ-12 Power connection.
      - 2) Port for thermostat connection.
      - 3) Service Port for diagnostic equipment.
      - 4) Damper actuator.
      - 5) LED indication for troubleshooting.
      - 6) Heating output signal(s).
      - 7) Cooling output signal(s).
      - 8) Supply air temperature sensor input.
      - 9) Contact closure input.
      - 10) BACNET communication capability.
    - b. Include a factory-installed, unit-mounted direct-digital controller.
    - c. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
    - d. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFM's.
      - 1) Occupied and unoccupied operating mode.
      - 2) Remote reset of temperature or CFM set points.
      - 3) Proportional, plus integral control of room temperature.
      - 4) Monitoring and adjusting with portable terminal.
      - 5) Time-proportional reheat coil control.
    - e. Room Sensor:
      - 1) Compatible with temperature controls specified.
      - 2) Wall-mounted, system powered, with temperature set-point adjustment including connection access for portable operator terminal.
  2. Airflow Sensor: Differential pressure airflow device measuring total, static, and wake pressures.
    - a. Sensor Requirements:

- 1) Plastic parts shall be fire-resistant, complying with UL 94.
  - 2) Control tubing shall be protected by grommets at the wall of the air flow sensor's housing.
  - 3) Furnished with multiple total and static pressure sensing ports and a center averaging chamber that amplifies the sensed air flow signal.
  - 4) Provide sensor with a pressure transducer to interface with the building control system.
- b. Signal accuracy: Provide accuracy within 5 percent throughout the terminal unit operating range.
- I. Identification: Provide label on each unit indicating Plan Number, cfm range, cfm factory-setting, and calibration curve (if required).

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that conditions are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

#### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install the inlets of air terminal units and air flow sensors a minimum of three duct diameters from elbows, transitions, and duct takeoffs.
- C. Provide ceiling access doors or locate units above easily removable ceiling components.

#### **3.3 ADJUSTING**

- A. Adjust damper linkages for proper damper operation.
- B. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to scheduled minimum flow.

#### **3.4 FIELD QUALITY CONTROL**

- A. Upon completion of installation and prior to initial operation, test and demonstrate that air terminals, duct connections to air terminals, and water coils are leak-tight.
  1. Leak Test:
    - a. Repair or replace air terminals and duct connections as required to eliminate leaks, and retest to demonstrate compliance.
    - b. Repair water leaks and retest until no leaks exist.
  2. Operational Test:
    - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
    - b. Test and adjust controls and safeties.
    - c. Replace damaged and malfunctioning controls and other equipment.

#### **3.5 CLEANING**

- A. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.
- B. Install new filters.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 23 37 13 - DIFFUSERS REGISTERS AND GRILLES****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Ceiling air diffusers.
- B. Registers and grilles.
- C. Linear slot diffusers.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:
  - 1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
  - 2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details. Indicate selections on product data.
  - 3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings at specified airflows.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.
- C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.
- D. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.
- E. Color Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for diffusers, registers, and grilles with factory-applied color finishes.
- F. Samples for Verification: Provide samples of diffusers, registers, and grilles, in manufacturer's standard sizes, showing the full range of colors. Prepare Samples from the same material to be used for the Work.

**1.3 QUALITY ASSURANCE**

- A. Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing the Performance of Air Outlets and Inlets".
- B. Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
- C. Provide air outlets and inlets bearing ADC Certified Rating Seal.
- D. Test and rate sound data for air outlets and inlets in accordance with AHRI 885 "Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets (with Addendum 1)".
- E. Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

**1.4 SPARE PARTS**

- A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

**PART 2 - PRODUCTS****2.1 CEILING AIR DIFFUSERS**

- A. Manufacturers
  - 1. Carnes Co.
  - 2. Greenheck.
  - 3. Krueger Mfg. Co.
  - 4. Metalaire; Metal Industries, Inc.
  - 5. Nailor Industries, Inc.
  - 6. Price Industries, Inc.
  - 7. Titus HVAC
  - 8. Tuttle & Bailey; Div. of Air Systems Components, Inc.
- B. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and provided with accessories as required for a complete installation.
- C. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- D. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.
- E. Types: Provide ceiling air diffusers of type, capacity, and with accessories and finishes as scheduled on the drawings.

**2.2 REGISTERS AND GRILLES**

- A. Manufacturers
  - 1. Carnes Co.
  - 2. Greenheck.
  - 3. Krueger Mfg. Co.
  - 4. Metalaire; Metal Industries, Inc.
  - 5. Nailor Industries, Inc.
  - 6. Price Industries, Inc.
  - 7. Titus HVAC
  - 8. Tuttle & Bailey; Div. of Air Systems Components, Inc.
- B. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and provided with accessories as required for a complete installation.
- C. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.
- D. Ceiling Compatibility: Provide registers and grilles with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with

accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of register and grille.

- E. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction which will contain each type of wall register and grille.
- F. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as scheduled on the drawings.

## 2.3 LINEAR SLOT DIFFUSERS

- A. Manufacturers
  1. Carnes Co.
  2. Greenheck.
  3. Krueger Mfg. Co.
  4. Metalaire; Metal Industries, Inc.
  5. Nailor Industries, Inc.
  6. Price Industries, Inc.
  7. Titus HVAC
  8. Tuttle & Bailey; Div. of Air Systems Components, Inc.
- B. General: Except as otherwise indicated, provide manufacturer's standard linear slot diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and provided with accessories as required for a complete installation.
- C. Performance: Provide linear slot diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- D. Compatibility: Provide linear slot diffusers with border styles that are compatible with adjacent ceiling or wall systems, and that are specifically manufactured to fit into ceiling or wall with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling and wall systems which will contain each type of linear slot diffuser.
- E. Linear Slot Diffusers: Slot diffusers shall be standard one-piece lengths up to 6-feet and shall be furnished in multiple sections greater than 6-feet.
  1. Provide straight and curved sections as required to accommodate layout shown on the drawings.
  2. Multiple sections shall be joined together end-to-end with alignment pins to form a continuous slot appearance. All alignment components shall be provided by the manufacturer.
  3. Where specified on the drawings, plenums shall be manufactured by the slot diffuser manufacturer. Plenums shall be internally insulated, by the manufacturer, with minimum ¼" thick, closed-cell insulation. Insulation shall not be made of fibrous material.
- F. Types: Provide linear slot diffusers of type, capacity, and with accessories and finishes as scheduled on the drawings.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Examine areas and conditions under which air outlets and inlets are to be installed for compliance with installation tolerances and conditions that would affect the performance of the equipment. Do not proceed with work until unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions, design drawings, referenced standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Coordinate with other work, including ductwork and duct accessories, to interface installation of air outlets and inlets with other work.
- C. Where a 90-degree elbow is required at the connection to air devices, provide a rigid duct elbow or, at Contractor's option, a flexible elbow assembly as specified in Division 23 section "Air Duct Accessories".
- D. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.
- E. Linear Slot Diffuser Installation:
  - 1. For installations in a hard ceiling, install diffuser prior to installation of drywall. Use manufacturer's hard ceiling clips for mounting to ceiling framing. Screws through face of diffuser are not acceptable.

**3.3 ADJUSTING**

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before beginning air balance.

**3.4 CLEANING**

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove dirt and smudges. Replace any air device that has damaged finishes.

END OF SECTION

**SECTION 23 51 00 - BREECHINGS CHIMNEYS AND STACKS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Special gas vents.

**1.2 DEFINITIONS**

- A. Breeching: The conduit conveying flue gas from the appliance to the chimney.
- B. Chimney: A structure containing one or more vertical or nearly vertical passageways for conveying flue gases to the outside atmosphere.
- C. Stack: A primarily vertical, round, vent.
- D. Vent: A flue-gas conveying system intended for use with certain gas-, liquid-, or solid fuel-fired appliances that do not produce flue gas outlet temperatures higher than a value specified in the listing vent standards.
- E. Category I Appliance: An appliance that operates with a non-positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.
- F. Category II Appliances: An appliance that operates with a non-positive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent.
- G. Category III Appliances: An appliance that operates with a positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.
- H. Category IV Appliances: An appliance that operates with a positive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent.

**1.3 SUBMITTALS**

- A. Product Data: Submit product data including materials, dimensions, weights, required clearances, and accessories.
- B. Shop Drawings:
  - 1. Indicate general construction, dimensions, weights, support, and layout of breeching, chimneys, and stacks.
  - 2. Submit layout drawings indicating plan view, elevations, and details.
  - 3. Submit detail assemblies and indicate method of field assembly, components, hangers and seismic restraints, and location and size of each field connection.
- C. Manufacturer's Instructions: Include installation instructions and indicated assembly, support details, and connection requirements.
- D. Manufacturer's Certificates: Submit certificates of compliance with specified reference standards.
- E. Welders Certificates: Include welder certification of compliance with ASME BPVC-IX.
- F. Wind and Seismic Certificates: Submit complete engineering report certifying that stacks meet the design wind and seismic loads.

**1.4 QUALITY ASSURANCE**

- A. Comply with the following Codes and Standards:
  - 1. NFPA 211 "Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances."
  - 2. NFPA 54 "National Fuel Gas Code" for natural gas and propane burning appliances.

3. NFPA 31 "Standard for the Installation of Oil-Burning Equipment" for fuel oil appliances.
4. UL: Comply with applicable portions of UL safety standards; provide products which have been UL listed and labeled.
5. SMACNA: Comply with SMACNA's "HVAC Duct Construction Standards" for fabricated breeching and smokepipe and with SMACNA's "Guide for Steel Stack Design and Construction" for steel stacks.
6. AWS: All welders and procedures shall be certified in accordance with AWS D1.1, "Structural Welding Code-Steel," for hangers and supports and in accordance with AWS Standard D9.1, "Sheet Metal Welding Code" for duct joining and seam welding.
7. ASHRAE: Comply with the ASHRAE Systems and Equipment Handbook for Chimney, Gas Vent, and Fireplace Systems material requirements and design criteria.

## 1.5 DELIVERY STORAGE AND HANDLING

- A. Delivery: Handle breeching and stack components carefully to prevent damage, denting and scoring. Do not install damaged components; replace with new.

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 SPECIAL GAS VENTS

- A. Manufacturers
  1. General:
    - a. AMPCO.
    - b. DuraVent Commercial.
    - c. Enervex Inc.
    - d. Heat-Fab Inc.
    - e. Metal-Fab, Inc.
    - f. Nova-Flex Group.
    - g. ProTech Systems Inc.
    - h. Schebler Chimney Systems.
    - i. Security Chimneys.
    - j. Selkirk Metalbestos.
- B. General: UL 1738 listed, rated for 1.25 inch w.c. positive or negative flue pressure complying with NFPA 211 and suitable for condensing-gas appliances.
- C. Single-wall Vents: Rated for 480 degrees F continuously, with shell constructed of ASTM A949, Type AL29-4C, ASTM A276 Type 316L, or ASTM A268 Type 444 stainless steel.
- D. Double-wall Vents: Rated for 550 degrees F continuously, with inner and outer jacket separated by at least a 1/2 inch annular space. Construct inner shell of ASTM A949, Type AL29-4C, ASTM A276 Type 316, or ASTM A268 Type 444 stainless steel listed for condensing appliances. Construct outer jacket of aluminized coated steel or Type 304, 316, or AL29-4C stainless steel.
- E. Accessories, UL labeled: Provide tees, adjustable and variable lengths, elbows, increasers, draft hood connectors, terminations, dampers, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners, fabricated from similar materials and designs as vent pipe straight sections, all listed for same assembly. Provide discharge assembly termination compatible with manufacturer system to protect against and/or drain rainfall.
- F. Appliance Adapter: Provide appliance adapter to connect double wall special gas vent to flue outlet of appliance and secure with hose clamp.
  - a. Enervex Inc. SR.
  - b. Heat-Fab Model 9401RHM.
  - c. Selkirk Metalbestos 3CV-AA .

**2.2 GUYING AND BRACING**

- A. Cable: Galvanized, stranded wire of the following thickness:
  - 1. Minimum Size: 1/4 inch in diameter
  - 2. For ID Sizes 4 to 15 inches: 5/16 inch in diameter.
  - 3. For ID Sizes 18 to 24 inches: 3/8 inch in diameter.
  - 4. For ID Sizes 27 to 30 inches: 7/16 inch in diameter.
  - 5. For ID Sizes 33 to 36 inches: 1/2 inch in diameter.
  - 6. For ID Sizes 39 to 48 inches: 9/16 inch in diameter.
  - 7. For ID Sizes 51 to 60 inches: 5/8 inch in diameter.
- B. Pipe: 1-1/4 inch diameter, galvanized steel.
- C. Angle Iron: Galvanized steel 2 by 2 by 1/4 inch.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 APPLICATION SCHEDULE**

- A. Category IV Appliances:
  - 1. Special gas vents, single wall for appliances with flue gases up to 480 degrees F continuously, double wall for flue gases up to 550 degrees F continuously.

**3.3 INSTALLATION GENERAL**

- A. Install in accordance with manufacturer's instructions.
- B. Maintain minimum clearances from combustibles specified in third party listing.
- C. Align connections accurately with internal surfaces smooth.
- D. Seal joints between sections of positive pressure vents in accordance with manufacturer's installation instructions, and using only sealants recommended by manufacturer.
- E. Support breechings from building structure, rigidly with suitable ties, braces, hangers, and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12 foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA (DCS) for equivalent duct support configuration and size. Reference Division 23 Section "Hangers and Supports for HVAC" for supports.
- F. Install guy wires and/or braces where maximum unsupported lengths of stacks are exceeded.
- G. Install concrete inserts for support of breechings, chimneys, and stacks in coordination with formwork.
- H. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack, minimum 1/4 inch per foot or per manufacturer's recommendations, whichever is more stringent. Provide flat bottom transitions where required to maintain continuous slope. Provide condensate drain connection at low points with 3/4" plenum rated drain tubing with pigtail trap sized for system pressure. Pipe drain line to nearest open site drain and terminate with air gap. Provide pH neutralizer in drain line in accessible location.
- I. All connections to common breechings shall be 45 degree lateral tees.

- J. Install firestopping to preserve fire resistance rating of partitions and other elements.
- K. Coordinate installation of dampers and draft control devices. Locate dampers as close to draft hood collar as possible.
- L. Install slip joints permitting removal of appliance without removal or dismantling of breeching, breeching insulation, chimneys, or stacks.

### **3.4 INSTALLATION OF SPECIAL GAS VENTS**

- A. Connect special gas vents to appliance adapters.
- B. Insulate single wall special vents serving instantaneous gas water heaters.
  - 1. Insulate single wall special gas vents for instantaneous gas water heaters. Refer to Division 23 specification section "HVAC Insulation" for insulation thickness, material and installation methods.

### **3.5 FIELD QUALITY CONTROL**

- A. Temporary Closure: At ends of breechings and chimneys that are not completed or connected to equipment, provide temporary closure that will prevent entrance of dust and debris until installations are completed.
- B. Touch-up or refinish sections or accessories that are scratched or marred during shipping and handling, or require touch-up after welding.

### **3.6 AD USTING AND CLEANING**

- A. Clean breechings internally during installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth.

END OF SECTION



**SECTION 23 51 13 - DRAFT CONTROL DEVICES****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Vent exhaust fan system.
- B. Combustion-air fan system.
- C. Draft and/or combustion air system controller
- D. Vent dampers.
- E. Dryer vent fans.
- F. Dryer vent system controller.

**1.2 SUBMITTALS**

- A. Product Data:
  - 1. Provide data on fans including materials of construction, fan curves with specified operating point clearly plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
  - 2. Provide data on dampers including materials of construction and airflow performance.
  - 3. Provide data for each controller including performance characteristics, electrical characteristics, finishes of materials, installation instructions and start-up instructions.
- B. Shop Drawings: Show fabrication and installation details for products. Include plans, elevations, sections, details, and attachments to other work. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, hangers and seismic restraints, and location and size of each field connection.
  - 1. Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring..
- C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, fan lubrication procedures, spare parts list, and maintenance and repair data.
- D. Warranties: Special warranties specified in this Section.

**1.3 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Mechanical draft system shall be guaranteed to operate to provide a constant draft that does not fluctuate more than +/- 0.01 inch W.C. under stable load conditions.
- C. Venting system shall comply with NFPA 54 "National Fuel Gas Code" to satisfy Factory Mutual (FM) Global Insurance requirements.
- D. Draft ventilators shall meet UL Standard 378 "Standard for Draft Equipment".
- E. Draft vent controllers shall contain features in compliance with UL Standard 378 "Standard for Draft Equipment".

**1.4 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of draft control system that fail in materials or workmanship within specified warranty period.
  - 1. Failures include failure of the fan due to corrosion.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Vent Exhaust Fan System Warranty: Provide a ten year warranty against corrosion perforation from the date of substantial completion. The warranty shall include 100 percent coverage of a contractor's response within a 24 hour Owner request.

**PART 2 - PRODUCTS****2.1 VENT EXHAUST FAN SYSTEM**

- A. Manufacturers:
  - 1. Enervex.
  - 2. Tjernlund Products Inc.
  - 3. US Draft.
- B. General: Provide demand controlled exhaust system, consisting of fans, motors, controls, and ductwork, designed to maintain negative pressure throughout the entire chimney or stack.
- C. Fan:
  - 1. Performance Requirements:
    - a. Capable of handling flue gases up to 550 degrees F continuously measured at the flue exit point.
  - 2. Construction:
    - a. Backward inclined centrifugal or axial type of inline design, statically and dynamically balanced with integral and non-removable weights.
    - b. The drive unit consisting of the impeller and motor shall be serviceable without having to remove the entire fan assembly from the vent system.
    - c. Spark resistant construction per AMCA 99-0401, Type B.
    - d. Housing: Minimum 0.063 inch thick, cast-aluminum or stainless-steel.
    - e. Wheel: Cast-aluminum, stainless-steel, or other non-ferrous material to eliminate the possibility of sparks and the potential of igniting unburned fuel and/or explosive gases.
- D. Motor:
  - 1. Type: Permanent split capacity, surface mounted permanent magnet, or electronically commutated type with an IP55 rating and Class F insulation.
  - 2. Construction: Totally enclosed out of the airstream, with pre-lubricated and sealed ball bearings. Bearings shall be rated for a minimum of 320 degrees F.
  - 3. Rating: Variable-speed duty, minimum Class F insulation
- E. Vent System:
  - 1. Reference Division 23 Section "Breechings, Chimneys, and Stacks" for additional system requirements.
- F. Variable Frequency Drive:
  - 1. Factory programmed as part of the mechanical draft system.
  - 2. Not be part of the draft vent system controller PID loop.
  - 3. Include safe torque-off function.
  - 4. Include sensorless vector control for permanent magnet and induction motor control.
  - 5. Reference Division 23 Section "Variable Frequency Drives for HVAC" for additional requirements.

**2.2 COMBUSTION-AIR FAN SYSTEM**

- A. Manufacturers:
  - 1. Enervex.
  - 2. Field Controls L.L.C.; the Venting Solutions Company.
  - 3. Tjernlund Products Inc.
  - 4. US Draft.
- B. General: Provide demand controlled combustion air system, consisting of fans, motors, controls, and ductwork, designed to maintain positive pressure to the appliance(s).
- C. Fan:
  - 1. Construction:
    - a. High efficiency, backward inclined centrifugal or tube-axial type, statically and dynamically balanced.
    - b. Spark resistant construction per AMCA 99-0401, Type B.
    - c. Housing: Galvanized steel or cast aluminum.
    - d. Wheel: Cast-aluminum, stainless-steel, or other non-ferrous material.
    - e. Assembly: Propeller and motor assembly shall be totally enclosed within the fan casing.
  - 2. Motor:
    - a. Type: Permanent split capacity, surface mounted permanent magnet, or electronically commutated with IP 55 rating.
    - b. Construction: Totally enclosed, fan-cooled, shaded-pole motor direct-mounted to the fan with pre-lubricated and sealed ball bearings; stainless-steel shaft.
    - a. Rating: Variable-speed duty, minimum Class F insulation
- D. Combustion Air System:
  - 1. Reference Division 23 Section "Breechings, Chimneys, and Stacks" for additional system requirements.
- E. Variable Frequency Drive:
  - 1. Factory programmed as part of the mechanical vent system.
  - 2. Not be part of the controller PID loop.
  - 3. Include safe torque-off function.
  - 4. Include sensorless vector control for permanent magnet and induction motor control.
  - 5. Reference Division 23 Section "Variable Frequency Drives for HVAC" for additional requirements.

**2.3 DRAFT AND OR COMBUSTION AIR SYSTEM CONTROLLER**

- A. Type: Proportional, Integral, Derivative (PID).
- B. Control:
  - 1. Capable of controlling both the appliance exhaust and combustion air systems simultaneously via a single unit and maintain pre-set adjustable system pressures via independent PID control loops.
  - 2. Capable of controlling multiple fans in lead-lag operation, parallel operation, and allow for redundancy in the event of fan failure.
  - 3. Capable of controlling pressure to within plus or minus 0.01" WC of the pressure setpoints.
  - 4. Capable of reaching and maintaining pressure set point within 20 seconds of appliance operation. Controller shall shut off appliances if set point is not maintained.
- C. Pressure transducer: Bi-directional type.
- D. Sensors:
  - 1. Provide a pressure sensor with probe and tubing for the vent flue pipe.
  - 2. Provide a pressure sensor with probe and tubing for the combustion air pipe or in the room as indicated on the drawings.

- E. Design for 120 VAC electrical service.
- F. Communication: Modbus RTU or BACnet.
  - 1. Provide alarm annunciation through fault codes and an LCD display.
  - 2. Perform programmable operation to include intermittent versus continuous fan operation, purge times, sensor sensitivity, alarm limits and displays, manual overrides, and low/high limit fan speeds.
- G. Safety Features:
  - 1. Interlocks to prevent burner operation during emergencies when mechanical or electrical problems occur.
  - 2. Interlocks to ensure proper combustion pressurization setpoint prior to appliance operation.
  - 3. Integrated operating priority option: Allow one or more appliances to operate during electrical or mechanical failure of the fan, provided the draft requirement can be met and safe operation assured.
- H. Enclosure: Minimum NEMA 1.

## 2.4 VENT DAMPERS

- A. Manufacturers:
  - 1. Enervex.
  - 2. Field Controls L.L.C.; the Venting Solutions Company.
  - 3. Johnson Controls, Inc.; Controls Group.
  - 4. US Draft.
- B. Damper Construction: Stainless-steel damper blade, shaft, and vent pipe with metal, pre-lubricated bearings.
  - 1. 24-V ac motor sized to power damper open and closed in approximately 15 seconds in each direction. Power shall be off when damper is at rest.
  - 2. Integrate damper control with vent exhaust fan system.
  - 3. Comply with ANSI Z21.66 or UL 378.
- C. Controls:
  - 1. 115-to 24-V control transformer.
  - 2. Keyed wiring harness.
  - 3. Damper end-switch to prove damper is open.
  - 4. Interlock with equipment to permit burner operation when damper is open.
  - 5. Hold-open switch for troubleshooting equipment controls.

## 2.5 DRYER VENT FANS

- A. Manufacturers:
  - 1. Enervex.
  - 2. LaundryFab, a division of US Draft.
  - 3. Tjernlund Products Inc.
- B. General Description: Direct-drive, variable speed motors, mechanical fans consisting of fan wheel and housing, factory-mounted motor, and accessories. Fans shall be listed in accordance with UL 705. Assembly shall be rated for operating temperatures up to 350 degrees F.
- C. Housings: Steel with corrosion resistant finish or cast aluminum, with duct connections designed to minimize lint collection.
  - 1. Designed to allow the entire impeller and motor assembly to be removed as a unit.
  - 2. Provide a service door for cleaning and service.
- D. Wheels: Cast-aluminum, statically and dynamically balanced.
- E. Motor: Totally enclosed, fan-cooled, variable speed, pre-lubricated and sealed ball bearings, Class B insulated.

- F. Variable frequency drive shall be as specified in Division 23 Section "Variable Frequency Drives for HVAC".

## 2.6 DRYER VENT SYSTEM CONTROLLER

- A. Manufacturers:
  - 1. Enervex.
  - 2. LaundryFab, a division of US Draft.
  - 3. Tjernlund Products Inc.
- B. General Description: System shall be furnished complete including ventilator fan, variable frequency drive, system controller and sensors.
- C. Modulating Fan Controller:
  - 1. Micro-processor based controller designed to maintain a constant pressure for increased efficiency and proper operation of the dryer vent system. Features included with the controller shall comply with UL 378, Standard for Draft Equipment and UL 508, Standard for Industrial Controls.
  - 2. Enclosure: NEMA 1 or 12 rated, suitable for indoor installations.
  - 3. Features:
    - a. Potentiometer to set the required duct pressure.
    - b. LCD display: Display both the pressure set point and actual duct pressure.
    - c. LED diodes or other means to verify ventilator operation, cycling, and alarm.
    - d. Provide safety shut-off with visual alarm to shut down dryer on insufficient duct pressure or fan failure.
    - e. Interlocks for appliances.
    - f. Terminal strip for interfacing with a building automation system.
  - 4. Accessories:
    - a. Duct probe with tubing and pressure transducer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install listed components in a manner conforming to the listing.
- C. Install support plates prior to installing inducer fan or dampers.
- D. Install draft inducer fans in single-wall vent section that is designed to couple with other vent materials.
- E. Secure draft inducer fans to appliances, breechings, or stacks with hardware compatible with connected materials.
- F. Install draft inducer fans with clearances for service and maintenance.
- G. Locate flue pressure sensor in vent flue pipe according to the manufacturer installation instructions.
- H. Locate combustion air pressure sensor in the combustion air pipe according to the manufacturer installation instructions. Sensor shall be located in the room with appliances and have flexible tubing extended outside for reference to neutral.
- I. Secure barometric dampers to breechings with hardware compatible with connected materials.
- J. Locate barometric and motorized vent dampers as close to draft hood collar as possible.
- K. Secure barometric and motorized vent dampers to appliances, breechings, or chimneys with hardware compatible with connected materials.

- L. Install PVC intake duct that is sized according to manufacturer's written instructions.
- M. Dryer Vent System Controller:
  - 1. Locate the duct pressure probe in the dryer vent duct according to the manufacturer installation instructions.
  - 2. Wire the pressure transducer to the modulating fan controller.

### 3.2 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems".
- B. Connect wiring according to Division 26 Section "Common Work Results for Electrical".

### 3.3 STARTUP

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions.
- C. Electrical: Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements of Division 26 Sections. Do not proceed with startup of fans or equipment served until wiring installation is acceptable to equipment installer.
- D. Remove and replace malfunctioning components and recheck.
- E. Startup: Contractor shall startup and demonstrate operation of system as follows:
  - 1. Start system according to manufacturer's instructions.
  - 2. Operate and adjust controls and safeties.
  - 3. Operate system including accessories and controls, to demonstrate compliance with requirements.

### 3.4 ADJUSTING

- A. Set field-adjustable switches and controls as indicated.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain draft control devices. Refer to Division 1 and Division 23 Section "General Mechanical Requirements".

### 3.6 TRAINING

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
  - 1. Overview of the system and/or equipment as it relates to the facility as a whole.
  - 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
  - 3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."
- C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time,

attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.

- D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 23 52 16 - CONDENSING BOILERS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Manufactured units.
- B. Boiler construction.
- C. Boiler trim.
- D. Fuel burning system.
- E. Factory installed controls.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.
- C. Water Sample: Conduct a water sample test prior to boiler installation to coordinate the chemical treatment requirements with the water treatment supplier.

**1.3 SUBMITTALS**

- A. General: Submit the following in accordance with the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories; and installation and startup instructions. For boilers with factory-mounted starters, provide short circuit current rating.
- C. Shop drawings detailing fabrication and installation of equipment assemblies. Indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring.
  - 2. AGA design certificates, for information.
- D. Manufacturer's field reports, indicating work supervised and performed and related observations, for information.
  - 1. Indicate compliance with specified performance and efficiency.
  - 2. Provide results of the following combustion tests:
    - a. Boiler firing rate.
    - b. Over fire draft.
    - c. Gas flow rate.
    - d. Heat input.
    - e. Burner manifold gas pressure.
    - f. Percent carbon monoxide.
    - g. Percent oxides of nitrogen.
    - h. Percent oxygen.
    - i. Percent excess air.
    - j. Flue gas temperature at outlet.
    - k. Ambient temperature.
    - l. Net stack temperature.

- m. Percent stack loss.
  - n. Percent combustion efficiency.
  - o. Heat output.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- G. Software: Copy of software provided under this section.

#### **1.4 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. NFPA Compliance:
- 1. Comply with NFPA 70 "National Electrical Code" for components and installation.
  - 2. Comply with NFPA 31 "Standard for the Installation of Oil Burning Equipment" for boilers with fuel oil burners.
  - 3. Comply with NFPA 54 "National Fuel Gas Code" for boilers with natural gas burners.
  - 4. Comply with NFPA 58 "Liquefied Petroleum Gas Code" for boilers with propane burners.
- C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
- 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- D. AGA Compliance: Design certified by AGA, tests and ratings according to AGA requirements.
- E. AHRI Compliance: Comply with AHRI 1500 "Performance Rating of Commercial Space Heating Boilers".
- F. ASME Compliance: Fabricate and stamp boilers according to ASME Boiler and Pressure Vessel Code, Section IV, "Heating Boilers." Provide control and safety devices in compliance with locally adopted edition of ASME CSD-1.

#### **1.5 DELIVERY STORAGE AND HANDLING**

- A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

#### **1.6 WARRANTY**

- A. Refer to Division 01 for additional warranty requirements.
- B. Provide a five year warranty to include coverage for heat exchanger.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Variable Primary Flow System Condensing Boilers.
- 1. Aerco.
  - 2. Camus Hydronics.
  - 3. Cleaver Brooks
  - 4. Fulton.

5. Lochinvar.
6. Raypak
7. RBI.
8. Viessmann.

## 2.2 MANUFACTURED UNITS

- A. Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.
- B. Unit: Metal membrane wall, water or fire tube, condensing boiler on integral structural steel frame base with integral fuel burning system, firing controls, boiler trim, insulation, and removable jacket, suitable for indoor application.
- C. Performance Characteristics: Refer to the schedule on the drawings for capacity, efficiency and electrical characteristics.

## 2.3 BOILER CONSTRUCTION

- A. Conform to the minimum requirements of ASME BPVC-IV and ANSI Z21.13 for construction of boilers.
- B. Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of ASHRAE Std 90.1.
- C. Required Directory Listings:
  1. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at [www.ahrinet.org](http://www.ahrinet.org).
  2. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); current edition at [www.nationalboard.org](http://www.nationalboard.org).
- D. Heat Exchanger: Construct with materials that are impervious to corrosion where subject to contact with corrosive condensables.
- E. Provide adequate tappings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.
- F. Insulate casing with insulation material, protected and covered by heavy-gage metal jacket.
- G. Factory apply boiler base and other components, that are subject to corrosion, with durable, acrylic, powder coated or painted.

## 2.4 BOILER TRIM

- A. ASME rated pressure relief valve.
- B. Flow switch.
- C. Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.
- D. Temperature and pressure gage.
- E. Pressure Switches:
  1. High gas pressure.
  2. Low gas pressure.
  3. Air pressure.
- F. Manual reset high limit.
- G. Boiler Pump (where required by boiler design):

1. Primary pump, factory supplied and sized for field installation to ensure minimum, continuous circulation through boiler.
2. Where pump is not provided by boiler manufacturer, provide pump in accordance with boiler manufacturer's recommendations.

## 2.5 FUEL BURNING SYSTEM

- A. Provide forced draft automatic burner or pulse combustion, integral to boiler, designed to burn natural gas and maintain fuel-air ratios automatically.
  1. Blower Design: Statically and dynamically balanced to supply combustion air; direct connected to motor.
  2. Forced Draft Design: Mixes combustion air and gas to achieve minimum 90 percent combustion efficiency.
  3. Pulse Combustion Design: Self-aspirating, not requiring blower for combustion.
  4. Combustion Air Filter: Protects fuel burning system from debris.
- B. Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture.
- C. Emission of Oxides of Nitrogen Requirements: Comply with local authorities having jurisdiction requirements for nitrous oxide emissions for natural gas fired systems, as applicable.
- D. Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe

## 2.6 FACTORY INSTALLED CONTROLS

- A. Option for internal or external (0-10) VDC control.
- B. Temperature Controls:
  1. Automatic reset type to control fuel burning system on-off and modulating firing rate to maintain temperature.
  2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.
  3. Low-fire start time delay relay.
  4. Flue gas temperature and supply water temperature compensation to prevent boiler over-firing.
- C. Electronic PI setpoint/modulation control system.
- D. Microprocessor-based, fuel/air mixing controls
- E. Controller: Provide a master firing control processor. Processor shall be capable of all boiler operation and efficient staging. The master firing control shall be equipped with open protocol communication according to the drawings and specifications. The processor shall be compatible with the existing or specified control system.
- F. Boiler pump time delay.

## 2.7 SOURCE QUALITY CONTROL

- A. Test and inspect boilers according to ASME Boiler and Pressure Vessel Code, Section IV for low-pressure boilers and Section I for high-pressure boilers.
- B. Provide factory tests to check construction, controls, and operation of unit.
- C. Manufacturer to conduct boiler inspection prior to shipment; submit copy of inspection report to Architect.

**2.8 ACCESSORIES**

- A. Exhaust mufflers (as applicable).
- B. Air supply mufflers (as applicable).
- C. Flow Switch: Furnish field-mounted differential pressure sensor or thermal dispersion flow switch (paddle-type flow switch not allowed).

**PART 3 - EXECUTION****3.1 COORDINATION**

- A. Coordinate layout and installation of boilers with related work.
- B. Furnish copy of manufacturer's wiring diagram submittal to electrical Installer.
- C. Coordinate size and location of concrete housekeeping pads.

**3.2 INSTALLATION**

- A. Install boilers level and plumb, according to manufacturer's written instructions, rough-in drawings, and referenced standards.
- B. Install according to NFPA 54.
- C. Support boilers on concrete pad constructed in accordance with Division 23 section "Common Work Results for HVAC". Cast anchor bolt inserts into pad.
- D. Provide spring vibration isolation mounts where recommended by manufacturer for pulse combustion boilers.
- E. Assemble units and parts shipped loose or disassembled.
- F. Install electrical devices furnished with boiler but not specified to be factory mounted.

**3.3 CONNECTIONS**

- A. Install piping adjacent to boiler to allow service and maintenance.
- B. Connect air intake and exhaust piping to boiler, size as recommended by manufacturer. Provide intake piping material per manufacturer's recommendations unless otherwise noted on the drawings. Refer to Division 23 Section "Breechings, Chimneys, and Stacks" for flue exhaust piping. Pitch toward boiler minimum of 2 percent or as indicated. Provide termination as indicated.
- C. Connect gas piping to boiler according to requirements of Division 22 Section "Natural Gas Systems." Provide union with sufficient clearance for burner removal and service.
  - 1. Install pressure relief lines from the gas train devices to discharge outside of the building. Relief lines shall be black steel pipe with malleable iron fittings one pipe size larger than the relief outlet of the device. Provide turn down with 40 mesh insect screen at discharge. Provide individual relief lines for each gas train device.
  - 2. Install pressure regulators required in the main gas piping a minimum of 10 feet from the burner connections.
- D. Connect hot water piping to supply and return boiler tapings, according to requirements of Division 23 section "Hydronic Piping." Provide shutoff valve and union or flange at each connection.
- E. Connect condensate piping to boiler connection and/or flue stack according to manufacturer's requirements. Install Schedule 40 CPVC pipe and fittings from boiler to nearest floor drain or as

indicated with PH neutralizer. Provide clear plastic tubing between boiler module connection and manifold connection.

- F. Pipe relief valves to nearest floor drain.

### **3.4 CLEANING AND TOUCH-UP PAINTING**

- A. Flush and clean boilers upon completion of installation, in accordance with manufacturer's start-up instructions.
- B. Just prior to substantial completion clean unit's exposed surfaces.
- C. Retouch any marred or scratched surfaces of factory-finished surfaces, using finish materials furnished by manufacturer.

### **3.5 STARTUP**

- A. Arrange with National Board of Boiler and Pressure Vessel Inspectors and/or local authority having jurisdiction for inspection of boiler piping and for certification of completed boiler units.
- B. Provide services of a factory-authorized service representative to provide startup service.
- C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements of Division 26 Sections. Do not proceed with boiler startup until wiring installation is acceptable to equipment installer.
- D. Start boilers according to manufacturer's instructions.
- E. Adjust burner for maximum burning efficiency.
- F. Operate and adjust controls and safeties.
- G. Retouch any marred or scratched surfaces of factory-finished surfaces, using finish materials furnished by manufacturer.

### **3.6 DEMONSTRATION**

- A. Provide services of a factory-authorized service representative to demonstrate the operation of the boiler, burner and controls.
- B. Operate boiler, including accessories and controls, to demonstrate compliance with requirements.

### **3.7 TRAINING**

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section. The contractor shall account for all shifts.
- B. Content: Training shall include but not be limited to:
  - 1. Overview of the system and/or equipment as it relates to the facility as a whole.
  - 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
  - 3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
- C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 23 53 23 - BOILER ACCESSORIES****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. Extent of boiler accessories work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Types of boiler accessories specified in this section include the following:
  - 1. Safety and relief valves.. Water relief valves.
- C. Refer to other Division-23 sections for boilers, piping, specialties, concrete pads, etc., required for installation of boiler accessories; not work of this section.

**1.2 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of boiler accessories, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
  - 1. ASME Compliance: Construct and install boiler accessories in accordance with ASME "Boiler and Pressure Vessel Code". Install boiler accessories in accordance with ASME B31.1 "Power Piping", or ASME B31.9 "Building Services Piping", as applicable.

**1.3 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights (shipping, installed, and operating where applicable), furnished specialties and accessories; and installation and start-up instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
- C. Wiring Diagrams: Submit ladder-type wiring diagrams for electrically operated boiler accessories. Clearly differentiate between portions of wiring that are factory-installed and portions to be field installed.
- D. Maintenance Data: Submit maintenance data and parts lists for each boiler accessory, including "troubleshooting" maintenance guide. Include this data and product data in maintenance manual; in accordance with requirements of Division 1.

**PART 2 - PRODUCTS AND MATERIALS****2.1 SAFETY AND RELIEF VALVES**

- A. Water Relief Valves: Provide water relief valves as indicated, of size and capacity as selected by Installer for proper relieving capacity, constructed in accordance with ASME Boiler and Pressure Vessel Code.
  - 1. Pressure Relief Valves: Construct of bronze body, metallic disc, metal seat, with non-mechanically guided stem. Set valve to relieve at 10 PSI above operating pressure.
  - 2. Manufacturers: Subject to compliance with requirements, provide water relief valves of one of the following:
    - a. Amtrol, Inc.
    - b. Bell & Gossett ITT.

- c. Spirax Sarco Co.
- d. Watts Regulator Co.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF BOILER ACCESSORIES**

- A. Install boiler accessories as indicated, in accordance with manufacturer's installation instructions, and with recognized industry practices, to ensure that boiler accessories comply with requirements and serve intended purposes. Comply with requirements of state and local boiler codes, applicable portions of ASME Boiler and Pressure Vessel Code, and applicable portions of ANSI B31.1 or ASME B31.9.
- B. Coordinate with other work as necessary to interface installation of boiler accessories with other components of heat generation systems.

#### **3.2 SAFETY AND RELIEF VALVES**

- A. Water Relief Valves: Install as indicated on top of boilers. Pipe discharge to floor drain.

#### **3.3 FIELD QUALITY CONTROL**

- A. Flush and clean boiler accessories upon completion of installation, and in accordance with manufacturer's installation instructions.
- B. Hydrostatically test, if required, assemble boiler accessories and piping in accordance with applicable sections of ASME Boiler and Pressure Vessel Code.

END OF SECTION

**SECTION 23 64 16 - CENTRIFUGAL WATER CHILLERS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Chiller Package.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Chilled water connections.
- E. Condenser water connections.
- F. Variable frequency drives.
- G. Starters.
- H. Electrical power connections.

**1.2 SUBMITTALS**

- A. Reference Division 01 for general submittal procedures.
- B. Product Data: Provide rated capacities, minimum and maximum chilled water flows, weights (shipping, installed, and operating), specialties and accessories and electrical requirements. Submit manufacturer's ladder type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field installed. Provide short circuit current rating of factory mounted starter or variable frequency drive.
- C. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
- D. Manufacturer's Certificate: Certify that components of package not furnished by manufacturer have been selected in accordance with manufacturer's requirements.
- E. Test Reports: Indicate energy input versus cooling load output from 0 to 100 percent of full load at specified and minimum condenser water temperature.
- F. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.
- G. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
- H. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble- shooting guide.
- I. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- J. Submit certification of compliance with ASME, UL, AND ASHRAE fabrication requirements specified in "Reference Standards" above.
- K. Submit certification of compliance with performance verification requirements specified in "Reference Standards" above.
- L. Submit field quality control reports specified in PART 3 of this Section.
- M. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Reference Division 01 for additional provisions.

2. Extra Refrigerant: One container.
3. Extra Lubricating Oil: One container.

### 1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- B. Provide certification of inspection in compliance with the requirements of Authority Having Jurisdiction.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- D. Machine Experience: At time of submission of bid or proposal, chiller model proposed must have acquired minimum of 2 years experience on each of 10 field installations, each machine having acquired minimum of 2,400 operating hours.
- E. UL Compliance: Fabricate centrifugal chillers to comply with UL 1995 "Standard for Safety Heating and Cooling Equipment".

### 1.4 DELIVERY STORAGE AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Handle chillers and components properly to prevent damage, breaking, denting and scoring. Do not install damaged reciprocating chillers or components; replace with new. Comply with manufacturer's rigging and installation instructions for unloading chillers, and transporting them to final location.
- C. Store chiller and components in clean dry space. Protect from weather, dirt, fumes, water, construction debris, and physical damage. Storage temperatures for unit controls are not to exceed 185 deg. F.

### 1.5 WARRANTY

- A. Reference Division 01 for additional warranty requirements.
- B. Manufacturer's Special Warranty on Compressor and Electric Motor: Written parts and labor warranty, signed by manufacturer agreeing to repair or replace compressor and/or compressor motor, including replacement of refrigerant.
  1. Warranty Period: Manufacturer's standard, but not less than five years after date of Substantial Completion.
- C. Manufacturer's Special Warranty on Compressor Bearings: Written parts and labor warranty, signed by manufacturer agreeing to repair or replace compressor bearings and related damage including replacement of refrigerant, and including tear down for bearing inspection in the fifth year of operation.
  1. Warranty Period: Manufacturer's standard, but not less than five years after date of Substantial Completion.
- D. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. Carrier.
- B. Daikin Applied.
- C. Dunham Bush.
- D. Trane.
- E. York.

**2.2 CHILLERS**

- A. Chillers: Factory assembled and tested, packaged, water cooled, hermetic or open type centrifugal chillers consisting of centrifugal compressors, compressor motors, condenser, evaporator, refrigeration accessories, instrument and control panel including gauges and indicating lights, auxiliary components and accessories, and motor starters. Provide with standard factory-finish.
- B. Rating: Comply with AHRI 550/590 "Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle".
- C. Safety: Comply with UL 1995 "Heating and Cooling Equipment".
- D. Comply with ASME BPVC-VIII-1 "Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels" for construction and testing of centrifugal chillers.
- E. Comply with ASHRAE Std 15 "Safety Standard for Refrigeration Systems" for safe construction and operation of centrifugal chillers.

**2.3 COMPRESSORS**

- A. Compressor Casing: Fine grain cast iron, horizontally or vertically split with machined passages and leak tested to minimum 150 psig, with gasketed sealed casing joints and refrigerant sight glass.
- B. Impellers: Single or multi-stage, in-line design, fully shrouded, statically and dynamically balanced, cast high strength aluminum alloy, tested to 20 percent over operating speed, designed and assembled for no critical speeds within operating range, mounted on heat treated forged or rolled steel shaft, nonferrous, labyrinth seals between stages.
- C. Guide Vanes: Modulating radial blade dampers on each stage, with externally mounted electric operator, suitable for capacity reduction to 10 percent of specified load without hot gas bypass when supplied with design entering water quantity and temperature.
- D. Bearings: Steel or aluminum journal bearings, pressure lubricated.
- E. Gear Box: Double helical design, symmetrical and center supported by spherically seated, self aligning bearing, arranged for inspection without disassembly.
  - 1. Provide speed increasing transmissions for variable speed chillers to not exceed 10,000 rpm compressor speed.
- F. Motor: Hermetically sealed or open type, designed for single or variable speed as defined on the Drawings, low slip, squirrel cage, induction type. Full load operation of the motor shall not exceed nameplate rating. Rotor shaft shall be heat treated carbon steel and designed such that the first critical speed is well above the operating speed. Provide for removal of the stator for service or replacement without breaking the main refrigerant piping connections.

- G. Lubrication: Provide forced circulation type lubrication system with positive displacement submerged oil pump, with oil cooler if required for proper performance, pressure regulator, replaceable oil filters, thermostatically controlled oil heater, and motor controls. System shall provide positive pressure lubrication of journals, bearings and seals (if any), during start-up, operation, and coast-down of chiller, including power interruptions. Interlock to start before chiller motor and run after motor is shut down. On units with two compressors provide redundant oil pump. Provide sight glass or electronic sensors for monitoring oil level.
- H. Refrigerant: Factory pre-charge unit with refrigerant.

## 2.4 EVAPORATOR

- A. Provide evaporator of shell and tube type, seamless or welded steel, seamless copper tubes with integral individually replaceable fins, rolled or silver brazed into tube sheets. Position intermediate tube support sheets along length of shell to avoid contact and relative motion between adjacent tubes. Tubes shall be removable from either end of the heat exchanger without affecting the strength and durability of the tube sheets and without causing leakage in adjacent tubes.
- B. Hydronic Piping Connections: Integral to the water heads with flanged or grooved connections.
- C. Test and, where applicable, stamp refrigerant side for 150 psig working pressure and water side for working pressure as scheduled on the drawings, in accordance with ASME BPVC-VIII-1.
- D. Provide marine type water boxes, machine welded to heat exchanger with tapped drain and vent connections, and flanged or mechanical joint connections arranged to permit inspection of tubes from either end without disturbing refrigerant and removable without disturbing water piping. Tube cleaning shall be within space shown on the drawings.
- E. Provide thermometer wells or thermistors for temperature controller and low temperature cutout. Provide suitable tappings for control sensors and gauges.
- F. Design and construct evaporator to prevent liquid refrigerant from entering the compressor.
- G. Provide carbon rupture disc or relief valve on shell in accordance with ASHRAE Std 15.
- H. Provide pressure limiting devices in accordance with ASHRAE Std 15.
- I. Construction and materials to comply with ASME BPVC-VIII-1 or ASHRAE Std 15 as applicable to chiller manufacturer and chiller model.

## 2.5 CONDENSERS

- A. Provide condensers of shell and tube type, seamless or welded steel construction with fabricated steel heads, seamless copper tubes with integral fins, rolled or silver brazed into tube sheets. Position intermediate tube support sheets along shell length to avoid contact and relative motion between adjacent tubes. Tubes shall be removable from either end of the heat exchanger without affecting the strength and durability of the tube sheets and without causing leakage in adjacent tubes.
- B. Hydronic Pipe Connections: Integral to the water heads with flanged or grooved connections.
- C. Test and, where applicable, stamp refrigerant side for 150 psig working pressure and water side for working pressure as scheduled on the drawings; in accordance with ASME BPVC-VIII-1.
- D. Provide marine type water boxes, machine welded to heat exchanger with tapped drain and vent connections, and flanged or mechanical joint connections arranged to permit inspection of tubes from either end without disturbing refrigerant and removable without disturbing water piping. Tube cleaning shall be within space shown on the drawings.
- E. Provide carbon rupture disc or relief valve on shell in accordance with ASHRAE Std 15.
- F. Provide pressure limiting devices in accordance with ASHRAE Std 15.

- G. Provide baffles to ensure even distribution of incoming gas and to concentrate non-condensable gases.
- H. Construction and materials to comply with ASME BPVC-VIII-1.

## 2.6 PURGE SYSTEM

- A. Provide purge system on positive pressure units, incorporating a low temperature refrigeration system to automatically remove non-condensable gases, water and air, and for condensing, separating, and returning refrigerant to the system.
- B. Provide all necessary devices to automatically isolate purge system from chiller.
- C. System discharge shall be maximum 0.60 pound of refrigerant per pound of air discharged.

## 2.7 INSULATION

- A. Insulate evaporators and other cold surfaces to prevent condensation, with ambient humidity of 75 percent and dry-bulb temperature of 90 deg. F, no air movement.
- B. Insulate condensers used for free cooling, heat recovery or heat pump operation with minimum 1" thick insulation.
- C. Provide manufacturer's standard insulation material.

## 2.8 CONTROLS

- A. Disconnect Switch: As indicated on the drawings.
- B. Flow Switch: Furnish field-mounted differential pressure sensor or thermal dispersion flow switch (paddle-type flow switch not allowed)
- C. Refrigerant Flow Control Devices:
  - 1. Provide refrigerant flow control devices between evaporator and condensers (and elsewhere as required) to regulate refrigerant flow at volume and pressure required to maintain evaporator liquid refrigerant at level sufficient to keep cooler heat transfer tubes adequately wetted through full range of chiller operation.
  - 2. Design devices to permit chiller operation at scheduled conditions, and to allow condenser entering water temperature to decrease to minimum permissible temperature or 1 deg. F above return chilled water temperature.
- D. Capacity Control:
  - 1. Designed and fabricated to regulate evaporator leaving water temperature. Design for capacity modulation, from full load to scheduled minimum load capacity under normal operating conditions, without overshooting and without hunting at scheduled throttling range.
- E. Safeties and diagnostics:
  - 1. Provide electronic overloads and indicating light, current fault protection and indication light, power failure indication light, high temperature protection and indication light, transient voltage protection insensitive to input phase sequence, phase loss protection, diagnostic test switches, and hinged access doors with key lock.
- F. Provide microprocessor-based control panel, factory-mounted and wired, containing solid state, fully automatic operating and safety controls. Provide proportional integral derivative (PID) control strategies. Provide operator interface that accesses chiller information and control adjustments at the face of the control panel.
- G. Provide communications port to communicate with the building management system with BACNet or LONWorks compatible interface for chiller monitoring, control and data gathering. Coordinate with the building controls contractor the exact building management system requirements.

- H. Provide electrical interlock to prevent chiller operation when chilled water pump(s) and/or condenser water pump(s) are not operating.
- I. Provide the following manufacturer's standard safety controls, including the following minimum functions, so that operating any one will shut down machine and require manual reset:
  - 1. Low evaporator refrigerant temperature.
  - 2. High condenser refrigerant pressure.
  - 3. Low oil pressure.
  - 4. Low refrigerant (evaporator) pressure.
  - 5. High compressor discharge temperature.
  - 6. Low evaporator leaving water temperature (freeze-stat).
  - 7. High motor temperature.
  - 8. High bearing temperature.
  - 9. High oil temperature.
  - 10. Compressor motor overcurrent or over voltage.
  - 11. Power interruption.
- J. Include anti-recycle timer, factory wired to control panel, limiting compressor motor restarts at time intervals as recommended by manufacturer.
- K. Provide the manufacturer's standard safety controls arranged so that operating any one will shut down machine and automatically reset.
- L. Provide a diagnostic module capable of indicating all lockout conditions specified above, plus recording the elapsed time (pre-alarm to alarm), the operating conditions of the compressor motor (amperes), refrigerant temperatures and pressures, and chilled and condenser water temperatures (entering and leaving) at the time of lockout.
- M. Provide the following devices on control panel:
  - 1. Manual Switches:
    - a. Machine off-auto switch.
    - b. Oil pump switch (manual or automatic).
    - c. Purge pump switch (manual-off-auto).
    - d. Machine selector switch to allow load, unload, hold or automatic operation.
  - 2. Manual Set Point Adjustments:
    - a. Leaving chilled water temperature.
    - b. Current demand limit.
  - 3. Status Lights:
    - a. Chilled water flow proven.
    - b. Cooling required.
    - c. Unit running.
    - d. Unit loading.
    - e. Unit unloading.
    - f. Manual reset required.
    - g. Remote chilled water set point active.
    - h. Remote current water set point active.
  - 4. Setpoint and Temperature Display:
    - a. Chilled water set point.
    - b. Current limit set point.
    - c. Entering evaporator water temperature.
    - d. Leaving evaporator water temperature.
    - e. Entering condenser water temperature.
    - f. Leaving condenser water temperature.
  - 5. Dial Type Pressure Gauges:
    - a. Evaporator refrigerant pressure.
    - b. Condenser refrigerant pressure.
    - c. Low oil pressure (oil sump).
    - d. High oil pressure (oil supply).



- N. Provide the following operating controls:
1. Solid state, chilled water temperature controller that controls electronic guide vane operator or compressor speed. Locate temperature sensor in entering chilled water.
  2. Adjustable thirty minute off timer prevents compressor from short cycling.
  3. Demand limit device to manually set maximum current infinitely between 40 percent and 100 percent of full load amperes.
  4. Automatic start that determines demand for chilled water from proof of chilled water flow and temperature differential between chilled water set point and supply temperature.
  5. Solenoid valve between heat recovery condenser and receiver to limit refrigerant level in condenser.
  6. Provide controls to ensure that compressor will start only under unloaded condition.
  7. Provide sequencing controls to ensure lubrication of compressor motor bearings and seals (if any). Sequence as follows:
    - a. Run lubrication system oil so that compressor motor bearing is lubricated before start-up,
    - b. Start compressor motor,
    - c. Provide lubrication during coast-down after compressor motor shut-down.
  8. Provide modular electronic or solid state controls.
  9. Design controls to automatically restart compressor after power failure interruptions, provided minimum time between starts has been complied with.

## 2.9 SOUND

- A. For water-cooled indoor chillers, sound pressure and/or power level ratings shall comply with AHRI Standard 575 "Method of Measuring Machinery Sound within Equipment Space".
- B. Maximum Permissible Sound Pressure Level (SPL): Use 0.0002 microbar as reference. SPL measurements shall be taken in multiple directions that uniformly cover 360 degrees. Measurements shall be taken at a distance from the unit as specified in the applicable AHRI Standard. Unit shall be operating at full load under standard AHRI ambient and water temperature conditions and within the installation parameters set forth by the applicable AHRI Standard.
- C. Do not exceed the maximum permissible dB level in any of the following octave bands:

Sound, dB	63Hz	125Hz	250Hz	.5kHz	1kHz	2kHz	4kHz	8kHz	LwA
Pressure	--	--	--	--	--	--	--	--	--
Power	--	--	--	--	--	--	--	--	--

## 2.10 VIBRATION ISOLATION

- A. Provide devices of type and size recommended by chiller manufacturer and as required in Division 23 Section "Vibration Isolation for HVAC."

## 2.11 VARIABLE FREQUENCY DRIVE (VFD) UNIT MOUNTED

- A. Furnish chiller with factory-mounted, liquid-cooled variable frequency drive (VFD) shipped completely factory-assembled, wired, and tested.
- B. Specifically design VFD to interface with the centrifugal water chiller controls and allow for the operating ranges and specific characteristics of the chiller. VFD control logic is to optimize chiller efficiency by coordinating compressor motor speed and compressor inlet guide vane position to maintain the chilled water setpoint while avoiding surge. If surge is detected, VFD surge avoidance logic shall adjust chiller operation to move away from and avoid surge at similar conditions in the future.
- C. VFD Efficiency: 97 percent or better at full speed and full load.
- D. Fundamental Displacement Power Factor: Minimum of 0.96.

- E. Provide voltage and current regulated, solid state, microprocessor-based pulse-width modulated (PWM) VFD. Output power devices to be IGBT transistors.
- F. Provide liquid-cooled heatsink to cool the power semi-conductor and capacitor.
- G. Provide cleanable shell and tube heat exchanger with water-cooled design. Do not provide plate and frame heat exchanger.
- H. Furnish VFD in a NEMA Type 1 metal enclosure having a minimum short circuit withstand rating of 65,000 amps per UL 508. Include three phase input lugs plus a grounding lug for electrical connections, output motor connection via factory-installed bus bars and all components properly segregated and completely enclosed in a single, metal enclosure.
  - 1. Enclosure to include a pad lockable, door-mounted circuit breaker with shunt trip and AIC rating of 65,000 amps.
  - 2. Entire chiller package to be listed by Underwriter's Laboratories Inc.
- I. VFD to be tested according to UL 508 and listed by a Nationally Recognized Testing Laboratory (NRTL) as designated by OSHA.
- J. Comply with recommendations stated in IEEE 519 "Recommended Practice and Requirements for Harmonic Control in Electric Power Systems".
  - 1. Include integrated active rectification control system to limit total demand distortion (TDD) in current at the VFD to less than or equal to 5 percent as measured at the VFD input. If active filters are used to meet this requirement, then the losses associated with the filter are to be included in the chiller performance on the selection.
- K. Fundamental Displacement Power Factor: Minimum of 0.96.
- L. Voltage Input: Nominal 480 volts, three phase, 60 hertz AC, plus or minus 10 percent of nominal voltage.
- M. Line Frequency: 38 to 60 hertz.
- N. VFD to include the following:
  - 1. All control circuit voltages physically and electrically isolated from power circuit voltage.
  - 2. 150 percent instantaneous torque available for improved surge control.
  - 3. Soft start, adjustable linear acceleration, coast-to-stop.
  - 4. Adjustable current limiting and UL approved electronic motor overload protection.
  - 5. Insensitivity to incoming power phase sequence.
  - 6. VFD and motor protection from the following faults:
    - a. Output line-to-line short circuit.
    - b. Line-to-ground short circuit.
    - c. Phase loss at VFD input.
    - d. Phase reversal/imbalance.
    - e. Over-voltage.
    - f. Under-voltage.
    - g. Over-temperature.
- O. Include the following VFD status indicators available to facilitate startup and maintenance:
  - 1. Output speed in hertz and rpm.
  - 2. Input line voltage.
  - 3. Input line kW.
  - 4. Output/load amps.
  - 5. Average current in percent RLA.
  - 6. Load power factor.
  - 7. Fault.
  - 8. VFD transistor temperature.
- P. Service Conditions (at full output power; no external venting or heat exchangers required):
  - 1. Operating Ambient Temperature: Between 32 degrees F and 104 degrees F.
  - 2. Room Ambient Relative Humidity: Up to 95 percent.

3. Elevation: Up to 3,300 feet. For every 300 feet above 3,300 feet, decrease the rated output current by one percent.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas to receive chillers for compliance with installation tolerances and other conditions affecting performance and maintenance of chillers.
- B. Examine proposed route of moving chillers into place and verify that it is free of interference.
- C. Verify piping roughing-in locations.
- D. Verify branch circuit wiring suitability. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's installation instructions.
- B. Install chillers plumb and level, and anchor. Support units using the vibration control devices. Vibration control devices are specified in Division 23 Section "Vibration Isolation for HVAC Piping and Equipment."
- C. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad.
- D. Install vibration isolators according to isolator manufacturer's written instructions.
- E. Install chiller accessories which have been shipped loose or unassembled for shipment purposes.
- F. Maintain manufacturer's recommended clearances for servicing and maintenance.
- G. Piping installation requirements are specified in other sections of Division 23. The Drawings indicate the general arrangement of piping, fittings, and specialties.
- H. Install piping adjacent to machine to allow servicing and maintenance.
- I. Provide flanged or grooved evaporator connections to chilled water piping with accessories as indicated in the details on the drawings.
- J. Furnish and install necessary auxiliary water piping for oil cooling units and purge condensers.
- K. Insulate evaporator and cold surfaces that are not factory insulated.
- L. Insulate condensers used for free cooling, heat recovery or heat pump operation that are not factory insulated.
- M. Provide flanged or grooved condenser connections to condenser water piping with accessories as indicated in the details on the drawings. Arrange piping to allow removal of condenser heads.
- N. Arrange piping for easy dismantling to permit tube cleaning.
- O. Provide piping from chiller rupture disc to outdoors. Size as recommended by manufacturer.
- P. Provide drain piping as indicated from rupture disc or relief valve to suitable drain.

#### **3.3 ELECTRICAL CONNECTIONS**

- A. Refer to Division 26 Sections for wiring devices, wires and cables, and electrical installation requirements.
- B. Install and connect proof of flow device switches.

- C. Provide for connection of electrical wiring between starter and chiller control panel, oil pump, and purge unit.
- D. Ground equipment.
  - 1. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### **3.4 MANUFACTURER S FIELD SERVICES**

- A. Provide services of a factory-authorized service representative to supervise field assembly of components and installation of chillers, including piping, electrical and control connections, and to report results in writing.
- B. Supply initial charge of refrigerant and oil if not completely factory charged.
- C. Demonstrate system operation and verify specified performance.
- D. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

### **3.5 CLEANING**

- A. Clean finishes to remove dust and dirt.
- B. Touch up scratches in unfinished surfaces to restore corrosion resistance.
- C. Touch up scratches in finished surfaces to restore finish.

### **3.6 STARTUP**

- A. Provide services of factory trained representative for minimum of one day to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, and calibrate controls.
- B. Start-up Service:
  - 1. Evacuate, dehydrate, vacuum pump and charge with specified refrigerant, and leak test in accordance with manufacturer's instructions, if not factory charged.
  - 2. Perform lubrication service, including filling of reservoirs, and confirming that lubricant is of quantity and type recommended by manufacturer.
  - 3. Do not place chillers in sustained operation prior to initial balancing of mechanical systems for interface with chillers.

### **3.7 TRAINING**

- A. Train operating personnel in operation and maintenance of units.
- B. Provide the services of the manufacturer's field representative to conduct training.
- C. At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of eight hours on the operation and maintenance of the equipment provided under this section.
- D. Training shall include but not be limited to:
  - 1. Overview of the system and/or equipment as it relates to the facility as a whole.
  - 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
  - 3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

- E. Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- F. Schedule training with Owner with at least 7 days' advance notice.

**3.8 MAINTENANCE**

- A. Provide a separate maintenance contract for specified maintenance service.
- B. Furnish service and maintenance of complete assembly for one year from Date of Substantial Completion.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 23 65 00 - COOLING TOWERS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Cooling Tower:
  - 1. Induced-draft, propeller fan, crossflow.
- B. Controls:
  - 1. Interlock wiring specified as factory-installed is work of this Section

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical product data, including rated capacities; pressure drop, fan performance data, weights (shipping, installed, and operating), installation and start-up instructions, and rating curves with selected points clearly indicated. Provide short circuit current rating of factory mounted starter or variable frequency drive.
- B. Shop Drawings: Submit assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of all components.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to cooling towers. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- D. Maintenance Data: Submit maintenance data and parts list for each cooling tower, control, and accessory; including "trouble- shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams, in operation and maintenance manual; in accordance with requirements of Division 1.
- E. Certifications: Submit required certifications and written tests results for required testing.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

**1.3 QUALITY ASSURANCE**

- A. CTI Certification:
  - 1. CTI ATC-105 Acceptance Test Code for Water Cooling Towers: Provide manufacturer's certification of tower cooling capacity in compliance with CTI ATC-105 -, based on factory-performance tests, and provide performance curve plotting Leaving-Water Temperature (LWT) against Wet-Bulb Temperature (WBT).
  - 2. CTI ATC-128 Test Code for Measurement of Sound from Water Cooling Towers: Provide manufacturers certification of tower sound output in accordance with CTI ATC-128.
- B. Certify tower wind resistance to withstand pressure indicated, in any direction.
- C. Certify earthquake resistance against loading as indicated.

**1.4 REGULATORY REQUIREMENTS**

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**1.5 DELIVERY STORAGE AND HANDLING**

- A. Factory assemble entire unit. For shipping, disassemble into as large as practical sub-assemblies so that minimum amount of field work is required for re-assembly.
- B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

**1.6 WARRANTY**

- A. One-year warranty after start-up, or eighteen months from date of shipment, whichever occurs first. Warranty to include coverage for defects in material and workmanship.
- B. Provide a five year warranty on fan assembly including fan, drive and motor.
- C. The entire tower, including structure, casing, basins, decking, fan(s), motor(s), and all mechanical drive components (including belts, if used) shall be warranted against failure due to defects in materials and workmanship for a period of five (5) years from the date of shipment to the job.
- D. Factory applied and polyurethane liner shall be warranted against failure due to defects in materials and workmanship for a period of ten (10) years from the date of shipment to the job

**1.7 SPARE PARTS**

- A. General: Furnish to Owner, with receipt, the following spare parts:
  - 1. One spare set of matched fan belts for each belt driven fan.
  - 2. Three spare spray nozzles for each tower cell.
  - 3. One spare gasket for each gasketed access and inspection opening.
  - 4. One valve seat for mechanical water make-up valve.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Baltimore Aircoil Co., Inc.
- B. Evapco Inc.
- C. Marley (The) Cooling Tower Co.

**2.2 MANUFACTURED UNITS**

- A. Fabricate cooling towers using manufacturer's standard design, materials, and construction in accordance with published product information, except as otherwise indicated.

**2.3 STRUCTURAL SYSTEM**

- A. Design structural system for the following live loading in addition to tower dead-loads and operating-loads:
  - 1. Wind Loading: 30 psf on exposed vertical surfaces.
  - 2. Shipping and Hoisting Load: 2g horizontal and 3g vertical.
  - 3. Live Load: Fan deck and hot water basin cover shall be designed for 50 psf live load or 200 lb. concentrated load.
  - 4. Fabricate structural system including assembly of collecting basin and steel casings by one of the following methods:
    - a. Bolt connections with fasteners having equal or better corrosion-resistance than materials fastened; seal joints to make watertight enclosure.
    - b. Weld connections and weld metal seams continuously to make watertight.
- B. Rigging supports:



1. Provide rigging supports on structure for final rigging.

## 2.4 COMPONENTS

- A. Pan and Casing:
  1. Collecting basin and sump:
    - a. Provide the following materials and types of units, designed and installed to support water and to ensure water tightness:
      - 1) Provide stainless steel.
      - 2) Provide integral type collecting basin and sump with lift-out strainer with openings smaller than nozzle orifices.
    - b. Provide the following connections at locations where shown on the drawings:
      - 1) Drain, overflow and water make-up.
      - 2) Bottom outlet.
      - 3) Bottom equalizer connection.
      - 4) Flume box with all hardware, gaskets flume and cover plate.
      - 5) Side bypass.
  2. Casings, Frame and Fan Deck:
    - a. Provide the following materials fabricated and installed by manufacturer to make tower watertight:
      - 1) Provide stainless steel.
- B. Fans:
  1. Fans and Drives:
    - a. Fans and drives shall be installed by manufacturer.
    - b. Fan: Select fan to meet specified sound ratings.
      - 1) Cast-aluminum propeller-fan of adjustable-pitch type.
    - c. Drive:
      - 1) V-belt drive: Designed for minimum 150 percent motor nameplate power. Fabricate fan and motor sheave(s) from corrosion-resistant materials to minimize maintenance and ensure maximum drive and powerband operating life. Provide bearings with minimum L-10 life of 80,000 hours per ABMA STD 11. Belt tension must be easily adjusted in the field.
    - d. Driveshaft:
      - 1) Composite steel epoxy coated for corrosion resistance.
      - 2) Type 304 stainless steel.
      - 3)
    - e. Hub Connection:
      - 1) Stainless steel.
  2. Fan bearings:
    - a. Provide the following types installed by manufacturer.
      - 1) Provide self-aligning ball bearings; include external extended grease lines, and fittings.
- C. Motor:
  1. .
  2. Motor Type: Provide totally enclosed, air over, energy efficient type motor.
  3. Motors driven by variable frequency drives shall be inverter duty type, rated for use with variable frequency drives.
  4. Motors: Refer to Section "Common Motor Requirements for HVAC Equipment" for additional requirements.
- D. Fan Guard:
  1. Welded steel rod and wire guard, hot dipped galvanized after fabrication.
- E. Safety:
  1. Handrails:

- a. Provide galvanized steel pipe rails of required height above tower. Include knee and toe rails of required diameter and heights.
  2. Ladders:
    - a. Provide galvanized steel or aluminum ladder, to top of cooling tower working surface.
- F. Distribution Section:
  1. Provide gravity flow type water distribution system installed by manufacturer to ensure even distribution of water over wetted-surface-fill.
  2. Provide the following materials designed and installed by manufacturer for the water distribution system.
    - a. Distribution basin: Open basin constructed of Stainless steel.
    - b. Piping: Schedule 40 PVC pipe header and removable schedule 40 PVC pipe branches.
    - c. Nozzles: Provide removable plastic, brass, or ceramic nozzles.
    - d. Provide weir dams or metering nozzles to provide at least 50 percent turndown capability.
    - e. Pressure Drop: Maximum pressure drop of 5 psi.
  3. Basin Covers:
    - a. Provide basin covers materials, removable and with handles, installed by manufacturer to prevent debris from entering the basin and to inhibit algae growth by eliminating sunlight:
    - b. Provide series 300 stainless steel.
  4. Inlet Connection:
    - a. Inlet connections on each distribution basin arranged for flanged pipe connection.
    - b. Single bottominlet connection with internal self-balancing distribution piping provided by manufacturer.
  5. Flow Control Valves
    - a. Provide butterfly valves for balancing flow to each distribution basin, and for shut-off during servicing
- G. Fill:
  1. Provide the following materials fabricated into wave-formed configurations installed by manufacturer to assure break-up of water into droplets:
    - a. Provide vertical sheets of polyvinyl chloride plastic having flame spread rating of 5 per ASTM E 84.
- H. Drift Eliminators:
  1. Provide the following materials fabricated by manufacturer into three-pass configuration to limit drift-loss to indicated maximum percentage of circulating-water flow-rate:
    - a. Provide polyvinyl chloride plastic, having flame spread rating of 5 per ASTM E 84.
- I. Inlet Screens:
  1. Provide the following materials, mounted in removable frames by manufacturer:
    - a. Provide PVC screens in series 300 stainless steel frames.
- J. Sound Attenuators:
  1. Provide the following materials, factory-fabricated and mounted by manufacturer at intake and discharge of tower, lined with waterproof sound-absorbent non-combustible material held in place by manufacturer's standard method except as otherwise indicated:
    - a. Line attenuators with glass fiber.
    - b. Secure lining with galvanized steel retainers.
    - c. Secure lining with series 300 stainless steel retainers.
- K. Service Access: Provide access doors, ladders and platforms for service of the cooling tower components.
  1. Access Doors: Provide hinged access doors on each cased face for entry into the cold-water basin. Include an internal walkway for inspection and maintenance.

2. Access Door Platform: Provide an external galvanized steel access platform at the access door of the unit(s). Provide an aluminum ladder and 1-1/4 inch (32 mm) galvanized steel pipe safety railing is included with the platform.
  3. Fan Deck Ladder with Handrails: Provide an aluminum ladder with steel safety cage and safety gate for access to the fan deck. 1-1/4 inch galvanized steel pipe handrail shall be provided around the perimeter of the cooling tower cells. The handrails shall be provided with knee and toe rails and shall conform to OSHA requirements applicable at the time of shipment.
  4. Internal Service Platform: Provide an internal platform in the plenum section to provide for inspection and maintenance of internal components and drive system.
  5. Louver Face External Platforms: Provide platforms and ladders for access to the hot water basins for inspection of spray water distribution.
- L. Water Level Control:
1. Liquid Level Switch:
    - a. Electric Probe Type:
      - 1) Stainless steel construction with minimum wire lead length required to adjust probe height for appropriate water level control.
      - 2) Provide individual probes to meet the required control points specified on the drawings.
- M. Vibration Cutout Switch:
1. Provide switch to de-energize fan motors if excessive vibration occurs due to fan imbalance.
  2. Provide enclosure NEMA rated for installation location.
  3. Provide vibration detection with sensitivity applicable to protect the proper operation of the fan system.
- N. Coatings:
1. Apply phosphatized pretreatment on zinc coated surfaces which have not been mill-phosphatized or polymer-coated. Apply gasoline-soluble rust preventative compound on ferrous parts which cannot be galvanized, including shafts and machined parts.
  2. Finish components with zinc-coated metal surfaces by one of the following methods:
    - a. Coat abraded areas and welded areas with galvanizing repair paint. Finish-paint exposed surfaces with zinc chromated paint.
    - b. Provide 2-1/4 oz. (per sq. ft. of sheet) zinc coating on basin and sump, after fabrication, by hot-dip galvanizing process. Coat abraded areas and welded areas of work with galvanizing repair paint.
    - c. Apply to metal surfaces not galvanized, zinc-rich paint which has been tested and accepted by UL as being equivalent to hot-dipped galvanized steel.
- O. Maximum Permissible Sound Pressure Level:
1. Use 0.0002 microbar as reference. Measure at 50' in several directions, uniformly covering 360 degrees. Do not exceed maximum permissible dB level, each of the following octave bands:

63 Hz	109	dB
125 Hz	110	dB
250 Hz	109	dB
500 Hz	103	dB
1000 Hz	99	dB
2000 Hz	94	dB
4000 Hz	90	dB
8000 Hz	87	dB

## 2.5 ACCESSORIES

- A. Electric Immersion Heaters: In pan suitable to maintain temperature of water in pan at 40 degrees F when outside temperature is 0 degrees F and wind velocity is 15 mph; immersion thermostat and float control operate heaters on low temperature when the pan is filled.
- B. Time Delay Relay: Limits fan motor starts to not more than six per hour.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine cooling towers before installation. Reject cooling towers that are damaged.
- B. Examine areas to receive equipment for compliance with requirements for installation tolerances and other conditions affecting unit performance.
- C. Final locations of equipment on the Drawings are approximate, unless dimensioned. Determine exact locations before roughing-in piping and electrical work.
- D. Examine proposed route of moving equipment into place and verify that it is free of interferences.
- E. Verify piping rough-in locations.
- F. Verify branch circuit wiring suitability.
- G. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install cooling towers where indicated, in accordance with equipment manufacturer's written instructions and with recognized industry practices, to ensure that cooling towers comply with requirements and serve intended purposes.
- B. Access: Provide access and service space around and over cooling towers as indicated, but in no case less than that recommended by manufacturer.
- C. Support: Install grade-mounted units on structural steel mechanical equipment stand. Anchor cooling tower to stand with removable fasteners. Coordinate tower structure with tower manufacturer and structural engineer. Account for tower cell location, spacing, etc.
  - 1. Mechanical equipment stand is specified in Division 5; not work of this Section.
- D. Placement: Install vibration isolators according to isolator manufacturer's recommendations. Refer to Division 23 Section "Vibration Isolation for HVAC" for vibration isolation requirements.
  - 1. Install gaskets or sealants between cooling tower cells.
  - 2. Level units to tolerance of 1/8" in 10'-0", in both directions.

### 3.3 CONNECTIONS

- A. Condenser Water Piping: Refer to Division 23 section "Hydronic Piping".

1. Provide flanged or union connections to cooling tower, with flexible pipe connections if tower is mounted on vibration isolators.
  2. Pitch lines so water will drain into sump.
  3. Connect inlets to cooling tower with shutoff valve, and balancing valve (if 2 or more inlets).
  4. Connect outlets with shutoff valves.
- B. Make-up and Water Piping: Refer to Division 22 section "Water Distribution Piping and Specialties".
1. Provide flanged or union connections to cooling tower, with flexible pipe connections if tower is mounted on vibration isolators.
  2. Pitch lines so water will drain into sump.
  3. Connect to automatic fill valve with 3-valve bypass, and backflow preventer.
- C. Drain Piping: Refer to Division 22 section "Sanitary Drainage and Vent Piping and Specialties".
1. Connect drain, overflow, and bleed lines to cooling tower as indicated, full size of connection on cooling tower.
- D. Refer to Division 26 Sections for wiring devices, wires and cables, and electrical installation requirements.

### 3.4 FIELD QUALITY CONTROL

- A. Provide the services of the manufacturer's field representative to inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer's recommendations.
- B. Test for capacity under actual operating conditions in accordance with CTI ATC-105 and verify specified performance.
- C. All seams on the tower and tower basin shall be properly sealed to avoid leaks. Contractor shall coordinate with manufacturer to correct any leaks prior to commencing water treatment.

### 3.5 CLEANING AND TOUCHUP

- A. Cleaning:
1. Clean inside of cooling tower thoroughly before filling for start-up.
  2. Clean factory-finished surfaces.
- B. Touchup:
1. Coated Surfaces: Repair any marred or scratched surfaces with manufacturer's touch-up paint or coating.

### 3.6 SYSTEM STARTUP

- A. Start-up tower in presence of Owner's operating personnel.
- B. Start-up: Comply with manufacturer's instructions for filling and start-up of operation, but not less than the following:
1. Verify lubrication of rotating parts; lubricate as needed.
  2. Verify fan rotation direction.
  3. Verify that motor amperage is in accordance with manufacturer's data.
  4. Balance condenser water flow to each tower, and to each inlet for multiple inlet towers.
  5. Adjust water level control for proper operating level.
  6. Adjust bleed valve for percentage of circulated water volume recommended by tower Water Treatment Consultant.
  7. Balance equalizer lines between multiple towers (if any).
  8. Adjust temperature controls and verify operation.
  9. Ensure chemical treatment system is installed, tested and operational prior to filling cooling tower.

**3.7 TRAINING**

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
  - 1. Overview of the system and/or equipment as it relates to the facility as a whole.
  - 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
  - 3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."
- C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

**SECTION 23 72 00 - AIR-TO-AIR ENERGY RECOVERY EQUIPMENT****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Heat wheels.

**1.2 SUBMITTALS**

- A. Product Data: Include rated capacities, furnished specialties, and accessories. Provide short circuit current rating of units with factory mounted starter or variable frequency drive.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, details, and attachments to other Work.
  - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
  - 3. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.
- D. Operation and Maintenance Data: Submit maintenance data and parts list for each unit, including "trouble-shooting" maintenance guide, servicing guide and preventative maintenance schedule and procedures. Include this data in maintenance manual; in accordance with requirements of Division 1.
- E. Warranty: Submit manufacturer's warranty and ensure forms are completed in Owner's name and registered with manufacturer.
- F. Field quality-control test reports.

**1.3 QUALITY ASSURANCE**

- A. Source Limitations: Obtain air-to-air energy recovery units through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of air-to-air energy recovery units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.
- D. AHRI Compliance: Capacity ratings for air-to-air energy recovery equipment shall comply with AHRI 1060 "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment".
- E. ASHRAE Compliance: Capacity ratings for energy recovery devices shall comply with ASHRAE 84 "Method of Testing Air-to-Air Heat Exchangers".
- F. NRCA Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.

#### 1.4 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 23 Section "Common Work Results for HVAC".

#### 1.5 SPARE PARTS

- A. Furnish spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: Furnish one set of each type of filter specified.
  - 2. Fan Belts: Furnish set of belts for each belt-driven fan in energy recovery units.
  - 3. Wheel Belts: Furnish set of belts for each heat wheel.

### PART 2 - - PRODUCTS

#### 2.1 HEAT WHEELS

- A. Manufacturers:
  - 1. Airxchange
  - 2. Aldes North America.
  - 3. FlaktGroup SEMCO.
  - 4. Heatex, Inc.
  - 5. Novel Aire Technologies
  - 6. Thermotech Enterprises, Inc.
  - 7. Xetex
- B. Cabinet: Galvanized steel with manufacturer's standard paint coating. Include the following:
  - 1. Internally insulated.
  - 2. Casing seals on periphery of rotor, and on duct divider, with 1-inch duct flanges for connection of supply and exhaust ducts.
  - 3. Support removable rotor on grease-lubricated ball bearings with extended grease fittings, or permanently lubricated ball bearings. Mount horizontal wheels on tapered roller bearing.
- C. Wheel: Provide enthalpy type for both sensible and latent heat recovery designed to ensure laminar flow.
  - 1. Construct wheel media of corrugated aluminum, glass-fiber or polymer material , with non-toxic, noncorrosive silica-gel or molecular sieve desiccant coating permanently bonded to the media.
  - 2. Provide wheel structure of stainless steel framework for supporting segments that are removable for servicing,
  - 3. Construct media for passing maximum 800 micrometer solids and maximum 0.04 percent cross contamination by volume of exhaust air.
  - 4. Energy recovery device shall transfer moisture entirely in the vapor phase, so unit shall not require a condensation pan. Drive rotor with belt around outside of rotor.
- D. Drive: Fractional horsepower motor and gear reducer.
  - 1. Provide adjustable variable-frequency controller for speed adjustment where scheduled. .
- E. Frost Protection: Provide heat or wheel speed control to eliminate frost accumulation where scheduled.
- F. Controls:
  - 1. For constant speed wheel, provide starting relay, factory mounted and wired, and manual motor starter for field wiring.
  - 2. For variable speed wheel, provide control panel factory mounted and wired to motor, with airstream thermostat and adjustable variable-frequency controller for field wiring; with pilot-light indication of rotor rotation and provisions for setting maximum and minimum speed.



- G. Rotation Detection: Provide electronic control module, electromagnetic sensor, and iron shuttle factory wired and mounted, with alarm bell for field wiring and mounting.

### **PART 3 - - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install heat wheels so supply and exhaust airstreams flow in opposite directions and rotation is from exhaust side to purge section to supply side.
  - 1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.
  - 2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
  - 3. Access doors and panels are specified in Division 23 Section "Air Duct Accessories."
- C. Install units with clearances for service and maintenance.
- D. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

#### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 sections. Drawings indicate general arrangement of piping, fittings, and specialties.
  - 1. Install piping adjacent to machine to allow service and maintenance.
  - 2. Condensate Drain Piping: Route condensate drain to nearest roof drain or to location shown on the drawings. Provide trap at connection to drain pan with depth as noted on the drawings and install cleanouts at changes in direction (refer to manufacturer's recommendations for any additional requirements). Size condensate drain piping in accordance with local code and as shown on the drawings.
  - 3. Connect condensate drain piping to the unit with appropriate trap. Verify that the piping material and installation is in accordance with Division 22 requirements.
- B. Duct and fan installation requirements are specified in other Division 23 sections. Drawings indicate general arrangement of ducts, fittings, and specialties. Provide flexible duct connectors where ducts are connected to units with fans.
- C. Ground equipment according to Division 26.
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

#### **3.3 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 2. Adjust seals and purge.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 4. Set initial temperature and humidity set points.
  - 5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

- B. Remove malfunctioning units, replace with new units, and retest as specified above.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

### 3.5 TRAINING

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
  - 1. Overview of the system and/or equipment as it relates to the facility as a whole.
  - 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
  - 3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
- C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION



**PROJECT MANUAL  
VOLUME 4**

**FOR**

**MOBILE ARENA  
401 Civic Center Drive  
Mobile, Alabama 36602**

**Project No. AMOB230117**

**BID SET**

December 13, 2024



**City of Mobile  
Architectural Engineering Department  
Government Plaza  
205 Government Street, South Tower, 5th Floor  
Mobile, Alabama 36602**

**Bid Date:** \_\_\_\_\_

**Set Number:** \_\_\_\_\_

## **OWNERSHIP OF DOCUMENTS AND DISCLAIMER**

The Project Manual, Technical Specifications, Drawings, and all other documents relating to this project have been prepared for this individual and particular project, and for the exclusive use of the original Owner, developer or other party so indicated.

Actual project conditions and as-built conditions may vary significantly. Changes made during bidding, negotiations, construction, due to additions or deletions of portions of this project, and/or for other reasons, may not be indicated in these documents.

These documents may not be used or relied upon as a certification of information indicated, or used for any other project, by any third parties or other parties, for any purpose whatsoever, without the prior written consent of Goodwyn Mills Cawood, LLC, or prior to receipt of mutually agreed to compensation paid to Goodwyn Mills Cawood, LLC, therefore.

The ownership, copyrights, and all other rights to these documents, are reserved by Goodwyn Mills Cawood, LLC, including in part, all copies thereof in any form or media. Reproduction of the material contained in these documents or substantial quotation of their provisions without prior written permission of Goodwyn Mills Cawood, LLC, violates the copyright and common laws of the United States and will subject the violator to legal prosecution.

### **Goodwyn Mills Cawood, LLC**

11 N. Water Street

Suite 15250

Mobile, AL 36602

## SECTION 00 01 05 – PROJECT DIRECTORY

**PROJECT DIRECTORY**

**OWNER:** **City of Mobile Architectural Engineering Department**  
Government Plaza 205 Government Street, South Tower, 5th  
Floor  
Mobile, Alabama 36602  
Phone: (251) 208-7492  
**Carleen Stout, Deputy Director, Real Estate  
and Asset Manager**

**ARCHITECT:** **GOODWYN MILLS CAWOOD, LLC**  
11 North Water Street  
Mobile, Alabama 36602  
Phone: (251) 460-4006  
**James R. Walker, AIA, Project Architect**  
**George Keith Parker, AIA, Project Manager**

**ARCHITECT:** **POPULOUS**  
4800 Main Street, Suite 300  
Kansas City, Missouri 64112  
Phone: (816) 221-1500  
**Aaron Bruckerhoff, AIA, Project Architect**

**CONSTRUCTION  
MANAGER:** **VOLKERT, INC**  
11 N Water Street, Suite 18290  
Mobile, AL 36602  
Phone: (864) 245-1917  
**Sam Matheny, Program Manager**

**STRUCTURAL  
ENGINEERS:** **WALTER P MOORE**  
1301 McKinney Drive, Suite 1100  
Houston, TX 77010  
Phone: (713) 630-7300  
**Erin Kueht, P.E., Structural**

**MECHANICAL/ELECTRICAL  
PLUMBING/ FP ENGINEERS:** **HENDERSON ENGINEERS**  
1801 Main Street, Suite 300  
Kansas City, MO 64108  
Phone: (816) 663-8700  
**Tyler Johnson, P.E., Project Manager**  
**Evan O'Brien, P.E., Lead Mechanical**  
**Mike Fiser, P.E., Lead Electrical**

**CIVIL  
ENGINEERS:**

**DRIVEN ENGINEERING**  
805 Morris Hill Road  
Semmes, AL 36575-6445  
Phone: (251) 649-4011  
**Avalisha Fisher, P.E., Civil**

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

## VOLUME 1

### SECTION 00 01 10 – TABLE OF CONTENTS

#### DIVISION 00 – PROCUREMENT & CONTRACTING REQUIREMENTS

00 01 00	COVER
00 01 05	DIRECTORY
00 01 07	PROFESSIONAL SEALS
00 01 10	TABLE OF CONTENTS
00 10 00	INVITATION TO BID
00 20 00	INSTRUCTIONS TO BIDDERS
00 22 00	SUPPLEMENTARY INSTRUCTIONS TO BIDDERS
00 24 00	PROPOSAL FORM
00 25 00	ATTACHMENT A TO PROPOSAL FORM
00 50 00	STANDARD FORM OF AGREEMENT OWNER/CONTRACTOR AIA A101-2017
00 72 00	GENERAL CONDITIONS OF THE CONTRACT AIA A201-2017
00 73 00	SUPPLEMENTARY PROJECT CONDITIONS

#### DIVISION 01 – GENERAL REQUIREMENTS

01 10 00	SUMMARY
01 23 00	ALTERNATES
01 25 00	SUBSTITUTION PROCEDURES
01 26 00	CONTRACT MODIFICATION PROCEDURES
01 29 00	PAYMENT PROCEDURES
01 31 00	PROJECT MANAGEMENT AND COORDINATION
01 32 00	CONSTRUCTION PROGRESS DOCUMENTATION
01 33 00	SUBMITTAL PROCEDURES
01 35 16	ALTERATION PROJECT PROCEDURES
01 40 00	QUALITY REQUIREMENTS
01 42 00	REFERENCES
01 43 39	MOCKUPS
01 45 29	STRUCTURAL TESTING AND INSPECTIONS
01 50 00	TEMPORARY FACILITIES AND CONTROLS
01 60 00	PRODUCT REQUIREMENTS
01 73 00	EXECUTION
01 77 00	CLOSEOUT PROCEDURES
01 78 23	OPERATION AND MAINTENANCE DATA
01 78 39	PROJECT RECORD DOCUMENTS
01 79 00	DEMONSTRATION AND TRAINING

#### DIVISION 02 – EXISTING CONDITIONS

NOT ISSUED

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 03 – CONCRETE**

03 10 00	CONCRETE FORMING AND ACCESSORIES		
03 20 00	CONCRETE REINFORCING		
03 30 00	CAST IN PLACE CONCRETE		
03 35 43	POLISHED CONCRETE FINISHING		
03 41 34	PRECAST PRETENSIONED CONCRETE SEATING UNITS		
03 45 00	PRECAST ARCHITECTURAL CONCRETE		

**DIVISION 04 – MASONRY**

04 20 00	UNIT MASONRY		
04 21 13.23	ADHERED BRICK VENEER		

**DIVISION 05 – METALS**

05 12 00	STRUCTURAL STEEL FRAMING		
05 31 00	STEEL DECKING		
05 40 00	COLD-FORMED METAL FRAMING		
05 45 00	METAL SUPPORT ASSEMBLIES		
05 50 00	METAL FABRICATIONS		
05 51 13	METAL PAN STAIRS		
05 51 16	METAL FLOOR PLATE STAIRS		
05 51 19	METAL GRATING STAIRS		
05 52 13	PIPE AND TUBE RAILINGS		
05 53 13	BAR GRATINGS		
05 70 00	DECORATIVE METAL		
05 70 10	VISION BARRIERS		
05 73 13	GLAZED DECORATIVE METAL RAILINGS		
05 75 00	DECORATIVE FORMED METAL		

**DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES**

06 10 00	ROUGH CARPENTRY		
06 20 00	FINISH CARPENTRY		
06 40 00	ARCHITECTURAL WOODWORK		
06 42 16	FLUSH WOOD PANELING		
06 65 00	SOLID SURFACE FABRICATIONS		

**DIVISION 07 – MOISTURE PROTECTION**

07 11 13	BITUMINOUS DAMPROOFING		
07 13 26	SHEET WATERPROOFING		
07 18 00	TRAFFIC COATINGS		
07 21 00	THERMAL INSULATION		
07 26 16	BELOW-GRADE VAPOR RETARDERS		
07 27 26	FLUID-APPLIED MEMBRANE AIR BARRIERS		



SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
07 42 13	INSULATED METAL WALL PANELS		
07 42 93	SOFFIT PANELS		
07 46 46	FIBER-CEMENT SIDING		
07 54 19	PVC MEMBRANE ROOFING		
07 62 00	SHEET METAL FLASHING AND TRIM		
07 71 00	ROOF SPECIALTIES		
07 72 00	ROOF ACCESSORIES		
07 76 00	ROOF PAVER AND PEDESTAL SYSTEM		
07 81 00	APPLIED FIRE PROTECTION		
07 81 23	INTUMESCENT FIRE PROTECTION		
07 82 00	BOARD FIRE PROTECTION		
07 84 13	PENETRATION FIRESTOPPING		
07 84 43	JOINT FIRESTOPPING		
07 91 00	PREFORMED PRECAST SEATING BOWL JOINT TREATMENTS		
07 92 00	JOINT SEALANTS		
07 95 00	EXPANSION CONTROL		

**DIVISION 08 – OPENINGS**

08 11 13	HOLLOW METAL DOORS AND FRAMES
08 14 16	FLUSH WOOD DOORS
08 31 13	ACCESS DOORS AND FRAMES
08 33 13	COILING COUNTER SHUTTERS
08 33 23	OVERHEAD COILING DOORS
08 41 13	ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
08 44 13	GLAZED ALUMINUM CURTAIN WALLS
08 51 13	ALUMINUM WINDOWS
08 56 53	SECURITY WINDOWS

**VOLUME 2**

08 71 00	DOOR HARDWARE
08 80 00	GLAZING
08 81 13	DECORATIVE GLASS GLAZING
08 83 00	MIRRORS
08 88 53	SECURITY GLAZING
08 91 19	FIXED LOUVERS

**DIVISION 09 – FINISHES**

09 21 16.23	GYPSUM BOARD SHAFT WALL ASSEMBLIES
09 22 16	NON-STRUCTURAL METAL FRAMING
09 29 00	GYPSUM BOARD
09 30 13	TILE
09 51 00	SUSPENDED CEILING SYSTEMS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
09 61 13	FLOOR SEALERS		
09 61 23	HAZARD STRIPING		
09 65 13	RESILIENT BASE AND ACCESSORIES		
09 65 16	RESILIENT SHEET FLOORING		
09 65 19	RESILIENT TILE FLOORING		
09 66 23	RESINOUS MATRIX TERRAZZO FLOORING		
09 67 23	RESINOUS FLOORING		
09 68 00	CARPETING		
09 69 00	ACCESS FLOORING		
09 72 00	WALL COVERINGS		
09 72 19	GRAPHICS WALL COVERINGS		
09 84 33	SOUND-ABSORBING WALL UNITS		
09 84 36	SOUND-ABSORBING CEILING UNITS		
09 91 13	EXTERIOR PAINTING		
09 91 23	INTERIOR PAINTING		
09 93 00	STAINING AND TRANSPARENT FINISHING		
09 96 00	HIGH-PERFORMANCE COATINGS		

**DIVISION 10 – SPECIALTIES**

10 11 00	VISUAL DISPLAY UNITS
10 12 00	DISPLAY CASES
10 14 00	SIGNAGE
10 21 13.14	STAINLESS STEEL TOILET COMPARTMENTS
10 21 16	SHOWER AND DRESSING COMPARTMENTS
10 22 26.13	ACCORDION FOLDING PARTITIONS
10 22 29	UPFOLDING PANEL PARTITIONS
10 22 39	FOLDING PANEL PARTITIONS
10 26 00	WALL AND DOOR PROTECTION
10 28 00	TOILET, BATH, AND LAUNDRY ACCESSORIES
10 28 19	TUB AND SHOWER ENCLOSURES
10 35 00	FLAGPOLES
10 43 13	DEFIBRILLATOR CABINETS
10 43 14	AUTOMATED EXTERNAL DEFIBRILLATORS
10 44 13	FIRE PROTECTION CABINETS
10 44 16	FIRE EXTINGUISHERS
10 51 13	METAL LOCKERS
10 51 19	PHENOLIC LOCKERS
10 51 20	CUSTOM WOOD LOCKERS
10 53 00	WALKWAY COVERS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 11 – EQUIPMENT**

11 13 13	LOADING DOCK BUMPERS
11 13 16	LOADING DOCK SEALS AND SHELTERS
11 13 19	STATIONARY LOADING DOCK EQUIPMENT
11 23 00	COMMERCIAL LAUNDRY EQUIPMENT
11 31 00	RESIDENTIAL APPLIANCES
11 40 00	FOOD SERVICE EQUIPMENT
11 47 00	ICE MACHINES
11 61 00	THEATER AND STAGE EQUIPMENT
11 61 43	STAGE CURTAINS
11 61 44	HALF-HOUSE CURTAINS
11 61 53	ARENA CURTAINS
11 82 26	FACILITY WASTE COMPACTORS

**DIVISION 12 – FURNISHINGS**

12 22 00	CURTAINS AND DRAPES
12 36 16	METAL COUNTERTOPS
12 48 13	ENTRANCE FLOOR MATS AND FRAMES
12 63 26	ARENA SEATS
12 66 00	TELESCOPING STANDS
12 66 23	PORTABLE PLATFORMS

**DIVISION 13 – SPECIAL CONSTRUCTION**

13 17 00	HYDROTHERAPY EQUIPMENT, POOLS, AND TUBS
13 18 11	ICE RINK GENERAL REQUIREMENTS
13 18 12	ICE RINK REFRIGERATION SYSTEM
13 18 13	ICE RINK FLOOR SYSTEM
13 18 14	ICE RINK PIPING, VALVES, AND ACCESSORIES
13 18 15	ICE RINK WASTE HEAT RECOVERY SYSTEM
13 18 16	ICE RINK DASHER BOARD SYSTEM AND ACCESSORIES

**VOLUME 3**

13 18 17	ICE RINK CENTRAL CONTROL SYSTEM
13 18 19	ICE RINK WATER TREATMENT SYSTEM
13 28 16	HOCKEY SAFETY NETTING SYSTEM

**DIVISION 14 – CONVEYING SYSTEMS**

14 21 00	GEARLESS MACHINE ROOM LESS TRACTION ELEVATORS
14 22 00	ELECTRIC TRACTION FREIGHT ELEVATORS
14 31 00	ESCALATORS
14 42 00	WHEELCHAIR LIFTS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 21 – FIRE SUPPRESSION**

21 00 00	TABLE OF CONTENTS AND SEAL		
21 00 10	GENERAL FIRE SUPPRESSION REQUIREMENTS		
21 05 00	COMMON WORK RESULTS FOR FIRE SUPPRESSION		
21 05 15	BASIC FIRE SUPPRESSION PIPING METHODS AND MATERIALS		
21 05 53	IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT		
21 11 00	FIRE SUPPRESSION WATER SERVICE PIPING		
21 12 00	FIRE SUPPRESSION STANDPIPES		
21 13 13	WATER BASED FIRE SUPPRESSION SYSTEMS		
21 31 13	ELECTRIC DRIVE CENTRIFUGAL PUMPS		

**DIVISION 22 – PLUMBING**

22 00 00	TABLE OF CONTENTS AND SEAL		
22 00 10	GENERAL PLUMBING REQUIREMENTS		
22 00 15	COORDINATION		
22 05 10	COMMON WORK RESULTS FOR PLUMBING		
22 05 13	COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT		
22 05 15	BASIC PIPING MATERIALS AND METHODS		
22 05 19	METERS AND GAUGES FOR PLUMBING PIPING		
22 05 23	GENERAL DUTY VALVES FOR PLUMBING PIPING		
22 05 29	HANGERS AND SUPPORTS FOR PLUMBING PIPING		
22 05 33	HEAT TRACING FOR PLUMBING PIPING		
22 05 50	VIBRATION ISOLATION FOR PLUMBING PIPING AND EQUIPMENT		
22 05 53	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT		
22 07 00	PLUMBING INSULATION		
22 11 00	WATER DISTRIBUTION PIPING AND SPECIALTIES		
22 11 11	MECHANICALLY JOINED PLUMBING PIPING SYSTEMS		
22 11 14	STAINLESS STEEL WATER DISTRIBUTION PIPING & SPECIALTIES		
22 11 23	DOMESTIC WATER PUMPS		
22 13 00	SANITARY DRAINAGE AND VENT PIPING & SPECIALTIES		
22 13 28	CONDENSATE PUMPS FOR HVAC EQUIPMENT		
22 14 00	STORM DRAINAGE PIPING AND SPECIALTIES		
22 14 89	SUMP PUMPS		
22 34 00	FUEL FIRED DOMESTIC WATER HEATERS		
22 40 00	PLUMBING FIXTURES		
22 70 00	NATURAL GAS SYSTEMS		

**DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING**

23 00 00	TABLE OF CONTENTS AND SEAL		
23 00 10	GENERAL MECHANICAL REQUIREMENTS		
23 00 15	ELECTRICAL COORDINATION FOR MECHANICAL EQUIPMENT		

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

23 05 00	COMMON WORK RESULTS FOR HVAC
23 05 10	BASIC PIPING MATERIALS AND METHODS
23 05 13	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
23 05 14	VARIABLE FREQUENCY DRIVES
23 05 16	EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING
23 05 19	METERS AND GAUGES FOR HVAC PIPING
23 05 23	GENERAL DUTY VALVES FOR HVAC PIPING
23 05 29	HANGERS AND SUPPORTS FOR HVAC PIPING & EQUIPMENT
23 05 50	VIBRATION ISOLATION FOR HVAC
23 05 53	IDENTIFICATION FOR HVAC PIPING & EQUIPMENT
23 05 93	TESTING, ADJUSTING AND BALANCING FOR HVAC
23 07 00	HVAC INSULATION
23 08 00	COMMISSIONING OF HVAC SYSTEMS
23 09 13	INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
23 09 14	REFRIGERANT MONITORING SYSTEMS
23 09 23	DIRECT-DIGITAL CONTROL FOR HVAC
23 21 13	HYDRONIC PIPING
23 21 13.13	BURIED HYDRONIC AND STEAM PIPING
23 21 13.23	MECHANICALLY JOINED HYDRONIC PIPING SYSTEMS
23 21 14	HYDRONIC SPECIALTIES
23 21 23	HYDRONIC PUMPS
23 25 00	HVAC WATER TREATMENT
23 31 13	METAL DUCTS
23 33 00	AIR DUCT ACCESSORIES
23 34 23	HVAC POWER VENTILATORS
23 34 33	AIR CURTAINS
23 36 00	AIR TERMINAL UNITS
23 37 13	DIFFUSERS, REGISTERS AND GRILLES
23 51 00	BREECHES, CHIMNEYS AND STACKS
23 51 13	DRAFT CONTROL DEVICES
23 52 16	CONDENSING BOILERS
23 53 23	BOILER ACCESSORIES
23 64 16	CENTRIFUGAL WATER CHILLERS
23 65 00	COOLING TOWERS
23 72 00	AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

#### **VOLUME 4**

23 73 13	CENTRAL STATION AIR HANDLING UNITS
23 82 00	TERMINAL HEATING AND COOLING UNITS
23 84 14	SELF CONTAINED HUMIDIFIERS
23 84 17	DESICCANT WHEEL UNITS
23 84 19	HYDROTHERAPY AIR HANDLING UNITS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 26 – ELECTRICAL**

26 00 00	TABLE OF CONTENTS AND SEAL		
26 00 10	GENERAL ELECTRICAL REQUIREMENTS		
26 05 00	COMMON WORK RESULTS FOR ELECTRICAL		
26 05 02	EQUIPMENT WIRING SYSTEMS		
26 05 04	PROVISIONS FOR ELECTRIC UTILITY SERVICE		
26 05 19	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES		
26 05 26	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS		
26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS		
26 05 33	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS		
26 05 43	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS		
26 05 53	IDENTIFICATION FOR ELECTRICAL SYSTEMS		
26 05 73	POWER SYSTEM STUDIES		
26 09 10	CENTRALIZED DIMMING SYSTEM		
26 09 23	LIGHTING CONTROL DEVICES		
26 22 00	LOW-VOLTAGE TRANSFORMERS		
26 24 13	SWITCHBOARDS		
26 24 16	PANELBOARDS		
26 27 26	WIRING DEVICES		
26 28 13	FUSES		
26 28 16	ENCLOSED SWITCHES AND CIRCUIT BREAKERS		
26 32 13	PACKAGED ENGINE-DRIVEN GENERATORS		
26 33 53	STATIC UNINTERRUPTIBLE POWER SUPPLIES		
26 36 00	TRANSFER SWITCHES		
26 41 13	LIGHTNING PROTECTION FOR STRUCTURES		
26 43 13	SURGE PROTECTIVE DEVICES		
26 51 00	INTERIOR LIGHTING		
26 53 00	INDOOR ARENA LIGHTING		
26 56 00	EXTERIOR AREA LIGHTING		

**DIVISION 27 – COMMUNICATIONS (TECHNOLOGY)**

27 00 00	TABLE OF CONTENTS - COMMUNICATIONS		
27 05 00	COMMONWORK RESULTS FOR COMMUNICATIONS		
27 05 26	GROUNDING AND BONDING FOR COMMUNICATIONS		
27 05 28	PATHWAYS FOR COMMUNICATIONS		
27 05 43	UNDERGROUND PATHWAYS & STRUCTURES FOR COMMUNICATIONS SYSTEMS		
27 05 53	IDENTIFICATIONS FOR COMMUNICATIONS		
27 11 00	COMMUNICATIONS EQUIPMENT ROOM FITTINGS		
27 13 00	COMMUNICATIONS BACKBONE CABLING		
27 15 00	COMMUNICATIONS HORIZONTAL CABLING		
27 31 24	IP TELEPHONE SYSTEM		
27 32 44	EMERGENCY RESPONDER TESTING		

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
27 35 23	EMERGENCY RESPONDER RADIO COVERAGE		
27 60 00	NETWORK ELECTRONICS		
27 62 00	WIRELESS NETWORK SYSTEMS		

**DIVISION 27 – COMMUNICATIONS (AUDIO – VIDEO)**

27 00 01	TABLE OF CONTENTS AND SEAL – AUDIO-VIDEO
27 00 11	GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO - VIDEO
27 05 01	COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO - VIDEO
27 41 00	AUDIO VIDEO SYSTEMS
27 41 16	AUDIO VIDEO SYSTEMS EQUIPMENT
27 41 22	LARGE FORMAT DISPLAY SYSTEMS
27 41 33	TELEVISION DISTRIBUTION SYSTEM
27 41 51	BROADCAST SYSTEMS PRE-WIRE

**DIVISION 28 – ELECTRONIC SAFETY AND SECURITY**

28 00 00	TABLE OF CONTENTS (SECURITY)
28 05 00	BASIC SECURITY REQUIREMENTS
28 05 20	BASIC SECURITY MATERIALS AND METHODS
28 05 26	GROUNDING AND BONDING FOR SECURITY SYSTEMS
28 05 28	SECURITY SYSTEMS PATHWAYS AND SUPPORT EQUIPMENT
28 13 00	ACCESS CONTROL SOFTWARE AND DATABASE MANAGEMENT
28 15 00	ACCESS CONTROL HARDWARE DEVICES
28 15 23	INTERCOM ENTRY SYSTEM
28 23 00	VIDEO SURVEILLANCE CAMERA SYSTEMS
28 41 10	SECURITY CONTROL ROOM EQUIPMENT
28 45 00	TABLE OF CONTENTS AND SEAL (FIRE ALARM)
28 46 00	FIRE DETECTION AND ALARM

**VOLUME 5****DIVISION 31 – EARTHWORK**

02 06 13	GEOTECHNICAL REPORT - SEE APPENDIX
31 00 00	TABLE OF CONTENTS AND SEAL
31 00 00	EARTHWORK
31 11 00	CLEARING, GRUBBING AND DEMOLITION
31 22 00	SITE GRADING
31 23 23 23	SOIL COMPACTION CONTROL
31 40 00	SHORING AND UNDERPINNING
31 63 29	DRILL DISPLACEMENT CAST-IN-PLACE PILES
32 12 16	ASPHALT PAVING
32 13 13	CONCRETE PAVING, CURBS, AND WALKS
32 90 00	PLANTING
33 14 11	WATER SERVICE PIPING
33 30 00	SANITARY SEWERAGE

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
33 31 00	SANITARY SEWER COLLECTION SYSTEM		
33 40 00	STORMWATER UTILITIES		

**DIVISION 32 – EXTERIOR IMPROVEMENTS**

32 00 00	TABLE OF CONTENTS AND SEAL
32 13 13	CONCRETE PAVING
32 13 16	DECORATIVE CONCRETE PAVING
32 13 73	CONCRETE PAVING JOINT SEALANTS
32 14 00	UNIT PAVING
32 17 26	TACTILE WARNING SURFACING
32 31 16	WELDED WIRE FENCES AND GATES
32 31 19	DECORATIVE METAL FENCES AND GATES
32 31 19.53	DECORATIVE METAL SECURITY FENCES AND GATES
32 32 23	SEGMENTAL RETAINING WALLS
32 33 00	SITE FURNISHINGS
32 84 00	PLANTING IRRIGATION
32 84 23	IRRIGATION WORK
32 90 00	PLANTING (LANDSCAPE WORK)
32 90 05	LANDSCAPE MAINTENANCE
32 91 13	SOIL PREPARATION
32 92 00	TURF AND GRASSES
32 92 23	SODDING
32 93 00	PLANTS

**DIVISION 33 – UTILITIES**

REFER TO DIVISION 31 ABOVE

**APPENDIX**

GEOTECHNICAL REPORT DATED AUGUST 16, 2024 (from Geotechnical Engineering Testing, Inc.)  
AVAILABLE UPON REQUEST

END OF SECTION



**SECTION 23 73 13 - CENTRAL STATION AIR HANDLING UNITS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Casing construction.
- B. Fan section.
- C. Coil section.
- D. Filter and air cleaner section.
- E. Damper section.
- F. Total energy recovery wheel section.
- G. Access section.
- H. Electrical.
- I. Roof mounting curb.

**1.2 DEFINITIONS**

- A. Low Pressure: Greater than 1 inch w.c. and less than or equal to 4 inches w.c. internal positive or negative pressure.
- B. Medium Pressure: Greater than 4 inches w.c. and less than 10 inches w.c. internal positive or negative pressure.
- C. High Pressure: Greater than or equal to 10 inches w.c. internal positive or negative pressure.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate the installation with size, location and installation of service utilities.
- B. Coordinate the work with other trades for installation of roof mounted air handling units on roof curbs.
- C. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- D. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

**1.4 SUBMITTALS**

- A. Product Data:
  - 1. Published Literature: Indicate dimensions, weights, capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
  - 2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
  - 3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.
  - 4. Sound Power Level Data: Certified fan outlet, inlet, and casing radiation at rated capacity. For variable speed fans, provide sound ratings at 100, 80 and 60 percent of maximum rpm.
  - 5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
  - 6. Certified coil performance ratings with system operating conditions indicated.
  - 7. Motor ratings and electrical characteristics plus motor and fan accessories.

8. Provide short circuit current rating of units with factory mounted starter or variable frequency drive.
  9. Dampers, including housings, linkages, and operators.
  10. Total pressure drop for the unit with itemized pressure drop per module. At a minimum, provide line items for the following:
    - a. External static pressure loss.
    - b. Unit inlet and outlet opening losses.
    - c. Internal filter, coil, and casing losses.
    - d. Pressure drop per module.
- B. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
- C. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- D. Specimen Warranty: Submit sample of manufacturer's warranty.
- E. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- F. Manufacturer's Instructions: Include installation instructions.
- G. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. Extra Fan Belts: One set for each unit.
  2. Extra Filters: One set for each unit.
- I. Product certificates signed by manufacturers of central-station air-handling units certifying that their products comply with specified requirements.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. AHRI Certification: Comply with the following for the applicable components,
  1. Factory test central-station air-handling units and their components in accordance with the applicable portions of AHRI 430 "Performance Rating of Central-Station Air-Handling Units". Units shall be listed and bear the label of the Air-Conditioning and Refrigeration Institute.
  2. AHRI 260 "Sound Rating of Ducted Air Moving and Conditioning Equipment".
  3. AHRI 410 "Standard for Forced-Circulation Air-Cooling and Air-Heating Coils".
  4. AHRI 640 (I-P) "Performance Rating Of Commercial and Industrial Humidifiers".
  5. AHRI 1060 I-P "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment".
- C. AMCA Compliance: Comply with the following standards for rating and testing of the applicable components specified herein.
  1. AMCA 210 "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating".
  2. AMCA 300 "Reverberant Room Method for Sound Testing of Fans".
  3. AMCA 301 "Methods for Calculating Fan Sound Ratings from Laboratory Test Data".
  4. AMCA 500-D "Laboratory Methods of Testing Dampers for Rating".
  5. AMCA 500-L "Laboratory Methods of Testing Louvers for Rating".
  6. AMCA 611 "Certified Ratings Program for Airflow Measurement Stations".

- D. NFPA Compliance: Central-station air-handling units and components shall be designed, fabricated, and installed in compliance with NFPA Standard 90A "Standard for the Installation of Air Conditioning and Ventilating Systems."
- E. UL Compliance: Electric coils, along with the complete central-station air-handling unit, shall be listed and labeled by Underwriters' Laboratories. Comply with the following for the applicable components.
  - 1. UL 508 "Industrial Control Equipment".
  - 2. UL 795 "Commercial-Industrial Gas Heating Equipment".
  - 3. UL 1598 "Luminaires".
  - 4. UL 1812 "Ducted Heat Recovery Ventilators".
  - 5. UL 1995 "Heating and Cooling Equipment".
- F. Nationally Recognized Tested Laboratory and NEMA Compliance (NRTL): Electric coils, along with the complete central-station air-handling unit shall be listed and labeled by a NRTL. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

## 1.6 DELIVERY STORAGE AND HANDLING

- A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Follow manufacturer's written instructions for rigging. Inspect for damage. Replace damaged units or components.
- B. Store in clean dry place off the ground and protect from weather, physical damage, and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish. Replace any sections that experience internal water damage due to lack of protection.
- C. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

## 1.7 SPARE PARTS

- A. General: Furnish to Owner, with receipt, the following spare parts for each air-handling unit.
  - 1. If HVAC equipment is used during the construction period, Contractor shall provide one set of filters (if system is designed to include pre-filters and after-filters, provide only pre-filters) when the unit is started and replace filters when needed, but not less than every month. On the day of substantial completion, the Contractor shall clean the unit and provide a new set of filters at each location in the unit.
  - 2. Furnish one additional complete set of belts for each central-station air-handling unit.
  - 3. Furnish one additional gasket for each sectional joint of each central-station air-handling unit.

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 MANUFACTURERS

- A. Aaon, Inc.
- B. Airtherm Mfg. Co.
- C. Air Zone Industries, Inc.
- D. Carrier Air Conditioning.
- E. Daikin Applied.
- F. Dunham-Bush, Inc.
- G. Johnson Controls Inc./ York International Corporation.

- H. VTS Group.

## 2.2 MANUFACTURED UNITS

- A. General Description: Factory assembled, consisting of fans, motor and drive assembly, coils, plenums, filters, and drip pans.
- B. Types: Central-station air-handling units included in this project are of the following types:
  - 1. Draw-through.
- C. Motor: Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so that the driven load will not require the motor to operate in the service factor range.
- D. Electrical Components: Refer to Division 26 Sections.

## 2.3 CASING CONSTRUCTION

- A. Full Perimeter Base Rail:
  - 1. Construct of galvanized steel.
  - 2. Provide base rail of sufficient height to raise unit for external trapping of condensate drain pans.
- B. Casing:
  - 1. Construct of one piece, insulated, double wall panels.
  - 2. Provide mid-span, no through metal, internal thermal break.
  - 3. Construct outer panels of galvanized steel and inner panels of galvanized steel.
  - 4. Casing Air Pressure Performance Requirements:
    - a. Able to withstand up to 10 inches w.g. positive or negative static pressure.
  - 5. Medium and high-pressure units shall be constructed with additional bracing and supports. Units rated at 5.5 inches w.g. and higher shall be connected to accessories sections with double-thickness neoprene-coated flexible connection.
- C. Access Doors:
  - 1. Construction, thermal and air pressure performance same as casing.
  - 2. Provide surface mounted handles on hinged, swing doors.
- D. Outdoor Unit Roof:
  - 1. Factory install single layer outer roof above inner roof.
  - 2. Slope at a minimum of 0.125 inches per foot from one side of unit to the other side, or from center to sides of unit.
  - 3. Roof assembly to overhang each unit wall or base rail to overhang curb to facilitate water runoff and prevent water intrusion into roof curb to base connection.
- E. Outside Air and Exhaust Air Weather Hood:
  - 1. Fabricate from same material as casing outer panel.
  - 2. Extend hood past perimeter of unit casing opening so as not to obstruct airflow path.
  - 3. Paint hoods with same finish as external surface of outdoor units.
  - 4. Provide inlet hood for each fresh air damper with a sine wave moisture eliminator to prevent entrainment of water into the unit from outside air.
  - 5. Provide exhaust hoods for each exhaust air opening.
  - 6. Size each hood for 100 percent of nominal fresh air damper capacities.
  - 7. Protect each hood with bird screen to prevent nesting at intake or exhaust air flow paths.
- F. Unit Flooring: Construct with sufficient strength to support expected people and equipment loads associated with maintenance activities.
- G. Casing Leakage: Seal joints and provide airtight access doors so that air leakage does not exceed one percent of design flow at the specified casing pressure.

- H. Insulation:
1. Insulation: Comply with NFPA Standard 90A "Standard for the Installation of Air Conditioning and Ventilating Systems," for insulation.
    - a. Type:
      - 1) Coated, glass-fiber insulation having a minimum density of 1-1/2 pcf.
      - 2) Foam injection.
    - b. Thickness: 1 inch.
    - c. Minimum R-Value: R-4.
    - d. Completely fill panel cavities in each direction to prevent voids and settling.
    - e. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from and including the cooling coil section.
- I. Drain Pan Construction:
1. Single-Wall Drain Pans: Formed sections of stainless steel. Fabricate pans in sizes and shapes to collect condensate from cooling coils (including coil piping connections and return bends) when units are operating at the maximum cataloged face velocity across the cooling coil. Insulate bottom and sides of drain pans. Comply with ASHRAE Std 62.1 for indoor air quality and sufficiently size to collect all condensate.
  2. Slope in two planes to promote positive drainage and eliminate stagnate water conditions.
  3. Locate outlet of sufficient diameter at lowest point of pan to prevent overflow at normal operating conditions.
  4. Provide threaded drain connections constructed of drain pan material, extended sufficient distance beyond the base to accommodate field installed, condensate drain trapping.
  5. Drain connections: Both ends of the pan.
  6. Pan top surface coating: Elastomeric compound.
  7. Units with stacked coils shall have an intermediate drain pan or a drain trough to collect condensate from top coil.
- J. Bottom Duct Connections: Provide steel or aluminum walking grate on structural supports where connections are located in sections accessible by personnel for maintenance.
- K. Marine Lights:
1. Provide factory mounted, water and dust resistant LED fixture(s) where shown on the Drawings with the following characteristics:
    - a. Non-ferrous metal housing.
    - b. Glass or polycarbonate lens.
    - c. Factory wired to a single switch within factory provided service module.
    - d. Instant on white light with minimum 8000 hour service life.
- L. Service Module:
1. Provide factory installed service module including GFCI receptacle independent from load side; designed to receive power from field supplied 120 volt source.
- M. Finish:
1. Outdoor Units:
    - a. Coat external surface of unit casing with primer and minimum 1.5 mil, enamel paint finish.
    - b. Comply with salt spray test in accordance with ASTM B177/B177M.
    - c. Color: Manufacturer's standard color.
  2. Indoor Units:
    - a. Provide exterior, galvanized steel panels without paint.

## 2.4 FAN ARRAY SECTION

- A. Performance — Fans shall conform to AMCA test standards, 205 (fan efficiency grade), 210 (air performance) and 300 (sound performance) and shall bear the AMCA certified ratings seal for

both sound and air, and fan efficiency grade (FEG). Sound certification shall apply to both inlet and outlet sound power levels.

- B. Construction — Fans shall be housed and incorporate a non-overloading type backward inclined airfoil blade wheel or centrifugal plenum wheel, heavy-gauge galvanized G90 steel frame, and front panel. The front panel shall have a removable inlet cone designed for smooth airflow transition into the wheel. The motor base shall be designed to ensure proper alignment of the fan wheel, motor and inlet cone. The design shall also ensure the structural integrity of the base to minimize vibration.
  - 1. The fan array shall consist of multiple fan and motor "cubes" or "cells", spaced in the air way tunnel cross section to provide a uniform air flow and velocity profile across the entire air way tunnel cross section and components contained therein.
  - 2. The fan cube dimensions must be variable, such that each fan rests in an identically sized cube or cell, and in a spacing such that the array dimensions fill a minimum of 90% of the cross sectional area of the AHU air way tunnel.
- C. Wheel — Wheels shall be constructed of non-overloading extruded airfoil shaped blades. Airfoil blades shall be continuously welded. The entire wheel shall be constructed of aluminum to reduce weight and vibration. Blades shall be extruded aluminum. Wheel hubs shall be machined aluminum. Aluminum fan wheels shall not require a finish coating. Wheels shall be attached to the motor shaft using taper lock bushings. The wheel and fan inlet shall be matched and have precise running tolerances for maximum performance and operating efficiency.
- D. Finish and Coating — Fans shall be constructed of corrosion resistant galvanized steel. Aluminum components shall be unpainted.
- E. Motors — Motors shall meet or exceed EISA 2007 (The Energy Independence and Security ACT of 2007) efficiencies. Motors shall be NEMA rated, 720, 900 1200, 1800 or 3600 RPM in 60 Hz, Open Drip Proof (ODP) or Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor. Motors shall include permanently sealed (L10-400,000 hr) bearings and shaft grounding rings to protect the motor bearings from electrical discharge machining due to stray shaft currents.
- F. Fan Balancing — All fans prior to shipment shall be run tested at the specified operating speed. Each fan shall be dynamically balanced as a complete unit in accordance with ANSI/AMCA 204-96 "Balance Quality and Vibration Levels for Fans" to a minimum Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken electronically in the axial, vertical and horizontal directions. Records of each fan balance shall be maintained and a written copy shall be available upon request.
- G. Fan Isolation:
  - 1. Blank off Panels — Each Multiple Fan section to be provided with fan blank-off panels to enable manual isolation of fan for servicing. Quantity of panels shall equal number of fans on a single VFD.
- H. Fan airflow measurement:
  - 1. Piezometer Ring: Rings shall be factory installed in each fan inlet. The device shall have a measurement accuracy of  $\pm 5\%$ . Tubing shall be field installed along with corresponding air flow monitoring station by DDC controls contractor so that the measurement is representative of all fans in the array.
- I. Fan Array Motor Control (common VFD operation with Array split into two banks)
  - 1. All fan motors shall be factory-wired to individual manual motor protection (MMP) device which shall consist of a motor overload relay with adjustable current rating and an on-off disconnect switch (one per motor) for power isolation. Field wiring of MMPs to fan motors shall not be permitted.
  - 2. MMPs shall be contained in a single control panel (MMP panel) and shall be mounted on the exterior wall panel of the fan array section.
  - 3. MMP panel shall have a single point of connection for input power wiring and shall feed power to individual MMP's through a common bus bar. Independent wiring of input power to individual MMP's shall not be permitted.

4. All VFDs shall be operated together from a single control point so that all fan motors operate together. Independent control of VFDs and fan motors shall not be permitted.
5. Contractor shall set VFD maximum speed if fan design maximum is above 60HZ.

## 2.5 COIL SECTION

- A. Testing Requirements: The following factory tests are required:
  1. Coil Performance Tests: Cooling and heating coils, except sprayed surface coils, shall be factory tested for rating in accordance with AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.
- B. Coil Pressure Ratings:
  1. Water Coils: Design for 200 psi working pressure at 325 F, and pressure test at 300 psi under water.
- C. Coil Sections: Common or individually insulated, galvanized steel casings for heating and cooling coils. Coil section shall be designed and constructed to facilitate removal of coil for maintenance and replacement and to assure full air flow through coils.
  1. Multizone units shall have air deflectors and air baffles for balanced air flow across both heating and cooling coils.
  2. Medium and high-pressure units shall have double gaskets between sections and coil connection penetrations through casing sealed to minimize leakage.
- D. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.
- E. Drain Pans: 24 inch downstream of coil and down spouts for cooling coil banks more than one coil high.
- F. Eliminators: Three break of galvanized steel, mounted over drain pan.
- G. Air Coils:
  1. Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.
- H. Fabrication:
  1. Tubes: 5/8 inch OD seamless copper expanded into fins, brazed joints.
  2. Fins: Aluminum or copper, constructed from flat plate with belled collars for tubes. Fins shall be bonded to tubes by mechanically expanding copper tubes.
    - a. Thickness: Minimum 0.006 inches.
    - b. Spacing: Maximum 12 fins per inch.
  3. Casing: Die formed channel frame of galvanized steel.
  4. Water Coil Turbulators: Bronze, spring-type.
- I. Water Heating Coils:
  1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
  2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type.
- J. Water Cooling Coils:
  1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
  2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.
  - 3.

## 2.6 FILTER AND AIR CLEANER SECTION

- A. General:
  1. Provide filter sections with filter racks, minimum of one access door for filter removal, and filter block-offs to prevent air bypass.

2. Filters shall comply with NFPA Standard 90A "Standard for the Installation of Air Conditioning and Ventilating Systems."
  3. Filter Section: Cabinet material and finish shall match the air-handling unit cabinet, with filter media holding frames arranged for flat or angular orientation. Section shall have access doors on both sides of the unit.
- B. Refer to Section "Particulate Air Filtration" for additional requirements for particulate air filters.
- C. Differential Pressure Gage:
1. Provide factory installed dial type differential pressure gage, flush mounted with casing outer wall, and fully piped to both sides of each filter to indicate status.
  2. Maintain plus/minus 5 percent accuracy within operating limits of 20 degrees F to 120 degrees F.

## 2.7 DAMPER SECTION

- A. General: Dampers and their operators shall comply with performance requirements specified in Division 23 Section "Instrumentation and Control Devices for HVAC."
- B. Mixing Boxes: Parallel-blade dampers in a reinforced, galvanized steel cabinet. Damper blades shall be galvanized steel mechanically fastened to steel operating rod. Connect operating rods for each set of dampers together with a common linkage and interconnect linkages so dampers operated simultaneously and in the opposite direction (one opens when the other closes).
- C. Combination Filter/Mixing Box: Parallel-blade dampers in a reinforced, galvanized steel cabinet. Damper blades shall be galvanized steel mechanically fastened to steel operating rod. Connect operating rods for each set of dampers together with a common linkage and interconnect linkages so dampers operate simultaneously and in the opposite direction (one opens when the other closes). Cabinet shall have support members to hold 2-inch-thick, pleated, flat permanent or throwaway filters. Mixing boxes shall have hinged access panels or doors to allow removal of filters for both sides of unit.
- D. Damper Blades:
1. Double-skin airfoil design with metal, compressible jamb seals and extruded-vinyl blade-edge seals on each blade.
  2. Self-lubricating stainless steel or synthetic sleeve bearings.
  3. Comply with ASHRAE Std 90.1 for rated maximum leakage rate.
  4. Provide leakage testing and pressure ratings in compliance with AMCA 500-D test methods.
  5. Arrange in parallel or opposed-blade configuration.

## 2.8 TOTAL ENERGY RECOVERY WHEEL SECTION

- A. Certified in accordance with AHRI 1060 I-P and UL 1812 for mechanical, electrical, and fire safety.
- B. Wheel Construction:
1. Dessicant Properties:
    - a. Factory coated.
    - b. Washable using standard detergent or alkaline based coil cleaner.
    - c. Resistant to high levels of humidity.
  2. Construct housing of stainless steel, aluminum, or galvanized steel.
  3. Factory set adjustable diameter seals and self-adjusting perimeter seals.
  4. Permanently sealed and lubricated wheel bearings.
  5. Motor:
    - a. Thermally protected.
    - b. Factory mounted.
- C. Maintenance and Access Features:
1. Access doors upstream and downstream of the wheel cassette.



2. Removable wheel segments to facilitate maintenance and cleaning.
  3. Adequate space for cleaning, service, and maintenance.
- D. Controls:
1. Wheel Control: Damper control of recovery capacity to 40 percent of initial total recovery capacity.
  2. Frost Prevention Control: Provide outside air bypass, return air preheat, or variable speed.

## 2.9 ACCESS SECTION

- A. Provide where indicated on the Drawings to allow for inspection, cleaning, and maintenance of field installed components.
- B. Construct access doors same as previously specified within this Section.

## 2.10 ELECTRICAL

- A. Combination Starter-Disconnects:
1. Provide combination starter-disconnect for each fan motor.
  2. Factory mount in full metal enclosure and wire to fan motor.
  3. Mount starter-disconnect on fan section externally in a NEMA enclosure rated for the installed location within a dedicated controls section or housed fan section.
    - a. Internal Enclosure Construction Characteristics:
      - 1) Integral part of unit casing to allow for thermal venting to casing interior.
      - 2) Accessible from unit exterior via access door.
      - 3) Construction of access doors same throughout unit.
  4. Include circuit breaker disconnect with through-the-door interlocking handle for externally mounted or beside--the-door interlocking handle for internally mounted starters,, spring loaded, and designed to rest only in the full and lockable ON or OFF state.
  5. Allow enclosure entry via a concealed defeater mechanism when the handle is in the ON position.
  6. Include the following items:
    - a. Hand-Off-Auto (H-O-A) switch.
    - b. Two normally open auxiliary contacts.
    - c. Overload heaters.
    - d. Manual reset overloads.
    - e. 120V control transformer with fusing and secondary grounding.
  7. Include power wiring from the starter control transformer to the secondary control system transformers, and start-stop wiring from the direct digital controller start-stop relay to the starter H-O-A switch.
- B. Combination VFD - Disconnects:
1. Provide factory mounted, combination VFD - disconnect for each fan motor or fan array arrangement as scheduled on the drawings.
    - a. Provide in accordance with Division 23 Section "Variable Frequency Drives".
  2. Factory mount in full metal enclosure and wire to fan motor.
  3. Mount VFD-disconnect on fan section externally in a NEMA enclosure rated for the installed location within a dedicated controls section, housed fan section or maintenance vestibule wall.
    - a. Internal Enclosure Construction Characteristics:
      - 1) Integral part of unit casing to allow for thermal venting to casing interior.
      - 2) Accessible from unit exterior via access door.
      - 3) Construction of access doors same throughout unit.
    - b. Provide service clearance required by VFD manufacturer and to meet NEC.
  4. Include circuit breaker disconnect with through-the-door interlocking handle for externally mounted or beside--the-door interlocking handle for internally mounted starters, spring loaded, and designed to rest only in the full and lockable ON or OFF state.

5. Allow enclosure entry via a concealed defeater mechanism when the handle is in the ON position.
6. Include control transformer with sufficient capacity to support the following items:
  - a. VFD and controls.
  - b. Binary output on-off wiring.
  - c. Analog output speed-signal wiring.
  - d. Wires that interface between VFD and direct digital controller.
7. Provide bypass relays and bypass circuitry with VFD-OFF-BYPASS selector switch where bypass is scheduled.

## 2.11 ROOF MOUNTING CURB

- A. Roof Curbs: Refer to Section "Hangers and Supports for HVAC" for pre-engineered roof equipment supports and Section "Vibration Isolation for HVAC Piping and Equipment" for vibration isolated equipment support bases.
- B. Include roof curb accessories for each roof mounted unit.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions under which air handling units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

### 3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Support floor-mounted units on concrete equipment bases using housed spring isolators. Secure units to anchor bolts installed in concrete equipment base.
- C. Suspended Units: Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.
- D. Secure roof-mounted units to roof equipment supports and grade-mounted units to curbs or base. Refer to the drawings for the type of support required for each air handling unit.
  1. Refer to Section "Hangers and Supports for HVAC Piping and Equipment" for standard roof curbs.
  2. Refer to Section "Vibration Isolation For HVAC" for vibration isolation curbs.
- E. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- F. Bolt sections together with gaskets.
- G. Install assembled unit on vibration isolators. Install isolated fans with resilient mountings and flexible electrical leads. Install restraining snubbers as indicated. Refer to Section "Vibration Isolation for HVAC". Adjust snubbers to prevent tension in flexible connectors when fan is operating.
- H. Provide fixed sheaves required for final air balance.
- I. Make connections to coils with unions or flanges.
- J. Piping installation requirements are specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:
  1. Arrange piping installations adjacent to units to allow unit servicing and maintenance.

2. Route unit condensate drain piping to location shown on the plan or, if not shown, to the nearest equipment or floor drain. Provide trap at connection to drain pan with depth as noted on the drawings and install cleanouts at changes in direction. Size condensate drain piping in accordance with local code and as shown on the drawings.
- K. Duct installations and connections are specified in other Division 23 sections. Make final duct connections with flexible connections. Ensure that metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- L. Electrical Connections: The following requirements apply:
  1. Electrical power wiring is specified in Division 26.
  2. Temperature control wiring and interlock wiring is specified in Division 23 section "Direct-Digital Control for HVAC."
- M. Grounding: Connect unit components to ground in accordance with the National Electrical Code.
- N. Hydronic Coils:
  1. Connect water supply to leaving air side of coil (counterflow arrangement).
  2. Provide shut-off valve on supply line and lockshield balancing valve with memory stop on return line.
  3. Locate water supply at bottom of supply header and return water connection at top.
  4. Provide manual air vents at high points complete with stop valve.
  5. Ensure water coils are drainable and provide drain connection at low points.
- O. Insulate Coil Headers Located Outside Air Flow as Specified for Piping: Refer to Section "HVAC Insulation" for additional requirements.
- P. Field-wire each factory provided control for field installation.

### 3.3 EQUIPMENT BASES

- A. Construct concrete equipment pads in accordance with Section "Common Work Results for HVAC."

### 3.4 ADJUSTING CLEANING AND PROTECTING

- A. Adjust water coil flow, with control valves to full coil flow, to indicated gpm.
- B. Adjust damper linkages for proper damper operation.
- C. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, intake plenum cabinet, heat exchange surfaces, cooling/heating coil sections, filter sections, access sections, etc.

### 3.5 FIELD QUALITY CONTROL

- A. Vibration Analysis:
  1. Measure vibration levels with an FFT (Fast Fourier Transformation) analyzer.
  2. Characteristics:
    - a. Frequency Response Range: 5 Hz thru 10 KHz (300 thru 600,000 cpm).
    - b. Capability to use a Hanning window.
    - c. Capacity to perform ensemble averaging.
    - d. Auto-ranging frequency amplitude.
    - e. Minimum amplitude accuracy over the selected frequency range of plus/minus 20 percent or plus/minus 1.5 dB.
  3. Use accelerometer, stud-mounted to collect data.
  4. Ensure the mass of the accelerometer and its mounting have minimal influence on the frequency response of the system over the selected measurement range.

- B. Final Acceptance Requirements:
  - 1. Use dial indicator gages to demonstrate fan and motor are aligned.
  - 2. Verify conformance to specifications using vibration analysis.
  - 3. Maximum Vibration Levels:
    - a. 0.075 inch per second at 1 times run speed and at fan/blade frequency.
    - b. 0.04 inch per second at other multiples of run speed.

### 3.6 SYSTEM STARTUP

- A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
  - 1. Remove shipping, blocking, and bracing.
  - 2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
  - 3. Perform cleaning and adjusting specified in this Section.
  - 4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
  - 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
  - 6. Set zone dampers to full open for each zone.
  - 7. Set face-and-bypass dampers to full face flow.
  - 8. Set outside-air and return-air mixing dampers to minimum outside-air setting.
  - 9. Comb coil fins for parallel orientation.
  - 10. Install clean filters. Do not operate air handling unit without pre-filters installed.
  - 11. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
  - 12. Disable automatic temperature control operators.
- B. Provide manufacturer's field representative to observe and approve systems startup.
- C. Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.
- D. Adjust for proper operation within manufacturer's published tolerances.
- E. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
  - 1. Replace fan and motor pulleys as required to achieve design conditions.
  - 2. Measure and record motor electrical values for voltage and amperage.
  - 3. Shut unit down and reconnect automatic temperature control operators.
  - 4. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for air-handling-system testing, adjusting, and balancing.

### 3.7 TRAINING

- A. At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel on the operation and maintenance of the equipment provided under this section.
- B. Demonstration: Demonstrate operation of system to Owner's personnel.
  - 1. Use operation and maintenance data as reference during demonstration.
  - 2. Conduct walking tour of project.
  - 3. Briefly describe function, operation, and maintenance of each component.
- C. Training: Train Owner's personnel on operation and maintenance of system.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of eight hours of training.
  3. Instructor: Manufacturer's training personnel.
- D. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- E. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 23 82 00 - TERMINAL HEATING AND COOLING UNITS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Unit heaters
- B. Fan-Coil units

**1.2 SUBMITTALS**

- A. Product Data: Submit product data for terminal heating and cooling units showing capacities, ratings, performance characteristics, and gages and finishes of materials..
- B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, construction details, and field connection details.
  - 1. Indicate length and number of pieces of elements and enclosures.
  - 2. Show corner pieces, end caps, cap strips, access doors and pilaster covers.
  - 3. Show support points and fastening methods.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to terminal heating and cooling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- D. Manufacturer's Instructions: Indicate installation instructions and recommendations.
- E. Operation and Maintenance Data: Submit maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement, and spare parts lists.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

**1.3 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. AHRI Compliance: Comply with the following AHRI standards for the applicable components specified herein.
  - 1. AHRI 210/240 "Performance Rating of Unitary Air-conditioning & Air-Source Heat Pump Equipment".
  - 2. AHRI 350 "Sound Performance Rating of Non-Ducted Indoor Air Conditioning Equipment".
  - 3. AHRI 410 "Forced-Circulation Air-Cooling and Air-Heating Coils".
  - 4. AHRI 440 "Performance Rating of Room Fan-Coil".
  - 5. AHRI 840 "Performance Rating of Unit Ventilators".
- C. I B R Compliance: Test and rate baseboard and finned tube radiation in accordance with I B R, provide published ratings bearing emblem of I B R.
- D. ISO Compliance: Fan coil units shall be manufactured in accordance with standard ISO 9001, Quality Management Systems, most current edition.
- E. NFPA Compliance:
  - 1. NFPA 70 "National Electric Code".
  - 2. NFPA 90A "Standard for the Installation of Air-Conditioning and Ventilating Systems".
- F. UL compliance:

1. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
2. UL 674 "Electrical Motors and Generators for Use in Hazardous (Classified) Locations".
3. UL 723 "Standard for Test for Surface Burning Characteristics of Building Materials, Underwriter's Laboratory".
4. UL 1995 "Heating and Cooling Equipment.

#### 1.4 DELIVERY STORAGE AND HANDLING

- A. Handle terminal heating and cooling units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged terminal heating and cooling units or components; replace with new.
- B. Store terminal heating and cooling units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Comply with Manufacturer's rigging and installation instructions for unloading terminal heating and cooling units, and moving them to final location.

#### 1.5 SPARE PARTS

- A. General: Furnish to Owner, with receipt, the following spare parts for terminal heating and cooling units.
  1. One set of matched fan belts for each belt driven fan.
  2. If HVAC equipment is used during the construction period, Contractor shall provide one set of filters (if system is designed to include pre-filters and after-filters, provide only pre-filters) when the unit is started and replace filters when needed, but not less than every month. On the day of substantial completion, the Contractor shall clean the unit and provide a new set of filters at each location in the unit.

### PART 2 - PRODUCTS AND MATERIALS

#### 2.1 UNIT HEATERS

- A. Manufacturers:
  1. Airtherm Mfg. Co.
  2. Daikin Applied.
  3. Dunham-Bush, Inc.
  4. Modine Mfg. Co.
  5. Rittling Hydro-Air Components, Inc.
  6. Trane (The) Co.
  7. Wing (The) Co.; Div. Wing Industries, Inc.
  8. Young Radiator Co.
- B. General: Provide unit heaters in locations as indicated, and of capacities, style, and having accessories as scheduled.
- C. Horizontal Unit Heaters:
  1. Casings: Construct of steel, phosphatized inside and out, and finished with baked enamel. Provide motor-mounted panel, minimum of 18-ga steel. Fabricate casing to enclose coil, louvers, and fan blades. Provide louvers for 4-way air diffusion.
  2. Fans: Construct of aluminum, and factory-balance. Provide fan inlet orifice, smooth, and drawn into casing back panel.
- D. Vertical Unit Heaters:



1. Casings: Construct of steel, phosphatized inside and out, and finished with baked enamel. Design casing to enclose fan, motor, and coil, design fan orifice formed into discharge panel. Provide air diffusers as scheduled.
  2. Fans: Construct of aluminum and factory-balance. Design so motor and fan assembly is removable through fan outlet panel.
- E. Coils: Construct of plate-type aluminum fins, mechanically bonded to copper tubes. Design coil for use in steam or hot water applications. Coil shall have minimum working pressure of 125 psig.
- F. Motors: Provide totally enclosed motors, with built-in overload protection, having electrical characteristics as scheduled.

## 2.2 FAN-COIL UNITS

- A. Manufacturers:
1. Airtherm Mfg. Co.
  2. Carrier Corp.
  3. Daikin Applied.
  4. Dunham-Bush, Inc.
  5. Enviro-Tec by Johnson Controls, Inc.
  6. Greenheck
  7. International Environmental Corp.
  8. Johnson Controls, Inc.
  9. Price
  10. Titus
  11. Trane (The) Co.
  12. Williams
  13. Zehnder Rittling.
- B. General: Provide fan-coil units having cabinet sizes, and in locations indicated, and of capacities, style, and having accessories as scheduled. Include in basic unit chassis, coils, fanboard, drain pan assembly, fans, housing, motor, filter and insulation.
1. Units shall be listed according to UL 1995.
  2. Units shall be certified according to AHRI 440.
  3. Units shall be manufactured in accordance with ISO 9001.
- C. Chassis: Construct chassis of galvanized steel with flanged edges.
- D. Insulation: Provide minimum 1/2-inch thick insulation for sound and thermal protection.
1. Provide faced, heavy density glass fiber.
- E. Cabinet: Construct of 18-ga steel removable panels, 16-ga front. Provide insulation over entire coil section. Clean cabinet parts, bonderize, phosphatize, and flow-coat with baked-on primer.
- F. Water Coils: Construct of 1/2 inch or 5/8 inch seamless copper tubes mechanically bonded to configured aluminum fins. Provide manual air vent to allow coil venting. Design for minimum 200 psi working pressure, and factory pressure test at minimum 300 psi under water.
- G. Auxiliary Heating Coils: Construct of 7/16 inch or 5/8 inch seamless copper tubes mechanically bonded to configured aluminum fins. Design for minimum 200 psi working pressure, and pressure test at minimum 300 psi under water.
- H. Drain Pans: Construct of galvanized steel. Insulate with polystyrene, elastomeric closed cell foam, or polyurethane insulation. Provide drain connection.
- I. Fans: Provide centrifugal forward curved double width wheels of reinforced fiberglass or galvanized steel, in galvanized steel fan scrolls.
- J. Motors: Provide motors with integral thermal overload protection. Run test motors at factory in assembled unit prior to shipping. Provide quickly detachable motor cords.

- K. Filters: Provide throwaway pleated type filters in fiberboard frames. Filters shall have minimum MERV rating per ASHRAE 52.2 of MERV 8 or as scheduled on the drawings.
- L. Dampers: Provide 18-ga steel damper blades with polyurethane stop across entire blade length. Provide factory-mounted electric operators for 25% open cycle.
- M. Electrical: Unit shall have single point power connection with voltage and phase as scheduled on the drawings.
- N. Accessories: Provide the following accessories as indicated and/or scheduled:
  - 1. Wall Boxes: Provide aluminum wall boxes with integral eliminators and insect screen.
  - 2. Discharge Grille Panels: Provide 18-ga galvanized or epoxy powder coated steel, stamped integral grilles, with access doors.
  - 3. Sub-Bases: Provide 18-ga steel sub-base, height as indicated.
  - 4. Extended Oilers: Provide plastic motor oiler tubes extending to beneath top discharge grille.
  - 5. Recessing Flanges: Provide 18-ga steel flanges for recessing fan-coil units into wall or ceiling.
  - 6. Provide an integral condensate switch to prevent unit from operating if drain becomes blocked.
  - 7. Provide an integral condensate pump with GFCI to continuously remove condensate.
  - 8. Floor mounted units: Provide adjustable leveling legs.
  - 9. Provide a service disconnect switch to isolate power from the unit during maintenance.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas to receive terminal heating and cooling units for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install terminal heating and cooling units in accordance with manufacturer's written instructions.
- B. Suspended Units: Suspend units from structural steel support frame using threaded steel rods and vibration isolation. Refer to Section "Vibration Isolation for HVAC" for additional requirements.
- C. Arrange installation of units to provide access space around units for service and maintenance.
- D. Unit Heaters
  - 1. Hang units from building substrate, not from piping. Mount as high as possible to maintain greatest headroom possible unless otherwise indicated.
  - 2. Support units with rod-type hangers anchored to building substrate.
  - 3. Protect units with protective covers during balance of construction.
- E. Fan Coil Units
  - 1. Install fan coil units level and plumb.
  - 2. Install fan coil units to comply with NFPA 90A.
  - 3. Ductwork: Refer to Division-23 section "Metal Ducts". Connect supply and return ducts to unit with flexible duct connections. Provide transitions to exactly match unit duct connection size.
  - 4. Vertical Units: Support vertical units with vibration isolation pads. Provide concrete base where indicated on the drawings.

### 3.3 PIPING CONNECTIONS

- A. Piping: Piping installation requirements are specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:
1. Arrange piping installations adjacent to units to allow unit servicing and maintenance.
  2. Connect water supply piping to the air leaving side of water coils.
  3. Connect condensate drain piping to the unit with appropriate trap. Verify that the piping material and installation is in accordance with Division 22 requirements.

### 3.4 ELECTRICAL WIRING

- A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electric Installer.
1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 Sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

### 3.5 ADJUSTING AND CLEANING

- A. General: Just prior to substantial completion clean unit's exposed surfaces and vacuum clean internal components including fan wheel, fan cabinet, all heat exchange surfaces, cooling/heating coil sections, filter sections, access sections, etc.
- B. Retouch any marred or scratched surfaces of factory-finished surfaces, using finish materials furnished by manufacturer.
- C. Install new filters in terminal heating and cooling units requiring same. Do not operate units without filters installed.

### 3.6 STARTUP

- A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
1. Remove shipping, blocking, and bracing.
  2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
  3. Perform cleaning and adjusting specified in this Section.
  4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
  5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
- B. Start-Up Services: Start-up terminal heating and cooling units in accordance with manufacturer's written start-up instructions. Do not operate units without filters installed. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
    - a. Replace fan and motor pulleys as required to achieve design conditions.
    - b. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for system testing, adjusting, and balancing.

**3.7 TRAINING**

- A. At a time mutually agreed upon between the Owner and Contractor, engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain terminal heating and cooling units.
- B. Content: Training shall include but not be limited to:
  - 1. Overview of the system and/or equipment as it relates to the facility as a whole.
  - 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
- C. Review data included in the operation and maintenance manuals.

END OF SECTION

**SECTION 23 84 14 - SELF CONTAINED HUMIDIFIERS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Electrode Steam Generator Unit.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's humidifier specifications, installation and start-up instructions, and current humidifier performance information with selection points clearly indicated.
  - 1. Provide dimensions, performance and construction details for the dispersion tubes and panels.
- B. Shop Drawings: Submit manufacturer's shop drawings indicating dimensions, required clearances, piping details and methods of assembly of components.
- C. Wiring diagrams detailing wiring for power and controls and differentiating between manufacturer-installed wiring and field-installed wiring.
- D. Maintenance data for humidifiers, for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23 Section "General Mechanical Requirements."

**1.3 QUALITY ASSURANCE**

- A. Codes and Standards: Provide humidifiers conforming to the following standards:
  - 1. Underwriters Laboratories, Inc. (UL) or Electrical Testing Laboratories (ETL): Provide electric humidifiers with UL or ETL label and listing.
- B. Certification: Provide humidifiers whose performances, under specified operating conditions, are certified by the manufacturer.

**1.4 DELIVERY STORAGE AND HANDLING**

- A. Delivery: Handle humidifiers carefully to prevent damage, denting and scoring. Do not install damaged humidifiers or components; replace with new.
- B. Storage: Store humidifiers and components in a clean, dry place. Protect from weather, dirt, water, construction debris, and physical damage.

**PART 2 - PRODUCTS AND MATERIALS****2.1 ELECTRODE STEAM GENERATOR HUMIDIFIER**

- A. Manufacturers:
  - 1. Armstrong Intl., Inc.
  - 2. Condair
  - 3. Dri-Steem Corporation
  - 4. Hygromatik, Div. of Carel
  - 5. Neptronic
  - 6. Pure Humidifier Co.

- B. Type: Provide packaged self-contained, all electric steam generators of the disposable or serviceable cylinder type, from which steam is piped to a dispersion tube or panel mounted in a duct or air handling unit or to a unit- or remote-mounted fan package as shown on the drawings.
- C. Steam Cylinders: Provide humidifier assemblies with one or more steam cylinders utilizing electrical current flow through the water to generate steam.
1. Provide cylindrical molded plastic casings.
  2. Provide cylinders with large surface area, lattice type electrodes.
- D. Dispersion Tubes:
1. Provide dispersion tubes designed to evenly distribute the specified quantity of steam uniformly over the entire cross section of the air stream.
  2. Provide single or multiple dispersion tubes as required to achieve total steam absorption in a steam travel distance as scheduled on the drawings.
  3. Construct dispersion tubes of Type 304 or 316 stainless steel.
  4. Provide condensate separators to remove condensate from steam supply to dispersion tube.
- E. Dispersion Panel:
1. Provide prefabricated steam dispersion grid assembly extending the full width and height of duct or plenum designed for short absorption distance with atmospheric steam applications.
  2. Provide nozzles/metered orifices, spaced evenly along distribution tubes to facilitate dry and uniform steam distribution.
  3. Provide Type 304 or 316 stainless steel headers and distribution tubes.
  4. Provide steam separator integral to the header to remove condensate from steam supply to dispersion tube.
- F. Steam Piping:
1. Provide type K or L, hard drawn copper pipe conforming to ASTM B88, from steam generator to dispersion tubes.
  2. Provide wrought copper, solder joint fittings conforming to ANSI B16.22.
  3. Make connections between copper pipe and steam generator and dispersion tube with insulated hose specifically designed for steam service.
  4. Slope piping down from dispersion tubes to steam generator minimum 1/4-inch per foot.
  5. Insulate piping in accordance with Division 23 Section "HVAC Insulation."
- G. Steam Generator Cabinet:
1. Provide 18 gauge, enamel finished steel steam generator cabinets.
  2. Provide lockable, hinged doors to allow access to cylinders, operating and safety controls, electrical components and water makeup and drain valves.
  3. Provide wall mounting brackets and associated hardware or floor supports with leveling adjustment as indicated.
- H. Controls:
1. Provide microprocessor based electronic humidifier operating controls.
  2. Provide capacity control based upon adjusting the water level in the cylinders and thereby modulating the electrical current flow through the water.
  3. Provide automatic adjustment of water level by the operation of automatic makeup and drain valves.
  4. Provide high water sensors in each cylinder which will close the makeup valve and energize an indicator light on the front of the steam generator cabinet.
  5. Provide controls that will automatically shut down the unit if an unsafe operating condition is detected and display failure mode.
  6. Provide a manual drain switch to allow draining of cylinders for servicing, replacement or mineral dilution.
  7. Provide a control package capable of accepting a varying electronic signal (voltage, resistance or current) from the control system specified in Division 23 Section "Direct-Digital Control for HVAC".

- I. Water Make-up and Drain:
  - 1. Provide humidifiers with factory piped water makeup and drain connections to the cylinders, with single point connections at the exterior of the cabinet.
  - 2. Provide separate makeup and drain solenoid valves for each cylinder in multiple cylinder units.
  - 3. Provide integral tempering system to maintain drain water at maximum temperature of 140 F.
  - 4. Provide an air gap at each fill connection to prevent back siphoning.
- J. Options: Provide the following options where scheduled on the drawings or as required for the installation.
  - 1. Provide a manual reset over-temperature switch factory installed on the humidifier reservoir for humidifier over-temperature protection.
  - 2. Provide airflow proving switch to lock out humidifier when no airflow is sensed.
  - 3. Insulate unit with minimum 1" thick fiberglass insulation with aluminum foil facing.
  - 4. Provide NEMA 3R or 4 weather tight control cabinet for units installed outdoors.
  - 5. Provide a factory installed temperature sensor mounted onto the front access plate of the humidifier reservoir utilized to maintain the water temperature above freezing for units installed outdoors.
  - 6. Provide a factory installed key lock on the cabinet door.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine ducts, air-handling units, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before humidifier installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. General: Install humidifiers in accordance with the manufacturer's instructions and in an arrangement that will permit access and ease of maintenance.
- B. Seal all duct and plenum penetrations with flange.
- C. Install galvanized steel drain pan with flood detector switch under each humidifier mounted in a duct.
  - 1. Provide alarm to the BAS or, if no BAS, to a local visual/audio alarm device.
  - 2. Provide drain connection near top of the drain pan side and connect to drain piping or route to nearest floor drain.
- D. Piping:
  - 1. Steam Piping: Install tube(s)/manifold supply piping pitched to drain condensate back to humidifier or as recommended by manufacturer.
  - 2. Water Piping: Install piping as indicated including unions, shutoff valves, strainers and pressure regulating valves. Refer to Division 22 for water piping and accessories.
  - 3. Drain Piping: Install drain piping as indicated including unions and traps and route to nearest floor drain.
  - 4. Slope steam and condensate piping towards traps. Slope drain piping towards discharge location.
- E. Electrical: Refer to Division 26 for electrical equipment, conduit and wiring requirements.

**3.3 FIELD QUALITY CONTROL**

- A. Provide the services of a factory authorized service representative to provide start-up service and to demonstrate proper operation of equipment, accessories and controls.

**3.4 TRAINING**

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
  - 1. Overview of the system and/or equipment as it relates to the facility as a whole.
  - 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
  - 3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."
- C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION



**SECTION 23 84 17 - DESICCANT WHEEL UNITS****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This Section includes desiccant wheel air-handling units with coils for outdoor installations.

**1.2 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
1. Product data for each desiccant wheel unit indicated, including the following:
    - a. Fan performance curves with system operating conditions indicated.
    - b. Fan sound power ratings.
    - c. Coil performance ratings with system operating conditions indicated.
    - d. Motor ratings and electrical characteristics plus motor and fan accessories.
    - e. Provide short circuit current rating of units with factory mounted starter or variable frequency drive.
    - f. Materials gages and finishes.
    - g. Filters with performance characteristics.
    - h. Dampers, including housings, linkages, and operators.
  2. Shop drawings from manufacturer detailing dimensions, weights, required clearances, components, and location and size of each field connection.
  3. Wiring diagrams detailing wiring for power and controls and differentiating between manufacturer-installed wiring and field-installed wiring.
  4. Product certificates signed by manufacturers of desiccant wheel units certifying that their products comply with specified requirements.
  5. Field quality control test reports specified in Part 3 of this Section.
  6. Maintenance data and recommended spare parts list for desiccant wheel units for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23 Section "General Mechanical Requirements."

**1.3 QUALITY ASSURANCE**

- A. NFPA Compliance: Desiccant wheel units and components shall be designed, fabricated, and installed in compliance with NFPA Standard 90A "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. AHRI Certification: Desiccant wheel units and their components shall be factory tested in accordance with the applicable portions of AHRI 430 - Standard for Air-Handling Units.

**1.4 SPARE PARTS**

- A. General: Furnish to Owner, with receipt, the following spare parts for each packaged heating and cooling unit.
1. One set of matched fan belts for each belt driven fan and desiccant wheel unit.
  2. If HVAC equipment is used during the construction period, Contractor shall provide one set of filters (if system is designed to include pre-filters and after-filters, provide only pre-filters) when the unit is started and replace filters when needed, but not less than every month. On the day of substantial completion, the Contractor shall clean the unit and provide a new set of filters at each location in the unit.
  3. Furnish one additional gasket for each sectional joint of each desiccant wheel unit.

**1.5 SPECIAL PROJECT WARRANTY**

- A. Warranty on Motor/Compressor: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, motors/compressors with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.
1. Warranty Period: 5 years from Date of Substantial Completion.

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bry-Air, Inc.
  2. Concepts and Designs
  3. Novel Aire
  4. Xetex, Inc.

**2.2 MANUFACTURED UNITS**

- A. General Description: Factory assembled, consisting of fans, motor and drive assembly, heating and cooling coils, desiccant wheel with reactivation system, damper, plenums, filters, and drip pans.
- B. Types: Desiccant wheel units included in this project are of the following types:
1. Chilled water coils.
- C. Motor and Electrical Components: Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment."

**2.3 UNIT BASE AND CABINET**

- A. Provide unit base of all steel construction with formed 2 inch by 8 inch 12-gage galvanized steel channel around outside perimeter and reinforced with 2 inch by 6 inch 12-gage galvanized channel on centers not exceeding 24 inches. Provide completed base constructed with G90 galvanized materials.
- B. Floor Construction: Floor panels shall be minimum 18 gauge galvanized steel with airtight seams and 2" of fiberglass insulation. There shall be no exposed insulation underneath unit.
- C. Exterior Housing Construction:
1. Construct unit housing of 2" thick urethane foam double wall construction, with galvalume exterior and galvanized interior wall skins.
  2. Provide access to service areas by means of full size service doors located to allow periodic maintenance and inspections. Construct doors with continuous aluminum hinge, compression type latches, and resilient gaskets. Door openings shall be flush with the floor to allow for ease of cleaning and washdown. Fabricate access doors with minimum of 2 inch urethane board insulation.
- D. Double-Wall Drain Pans: Formed sections of 304 stainless steel. Fabricate pans in sizes and shapes to collect condensate from cooling coils (including coil piping connections and return bends) when units are operating at the maximum cataloged face velocity across the cooling coil. Fill space between double-wall construction with fiberglass or mineral wool insulation and seal moisture tight.

1. Units with stacked coils shall have an intermediate drain pan or a drain trough to collect condensate from top coil.
- E. Provide bird screen on all outdoor air inlets.
- F. Service Vestibule: Provide unit with built-in service vestibule that provides access to electrical panel, dehumidifier components, controls, variable frequency drive, and compressors while providing protection from weather. Construct service vestibule with synthetic rubber floor matting that provides electrical insulation to 20,000 volts RMS/AC, main unit disconnect switch, and service light and ground fault duplex receptacle powered independently from main unit power supply.

## 2.4 DEHUMIDIFIER AND CONTROL COMPONENTS

- A. Provide dehumidifier of design and construction proven in field by minimum of five years' operating performance.
- B. Dehumidifier: Non-cyclic sorption type with single desiccant rotary structure designed for continuous operation. Construction arrangement shall provide counter flow of process and reactivation air streams with full face pressure seals to prevent cross leakage with static pressure differentials up to 8 inches water gage.
- C. Provide rotary structure consisting of 100 percent inert silicates impregnated with an inorganic, non-granular, crystalline desiccant which transfers water in vapor phase or of non-crystalline form of silicon dioxide (titanium silica gel). The design shall assure laminar air flow through the structure for minimum pressure loss with maximum transfer surface.
- D. Dehumidifier shall include honeycomb desiccant wheel and drive system, natural gas direct-fired reactivation heater, fan and motor assemblies for reactivation and process air flow, reactivation and process air flow indicating gages, inlet filters for reactivation and process air, reactivation energy control system, and overheat, rotation, and heater proving fault circuitry.
- E. Heat pipe located in process air stream.
- F. Provide humidistats for each unit.

## 2.5 FAN SECTION

- A. Testing Requirements: Units' fans performance ratings for flow rate, pressure, power, air density, speed of rotation, and efficiency shall be factory tested.
- B. Fan Section Construction: Fan sections shall be equipped with a formed steel channel base for integral mounting of fan, motor, and casing panels. The fan scroll, wheel, shaft, bearings, and motor shall be mounted on a structural steel frame with frame mounted on base with spring vibration isolators with an isolation efficiency of not less than 90%. Supply fan shall be belt driven with an adjustable pitch sheave.
- C. Equip units with reactivation air fans to provide scheduled air flows against static pressures indicated. Reactivation air fan shall be single width, single inlet with backward inclined airfoil blades. Reactivation air fan shall be direct drive with a ODP motor. Motors shall be open drip proof NEMA Design B with Class B insulation and 1.15 service factor.
- D. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower. Supply fan wheel shall be plenum fan with airfoil blades as indicated. Airfoil wheels shall be steel painted with zinc chromate primer and an enamel finish coat. Fan shaft shall be solid steel, turned, ground, and polished. Fan wheels shall be keyed to the shaft.
- E. Shaft Bearings: Grease-lubricated ball bearings selected for 200,000 hours' average life, with grease fittings extended to an accessible location outside the fan section.

- F. Fan Drives: Designed for a 1.4 service factor and factory mounted with final alignment and belt adjustment made after installation.
  - 1. Belt Drive: Motors and fan wheel pulleys shall be adjustable pitch for use with motors up to and including 15 HP and fixed pitch for use with motors larger than 15 HP.
  - 2. Motors shall have steel belt guards.

## 2.6 FAN MOTORS

- A. Torque Characteristics: Sufficient to accelerate the driven loads satisfactorily.
- B. Motor Sizes: Minimum size as indicated. If not indicated, large enough so that the driven load will not require the motor to operate in the service factor range.
- C. Temperature Rating: 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class A Insulation).
- D. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.
- E. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design B. Refer to Section "Common Motor Requirements for HVAC Equipment" for additional requirements.
  - 1. Bases: Adjustable.
  - 2. Bearings: The following features are required:
    - a. Ball or roller bearings with inner and outer shaft seals.
    - b. Grease lubricated.
    - c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
  - 3. Enclosure Type: The following features are required:
    - a. Open drip-proof motors where satisfactorily housed or remotely located during operation.
    - b. Guarded drip-proof motors where exposed to contact by employees or building occupants.
  - 4. Overload protection: Built-in, automatic reset, thermal overload protection.
  - 5. Noise rating: Quiet.
  - 6. Efficiency: Energy-efficient motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, Test Method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors" in accordance with IEEE Standard 112, Test Method B.
  - 7. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, and special features.
- F. Starters, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26.

## 2.7 WATER COILS

- A. Testing Requirements: The following factory tests are required:
  - 1. Coil Performance Tests: Cooling and heating coils, except sprayed surface coils, shall be factory tested for rating in accordance with AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.
- B. Coil Sections: Common or individual insulated, galvanized steel casings for heating and cooling coils. Coil section shall be designed and constructed to facilitate removal of coil for maintenance and replacement and to assure full air flow through coils.
  - 1. Medium- and high-pressure units shall have double gaskets between sections and coil connection penetrations through casing sealed to minimize leakage.
- C. Coils, General: Drainable, rigidly supported across the full face of the coil, and pitched to allow drainage.

1. Fins: Aluminum or copper, constructed from flat plate with belled collars for tubes. Fins shall be bonded to tubes by mechanically expanding copper tubes.
2. Tubes: Seamless copper.
3. Coil Casing: Galvanized steel.
4. Headers for Water Coils: Steel or cast iron, with connections for drain valve and air vent and threaded piping connections.
5. Water Coil Turbulators: Bronze, spring-type.

## 2.8 FILTERS SECTION

- A. Air Filters: Refer to Division 23 Section "Particulate Air Filtration" for air filters required for desiccant wheel units.
- B. General: Filters shall comply with NFPA Standard 90A "Standard for the Installation of Air Conditioning and Ventilating Systems."
- C. Filter Section: Process air inlet, reactivation air inlet, and return air inlet plenums shall be equipped with heavy gage galvanized steel racks to provide for slide out removal of filters, with filter media holding frames arranged for flat orientation.

## 2.9 ELECTRICAL SECTION

- A. The main electrical control panel shall be located in a service vestibule that includes a vaporproof service light and ground fault receptacle powered independently from the main unit power supply.
- B. All electrical controls shall be UL listed, and the entire unit factory wired in accordance with National Electrical Code standards and either ETL or UL listed.
- C. The unit shall be supplied with a non-fused main power disconnect which is mounted in the service vestibule. A single point power connection shall be provided for all units.
- D. Provide phase loss and low voltage shutdown protection.

## 2.10 AUXILIARY GAS HEAT SECTION

- A. Gas fired heaters shall be sized to provide capacities scheduled for auxiliary supply air heat and auxiliary reactivation air heat.
- B. Gas heaters shall be of power vented type and shall be AGA or ETL certified. Heat transfer surface shall be constructed of type 400 series stainless steel or aluminized steel and shall be suitable for use downstream from a cooling coil.
- C. Heaters shall be complete with all operational controls including an integral induced draft fan, combination gas valve with manual shutoff, temperature limit control, and automatic spark or hot surface ignited pilot with electronic flame supervision.
- D. Heaters shall include a stainless steel drain pan to encompass entire heater.

## 2.11 VARIABLE FREQUENCY DRIVES

- A. Provide variable frequency drive where indicated on the drawings. Locate variable frequency drive in service vestibule of unit.
- B. Variable frequency drive shall comply with all the requirements in specification Division 23 Section "Variable Frequency Drives".

## 2.12 DAMPERS

- A. General: Dampers and their operators shall comply with requirements specified in Division 23 Section "Instrumentation and Control Devices for HVAC."

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas and conditions under which desiccant wheel units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

**3.2 INSTALLATION GENERAL**

- A. General: Install desiccant wheel units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Support roof-mounted units on roof curbs provided by General Contractor. Secure units to roof curb with anchor bolts. Refer to schedule on the drawings for minimum roof curb height.
- C. Arrange installation of units to provide access space around desiccant wheel units for service and maintenance.

**3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 Section "Basic Piping Materials and Methods". The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:
  - 1. Arrange piping installations adjacent to units to allow unit servicing and maintenance.
  - 2. Connection piping to air-handling units with flexible connectors.
  - 3. Connect water supply piping to the air leaving side of water coils.
  - 4. Condensate Drain Piping: Route condensate drain to nearest roof or equipment drain or to location shown on the drawings. Provide trap at connection to drain pan with depth as noted on the drawings and install cleanouts at changes in direction (refer to manufacturer's recommendations for any additional requirements). Size condensate drain piping in accordance with local code and as shown on the drawings.
- B. Duct installations and connections are specified in other Division 23 Section "Metal Ducts". Make final duct connections with flexible connections.
- C. Electrical Connections: Electrical power wiring is specified in Division 26.
- D. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

**3.4 ADJUSTING CLEANING AND PROTECTING**

- A. Adjust water coil flow, with control valves to full coil flow, to indicated gpm.
- B. Adjust damper linkages for proper damper operation.
- C. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, intake plenum cabinet, heat exchange surfaces, desiccant wheel, cooling/heating coil sections, filter sections, access sections, etc.

**3.5 STARTUP**

- A. Supervision of start-up of equipment shall be provided by factory trained personnel.
- B. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
  - 1. Remove shipping, blocking, and bracing.

2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
  3. Perform cleaning and adjusting specified in this Section.
  4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
  5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
  6. Comb coil fins for parallel orientation.
  7. Install clean filters. Do not operate unit without filters.
  8. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
  9. Disable automatic temperature control operators.
- C. Starting procedures for desiccant wheel units:
1. Manufacturer shall provide factory trained personnel to supervise start up and testing of equipment.
  2. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
    - a. Replace fan and motor pulleys as required to achieve design conditions.
    - b. Measure and record motor electrical values for voltage and amperage.
    - c. Shut unit down and reconnect automatic temperature control operators.
    - d. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for air-handling-system testing, adjusting, and balancing.
  3. Energize dehumidifier, desiccant wheel, blowers, and auxiliary heaters.
    - a. Replace fan and motor pulleys as required to achieve design conditions.
    - b. Measure and record motor electrical values for voltage and amperage.
    - c. Shut unit down and reconnect automatic temperature control operators.

### 3.6 TRAINING

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
1. Overview of the system and/or equipment as it relates to the facility as a whole.
  2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
  3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."
- C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 23 84 19 - HYDROTHERAPY AIR HANDLING UNITS****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. Section includes swimming pool heating and cooling units.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties and accessories; and installation and start-up instructions. Provide short circuit current rating of units with factory mounted starter or variable frequency drive.
- B. Shop Drawings:
  - 1. Submit manufacturer's assembly-type shop drawings indicating dimensions, required clearances, and methods of assembly of components
- C. Wiring Diagrams: Submit wiring diagrams detailing the manufacturer's electrical requirements for power supply wiring for swimming pool air handling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- D. Operation and Maintenance Data: Submit maintenance data and parts list for each unit, including "trouble-shooting" maintenance guide, servicing guide and preventative maintenance schedule and procedures. Include this data in maintenance manual; in accordance with requirements of Division 1.

**1.3 QUALITY ASSURANCE**

- A. Codes and Standards:
  - 1. Energy Efficiency Ratio (EER) of rooftop units shall be equal to or greater than prescribed by ASHRAE 90.1-2004 "Energy Standard For Buildings Except Low-Rise Residential Buildings".

**1.4 SPARE PARTS**

- A. Extra Materials: Furnish to Owner, with receipt, the following spare parts for each roof mounted heating and cooling unit:
  - 1. One set of matched fan belts for each belt-driven fan.
  - 2. One set of spare filters of each type required for each unit. Obtain receipt from Owner that spare filters have been provided. In addition to the spare set of filters, install new filters at completion of installation work, and prior to testing, adjusting, and balancing work.
  - 3. the day of substantial completion, the Contractor shall clean the unit and provide a new set of filters at each location in the unit.

**1.5 SPECIAL WARRANTY**

- 1. Warranty Period: 5 years from date of substantial completion.

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. Subject to compliance with requirements, provide units of one of the following:
1. Dectron.
  2. Desert Aire.
  3. Poolpak.
  4. Seresco.

**2.2 GENERAL**

- A. Furnish and install enclosed hydrotherapy environmental control energy recovery system. The system shall be specifically designed for control of the hydrotherapy environment. Field assembled or modified commercial grade equipment is not acceptable. Capacities and specifications shall comply with the mechanical schedule. Units shall be completely factory assembled and tested. Outside air, fans, motors, and all operating and safety controls specified shall be furnished, factory installed and factory tested.
- B. Units shall be built to comply with UL Standard 465 and be ETL certified and bear the ETL label. The unit's cooling, heating, dehumidifying, ventilating, and exhausting capacity and performance shall meet or exceed that shown on the schedule. System shall include supply air fans, complete logic control system & power for single point connection. Electrical ladder wiring diagrams shall be laminated and attached to the control panel access doors. Installation and maintenance manuals shall be supplied with each unit.

**2.3 PRINCIPLE OF OPERATION**

- A. The unit shall control space temperature and relative humidity, and shall provide controlled ventilation. Warm moist air from the pool is drawn over an evaporator coil by the supply fan and the latent and sensible heat is removed from the air. The resulting dryer cooler air is mixed with a fixed amount of outside air to ensure proper indoor air quality. The mixed air is drawn by the supply fan over a re-heating coil and an if specified, an auxiliary heating device.
- B. The cooling system is activated if either the space temperature deviates from, or the relative humidity rises above its set point.
- C. The unit shall monitor space and relative humidity.

**2.4 CABINET CONSTRUCTION**

- A. Cabinets shall be constructed in a water and air tight manner. The manufacturer's standard cabinet construction shall result in an ASHRAE/ANSI Standard 111-88 Leakage Class of less than nine (9) as measured in accordance with AMCA Standard 210-85. Unit serial numbers shall be permanently welded into the base frame.
- B. .
- C. Floor Sheets:
1. All floor sheets shall be fabricated of 18 gauge minimum bright galvanized sheet steel which has been continuously hot dip coated with a durable protective coating of zinc. All thickness shall conform to ASTM A-653 for lock-former quality. Zinc coating weight shall be G-90 (1.25 oz/square foot) as per ASTM A-653. Finish shall be bright spangle. All joints shall be sealed with an industrial adhesive sealant for water and air tightness. This sealant shall conform to ASTM C-834-76 and Federal Specification TTS-230C, Class B.

Floors shall be double wall and insulated with minimum of 4 in. of fiberglass insulation having a insulating value of no less than R-11.

D. Casing Panels

1. All panels shall be fabricated of 18 gauge sheet steel with 20 gauge solid sheet steel liners. All sheet steel shall be continuously hot dip coated with a durable protective coating of zinc. The steel shall conform to ASTM A-653 for lock-former quality. Zinc coating weight shall be G-90 (1.25 oz/square foot) as per ASTM A-653. Prior to fabrication, both the outer sheet steel shell inner liner will be submerged in a heated phosphoric acid bath to remove all oil and mill scale. A coating of zinc rich epoxy primer shall be applied on both top and reverse sides of each sheet baked on at 400°F. All panel corners will be caulked with sealant. After insulation, liners shall be permanently welded to the outer shell. Panels shall be flange type with a minimum 1 in. flange caulked and sealed to the structural member to form the air seal with the panel. Fasteners used to attach the panel will pass through this flange and into one side of the tube but not penetrating into the air tunnel. Panels shall not exceed 48 in. without a structural steel support member in at least one axis. Panel joints shall be recessed and shall have a mastic coating, insulated and covered with a removable trim strip. All panel joints shall be sealed with an industrial neoprene gasket for water and air tightness.

- E. Durable access doors shall be provided into all sections of the air handling equipment for easy access of all components. The doors shall be of the same gauge as the unit cabinet. Access doors shall be double wall and completely insulated between the interior and exterior sheet metal of the door. Insulation shall be the same as that of the unit cabinet. Single wall construction is not acceptable. Each door shall have three (3) - 6 inch stainless steel piano hinges. Access panels without hinges is not acceptable. Ventlok high compression latches shall be used on access doors. Latches shall be provided with lock and require a key for entry. All access doors shall be gasketed around the complete perimeter. The gasket shall be a neoprene/EPDM rubber bulb type. All bulb door gasket shall have internal aluminum clips. The bulb gasket shall be rated by the manufacturer for a constant exposure temperature range of -20°F to 160°F. Gasket shall exhibit excellent compression characteristics. Doors shall swing open against the section pressure. Optional Viewing Windows Door viewing windows shall be double pane wire reinforced type. All windows shall be fabricated with an integral desiccant between the hermetically sealed panes.

- F. The finish coat on the exterior of the unit shall be a high gloss alkyd enamel specially formulated for its weathering characteristic. Epoxy coatings will not be acceptable for outdoor applications due to the UV chalking that occurs during the life of the unit. The total coating thickness shall not be less than 1.5 mils. The color shall be machine gray. The color shall be selected by the architect. Pencil hardness shall be B or greater. Direct impact resistance shall be 30 or greater as per ASTM d-2794. Adhesion on the actual metal substrate shall comply with ASTM D-3359-B with no lifting. In an unscribed condition the coating shall exhibit no visible effects after 100 hours exposure to 100% relative humidity at 100F per ASTM D-2247. Less than 1mm undercutting and no blistering shall be exhibited on coatings applied to untreated cold rolled steel panels in a scribed condition after 100 hr exposure in 5% salt spray testing at 95F and 95% relative humidity as per ASTM B-117. Sixty degree gloss retention after six(6) months South Florida weathering shall not decrease by more than 5%.

## 2.5 CONDITIONING COILS

- A. All coils shall meet or exceed all capacities specified on the mechanical schedule for the project. All water coil performances shall be certified by the manufacturer to be in accordance with A.R.I. Standard 410. Cooling coils shall be mounted in the unit for horizontal air flow. Coil air face velocities shall not exceed the specified velocities of the mechanical schedule. All coils shall be mounted on steel glide channels and fastened to the air seal wall. Coils shall be mounted to air seal wall structure with high strength 0.25 inch bolts, lock washers and nuts. Air seal joints shall be completely caulked with a silicone adhesive sealant.

- B. COILS SECTION
- C. Testing Requirements: The following factory tests are required:
1. Coil Performance Tests: Cooling and heating coils, except sprayed surface coils, shall be factory tested for rating in accordance with AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.
- D. Coil Pressure Ratings:
1. Water Coils: Design for 200 psi working pressure at 325 F, and pressure test at 300 psi under water.
- E. Coil Sections: Common or individually insulated, galvanized steel casings for heating and cooling coils. Coil section shall be designed and constructed to facilitate removal of coil for maintenance and replacement and to assure full air flow through coils.
1. Multizone units shall have air deflectors and air baffles for balanced air flow across both heating and cooling coils.
  2. Medium and high-pressure units shall have double gaskets between sections and coil connection penetrations through casing sealed to minimize leakage.
- F. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.
- G. Drain Pans: 24 inch downstream of coil and down spouts for cooling coil banks more than one coil high.
- H. Eliminators: Three break of galvanized steel, mounted over drain pan.
- I. Air Coils:
1. Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.
- J. Fabrication:
1. Tubes: 5/8 inch OD seamless copper expanded into fins, brazed joints.
  2. Fins: Aluminum or copper, constructed from flat plate with belled collars for tubes. Fins shall be bonded to tubes by mechanically expanding copper tubes.
    - a. Thickness: Minimum 0.006 inches.
    - b. Spacing: Maximum 12 fins per inch.
  3. Casing: Die formed channel frame of galvanized steel.
  4. Water Coil Turbulators: Bronze, spring-type.
- K. Water Heating Coils:
1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
  2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type.
- L. Water Cooling Coils:
1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
  2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.
- M. HOT WATER HEATING COIL
1. Hot water coils shall be tested to 350 psig compressed air under clear water. Coils shall be designed to operate at 200 psig internal pressure and up to 300°F. Internal tubes shall be round seamless 1/2 in., 0.016 in. wall copper tubes which have been deoxidized by the addition of phosphorous. Coil casings shall be constructed of a minimum of 16 gauge continuous galvanized steel  SS or Copper optional  Coil casing reinforcements shall be required for fin lengths over 42 in. Coil fins shall be plate type, die-formed ripple edge corrugated 0.006 in. aluminum with guide channels to create turbulent wiping behind the tubes with collars drawn and belled. Internal copper tubes shall be staggered in direction of air flow. The copper circuiting tubes shall be mechanically expanded to the phenolic coated aluminum or copper fins. Uncoated copper fins will not be accepted. The fin spacing shall be a maximum of 10 fins per inch.

2. All hot water coils shall be drainable with a 0.25 in. FPT plugged drain or vent tap on the supply and return headers. Seamless copper tubes shall be brazed to the copper supply and return headers.
3. Hot water coil control valve will be furnished and installed by the unit manufacturer.

## 2.6 AIR FILTERS

- A. Filter holding frames shall be of heavy duty construction designed for industrial applications. Holding frames applied in low efficiency filter applications will be upstream accessible. Holding frames shall be constructed from no less than 18 gauge galvanized steel. They shall be equipped with polyurethane foam gaskets, fasteners and filter centering dimples. The in-line depth shall not be less than 2.75 in. in order to effect adequate bearing surface for built-up filter banks. Filter fasteners shall be capable of being installed without the requirement of tools, nuts or bolts. The holding frame shall be designed to accommodate standard size filters with the application of the appropriate type fastener. Holding frame assemblies shall be sized for a maximum of 500 fpm or shall meet or exceed area specified by the mechanical schedule.
- B. Provide filters with MERV ratings as listed in the equipment schedule.

## 2.7 CONTROL DAMPERS

- A. General: Dampers and their operators shall comply with performance requirements specified in Division 23 Section "Instrumentation and Control Devices for HVAC."
- B. Construction:
  1. Aluminum dampers shall be heavy duty construction designed for industrial applications.
  2. The frame shall be fabricated from 16 gauge galvanized steel formed C channel. Side framing shall have extruded bearing holes which decrease wear and allow smooth rotation of the blade shaft bearing.
  3. Damper linkage shall be concealed in the frame out of the air stream for reduced air turbulence. Low operating torque linkage rides on self lubricated delrin type bearings contained within the quadrant clamp. Rigid low maintenance design is capable of handling higher torque requirements.
  4. Drive shafts shall be square to ensure proper alignment and positive locking connection between the blade, axle and linkage. Round drive shafts are unacceptable.
- C. Blades:
  1. Blades shall be parallel blade type when used to mix airstreams and opposed blade type for all other applications.
  2. Blades must be suspended so that blades are centered and bottom edge blade seals are not unduly compressed. Blade end seals shall be spring type tempered stainless steel.
  3. Blades shall be fabricated from no less than 6063-T6 heavy gauge extruded aluminum.
  4. Blades shall be airfoil in shape and utilize the triple-V-groove design and be furnished with a low-leak blade edge seal of material suitable for the environment and application.

## 2.8 FAN MOTORS

- A. Motors shall be NEMA design B with Class F insulation. Motors shall have electrical characteristics and horsepower as specified on the mechanical schedule. All motors shall have a minimum service factor of 1.15. Motors shall have ball bearings. Motors shall be TEFC and high efficiency, and be designed for 1750 RPM. Brake horsepower requirement of the fans shall not exceed 90% of the motor horsepower. The motor shall be located within the unit and mounted on an adjustable heavy steel base. The motor base shall be fastened securely to the structural steel framing of the fan assembly. This entire assembly shall have vibration isolators. Refer to Section "Common Motor Requirements for HVAC Equipment" for additional requirements.

**2.9 CONTROL PANEL**

- A. Each unit shall be equipped with a control panel built as an integral part of the unit. Each unit shall be wired and tested at the factory before shipment. Wiring shall comply with requirements of the latest NEC issue. Where applicable, UL listed components shall be used. Components shall be labeled and wires numbered per the wiring diagram. The unit shall bear the ETL certification label. The control panel shall contain a three pole main power terminal, starters, contactors, three phase overload protection, fuse blocks with fuses, numbered terminal strip, a line voltage to 115 volt control transformer with primary and secondary and control circuit switch.
- B. The controller shall be micro computer based DDC system. The following functions/setpoints will be programmable at the panel:
  - 1. Indoor Air Temperature
  - 2. Indoor Air Relative Humidity
  - 3. Occupied/Unoccupied Schedule
- C. An LED zone terminal will be provided for remote monitoring of the dehumidifier. Remote terminal shall be capable of monitoring of all setpoints listed below:
  - 1. Power On
  - 2. Indoor Air Temperature
  - 3. Indoor Air Relative Humidity
  - 4. Air Heating Mode
  - 5. Air Dehumidification Mode

**2.10 CONTROL SENSORS**

- A. The unit shall be factory supplied with the following factory mounted and wired control sensors:
  - 1. Indoor Air Temperature
  - 2. Indoor Relative Humidity

**2.11 UNIT MOUNTED DISCONNECT SWITCH**

- A. Each unit shall be equipped with a mounted and wired non-fused disconnect switch to meet the NEC requirement for DISCONNECTING MEANS WITHIN THE SIGHT OF THE UNIT.

**2.12 ELECTRIC ELECTRONIC ACTUATORS**

- A. The actuators for modulating service are direct-coupled electronic type. The actuators for the outside air and exhaust air are automatic return type. The input signal is 0-10 vDC and power requirements are 24 vDC.

**2.13 OPERATING AND SAFETY CONTROLS**

- A. Each unit shall be provided with a complete operating and safety logic control system. The control system shall shut down the unit in case of high refrigerant pressure, low refrigerant pressure and /or oil failure conditions. The water pump supplying each system will be interlocked (by others) with the pool water pump to provide safe operation. Operating and safety control system shall include all relays, contactors, sensors and switches necessary to operate complete unit.

**2.14 FACTORY TESTING AND QUALITY ASSURANCE**

- A. The fans shall be factory run tested to insure structural integrity and proper RPM. All electrical circuits shall be tested to ensure correct operation before shipment of unit. Units shall pass quality control and be thoroughly cleaned prior to shipment.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas and conditions under which units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

**3.2 INSTALLATION OF SWIMMING POOL AIR HANDLING UNITS**

- A. General: Comply with the manufacturer's printed instructions except where more stringent requirements are shown or specified, and except where manufacturer's technical representative directs otherwise. Install unit where shown on drawings. Provide adequate clearance around unit for air flow and service.
- B. Suspended Units: Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.
- C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical installer.
  - 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.
- D. Ductwork: Refer to Division-23 Section "Metal Ducts". Connect supply and return ducts to unit with flexible duct connections. Provide transitions to exactly match unit duct connection size.
- E. Piping: Piping installation requirements are specified in other Division 22 Sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:
  - 1. Arrange piping installations adjacent to units to allow unit servicing and maintenance.
  - 2. Connection piping to air-handling units with flexible connectors.
  - 3. Connect water supply piping to the air leaving side of water coils.
  - 4. Route unit condensate drain to location shown on the drawings or, if not shown, to nearest indirect waste connection. Provide trap at connection to drain pan with depth as noted on the drawings and install cleanouts at changes in direction. Size condensate drain piping in accordance with local code and as shown on the drawings.

**3.3 ADJUSTING CLEANING AND PROTECTING**

- A. Adjust fan for required airflow in accordance with Division 23 Section "Testing, Adjusting and Balancing for HVAC." Tighten belts as required for proper operation.
- B. Adjust damper linkages for proper damper operation.
- C. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, intake plenum cabinet, heat exchange surfaces, cooling/heating coil sections, filter sections, access sections, etc.

**3.4 STARTUP**

- A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
  - 1. Remove shipping, blocking, and bracing.
  - 2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
  - 3. Perform cleaning and adjusting specified in this Section.

4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
  5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
  6. Set outside-air and return-air mixing dampers to minimum outside-air setting.
  7. Comb coil fins for parallel orientation.
  8. Install clean filters. Do not operate air handling unit without pre-filters installed.
  9. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
  10. Disable automatic temperature control operators.
- B. Start-Up Services: Complete start-up service shall be provided by the equipment manufacturer's authorized representative and shall include complete sequencing of all controls and unit operation. Do not operate units without filters installed. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
    - a. Replace fan and motor pulleys as required to achieve design conditions.
    - b. Measure and record motor electrical values for voltage and amperage.
    - c. Shut unit down and reconnect automatic temperature control operators.
    - d. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for system testing, adjusting, and balancing.

### 3.5 TRAINING

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
1. Overview of the system and/or equipment as it relates to the facility as a whole.
  2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
  3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."
- C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

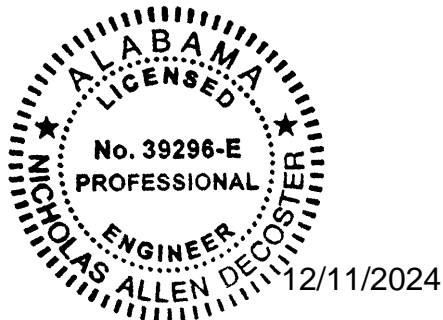


**TABLE OF CONTENTS**

**DIVISION 26 - ELECTRICAL SPECIFICATION**

260010 GENERAL ELECTRICAL REQUIREMENTS  
260500 COMMON WORK RESULTS FOR ELECTRICAL  
260502 EQUIPMENT WIRING SYSTEMS  
260504 PROVISIONS FOR ELECTRIC UTILITY SERVICE  
260519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES  
260526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS  
260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS  
260533 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS  
260543 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS  
260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS  
260573 POWER SYSTEM STUDIES  
260910 CENTRALIZED DIMMING SYSTEM  
260923 LIGHTING CONTROL DEVICES  
262200 LOW-VOLTAGE TRANSFORMERS  
262413 SWITCHBOARDS  
262416 PANELBOARDS  
262726 WIRING DEVICES  
262813 FUSES  
262816 ENCLOSED SWITCHES AND CIRCUIT BREAKERS  
263213 ENGINE-DRIVEN GENERATORS  
263600 TRANSFER SWITCHES  
264113 LIGHTNING PROTECTION FOR STRUCTURES  
264313 SURGE PROTECTIVE DEVICES  
265100 INTERIOR LIGHTING  
265300 INDOOR COURT LIGHTING  
265600 EXTERIOR LIGHTING

END OF DIVISION 26 TABLE OF CONTENTS



**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 26 00 10 - GENERAL ELECTRICAL REQUIREMENTS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and to all following sections within Division 26.

**1.2 SECTION INCLUDES**

- A. This Division requires providing complete functioning systems, and each element thereof, as specified, indicated, or reasonably inferred, on the Drawings and in these Specifications, including every article, device, or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the Work include, but are not limited to, materials, labor, supervision, supplies, tools, equipment, transportation and utilities.
- B. Division 26 of these Specifications, and Drawings numbered with prefixes E, generally describe these systems, but the scope of the electrical work includes all such work indicated in all of the Contract Documents, including, but not limited to: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.
- C. Drawings are graphic representations of the Work upon which the Contract is based. The Contractor will show the materials and their relationship to one another, including sizes, shapes, locations, and connections. The Contractor also convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, outlets and circuits without showing all of the exact details as to elevations, offsets, control lines, and other installation requirements. Use the Drawings as a guide when laying out the Work and to verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory and properly operating system.
- D. Specifications define the qualitative requirements for products, materials, and workmanship upon which the Contract is based.

**1.3 DEFINITIONS**

- A. Whenever used in these Specifications or Drawings, the following terms shall have the indicated meanings:
  - 1. Furnish: "To supply and deliver to the project site, ready for unloading, unpacking, assembling, installing, and similar operations."
  - 2. Install: "To perform all operations at the project site, including, but not limited to, and as required: unloading, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, testing, commissioning, starting up and similar operations, complete, and ready for the intended use."
  - 3. Provide: "To furnish and install complete, and ready for the intended use."
  - 4. Furnished by Owner (or Owner-Furnished) or Furnished by Others: "An item furnished by the Owner or under other Divisions or Contracts, and installed under the requirements of this Division, complete, and ready for the intended use, including all items and services incidental to the Work necessary for proper installation and operation. Include the installation under the warranty required by this Division."
  - 5. Engineer: Where referenced in this Division, "Engineer" is the Engineer of Record and the Design Professional for the Work under this Division.

- a. A Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the "Architect".
  6. Contract Administrator: Where referenced in this Division, "Contract Administrator" is the primary liaison between the Owner and the Contractor. Specifically, for this project this is the "Architect".
  7. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
  8. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other NRTLs that are acceptable to the AHJ, and standards that meet the specified criteria.
  9. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
    - a. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
    - b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
  10. Value Engineering: A systematic method to improve the "value" of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.
  11. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified
- B. When 'furnish', 'install', 'perform', or 'provide' is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.
- C. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.
- D. Manufacturers: The listing of specific manufacturers does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed are not relieved from meeting these specifications in their entirety.
  1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
  3. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference, unless otherwise noted.
- E. The following definitions apply to excavation operations:
  1. Additional Excavation: Where excavation has reached indicated sub-grade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.

2. Sub-base: as used in this section refers to the compacted soil layer used in pavement systems between the sub-grade and the pavement base course material.
3. Sub-grade: as used in this section refers to the compacted soil immediately below the slab or pavement system.
4. Unauthorized excavation consists of removal of materials beyond indicated sub-grade elevations or dimensions without specific direction from the Contract Administrator.

#### 1.4 REFERENCE STANDARDS

- A. Execute all work in accordance with, and comply at a minimum with, National Fire Protection Association (NFPA) codes, state and local building codes, and all other applicable codes and ordinances in force, governing the particular class of work involved, for performance, workmanship, equipment, and materials. Additionally, comply with rules and regulations of public utilities and municipal departments affected by connection of services. Where conflicts between various codes, ordinances, rules, and regulations exist, comply with the most stringent. Wherever requirements of these Specifications, Drawings, or both, exceed those of the above items, the requirements of these Specifications, Drawings, or both, shall govern. Code compliance, at a minimum, is mandatory. Construe nothing in these Construction Documents as permitting work not in compliance, at a minimum, with these codes. Bring all conflicts observed between codes, ordinances, rules, regulations and these documents to the Contract Administrator's and Engineer's attention in sufficient time, prior to the opening of bids, to prepare the Supplementary Drawings and Specifications Addenda required to resolve the conflict.
- B. If the conflict is not reported timely, prior to the opening of bids, resolve the conflict and provide the installation in accordance with the governing codes and to the satisfaction of the Contract Administrator and Engineer, without additional compensation. Contractor will be held responsible for any violation of the law.
- C. Obtain timely inspections by the constituted authorities having jurisdiction; and, upon final completion of the Work, obtain and deliver to the Owner executed final certificates of acceptance from these authorities having jurisdiction.
- D. All material, manufacturing methods, handling, dimensions, methods of installation, and test procedures shall conform to industry standards, acts, and codes, including, but not limited to the following, except where these Drawings and Specifications exceed them:
 

IBC	International Building Code
ADA	Americans with Disabilities Act
AEIC	Association of Edison Illuminating Companies
ANSI	American National Standards Institute
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
ICEA	Insulated Conductors Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code, NFPA 70
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers' Association
NETA	InterNational Electrical Testing Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Act
UL	Underwriter's Laboratories
- E. Comply with rules and regulations of public utilities and municipal departments affected by connections of services.

- F. Perform all electrical work in compliance with applicable safety regulations, including OSHA regulations. All safety lights, guards, and warning signs required for the performance of the electrical work shall be provided by the Contractor.
- G. Obtain and pay for all permits, licenses and fees that are required by the governing authorities for the performance of the electrical work.

### **1.5 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate with other divisions for electrical work included in them but not listed in Division 26 or indicated on electrical Drawings.
- B. Visit the site and ascertain the conditions to be encountered in installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provisions for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, and incorrect or faulty installation of any of the Work under this Division or for additional compensation for any work covered by this Division.
- C. Refer to Drawings and divisions of the other trades and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. Make all offsets required to clear equipment, beams and other structural members, and to facilitate concealing conduit in the manner anticipated in the design.
- D. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
- E. Provide materials with trim that will fit properly the types of ceiling, wall, or floor finishes installed.
- F. Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
- G. Maintain an electrical foreman on the jobsite at all times to coordinate this work with other trades so that various components of the electrical systems is installed at the proper time, fits the available space, and allows proper service access to all equipment. Carry on the Work in such a manner that the Work of the other trades will not be handicapped, hindered, or delayed at any time.
- H. Work of this Division shall progress according to the "Construction Schedule" as described in Division 01 and as approved by the Contract Administrator. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of all schedule dates.

### **1.6 MEASUREMENTS AND LAYOUTS**

- A. The Drawings are schematic in nature but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the Work. Figured dimensions take precedence to scaled dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. Correct, at no additional costs to the Owner, errors that could have been avoided by proper checking and inspection.

### **1.7 COORDINATION DRAWINGS**

- A. Coordination Drawings, General: Prepare coordination drawings according to the requirements of individual Sections. Additionally, prepare coordination drawings as required scope of installation is not completely shown on Shop Drawings, where limited space availability

necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one trade.

1. Information shall be project specific and drawn accurately to a scale large enough to resolve conflicts. Do not base coordination drawings on standard dimensional data.
  2. Prepare floorplans, sections, elevations, and details as needed to adequately describe relationship of various systems and components.
  3. Clearly indicate functional and spatial relationships of components of all systems specified in the Contract Documents, including but not limited to: architectural, structural, civil, mechanical, electrical, fire protection, and specialty systems.
  4. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
  5. Show location and size of access doors required for access to concealed equipment, fittings, controls, terminations, and cabling.
  6. Indicate required installation sequence to minimize conflicts between entities.
  7. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Contract Administrator indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
  8. The details of the coordination are the responsibility of the Contractor and, where indicated on the Drawings, minor adjustments in raceway routing, device placement, device type, or equipment arrangement are not to be considered changes to the Contract.
- B. Equipment Room Coordination Drawings: In accordance with the submittal procedures outlined within these Specifications, provide dimensioned layouts of electrical equipment locations within electrical rooms/closets, mechanical rooms, generator rooms, and fire pump rooms with equipment drawn to scale and identified therein.
1. Clearly identify all required working clearances and access provisions required for installation and maintenance.
  2. Equipment layouts should be arranged accounting for considerations for required door openings and the clearances required by the equipment manufacturer.
  3. Indicate path to allow for the future removal of each large piece of equipment (up to and including generators and unit sub-station transformers) without removal of non-related equipment or architectural elements.
  4. Include work provided by others routed through the equipment rooms.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
  2. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.
    - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Contract Administrator.
  3. Where the Engineer's digital data files are provided to the Contractor for use in preparing coordination digital data files, the Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings or Specifications.
  4. Submit coordination drawings in accordance with the submittal procedures outlined within these Specifications.

## 1.8 SUBMITTALS

- A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.

- B. Refer to Division 01 for acceptance of electronic submittals. If not specified by Division 01, provide electronic submittals. If Division 01 requires paper submittals, provide the quantity of submittals required, but no fewer than seven (7) sets.
- C. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Architect and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 01, Contractor shall include the website, username and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives. Contractor shall allow for the Engineer Review Time as specified. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.
- D. Engineer Review Time: Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time plus to/from mailing time via the Architect, plus a duplication of this time for resubmittal if required. Transmit submittals as soon as possible after Notice to Proceed and before Mechanical construction starts.
- E. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.
- F. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division as noted in each individual Section. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.
- G. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.
- H. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.
- I. Refer to individual Sections for additional submittal requirements.
- J. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- K. Submittals shall contain the following information:
  - 1. The project name.
  - 2. The applicable specification section and paragraph.
  - 3. Equipment identification acronym as used on the drawings.
  - 4. The submittal date.
  - 5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
  - 6. Submittals not so identified will be returned to the Contractor without action.
- L. The checking and subsequent acceptance by the Engineer and/or Contract Administrator of submittals shall not relieve responsibility from the Contractor for (1) deviations from Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.



- M. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.

### 1.9 SUBSTITUTIONS

- A. Refer to Division 01 and General Conditions for substitutions in addition to requirements specified herein.
- B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.
- D. Request for Substitution:
  - 1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
  - 2. The burden of proof of the merit of the proposed substitution is upon the proposer.
  - 3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Contract Administrator, and Owner the following:
    - a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
    - b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
    - c. Proposed substitution has received necessary approvals of the Authorities Having Jurisdiction.
    - d. Same warranty will be furnished for proposed substitution as for specified Work.
    - e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
    - f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.
- E. Substitution Consideration:
  - 1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
  - 2. Prior to receipt of Bids: No substitutions will be considered prior to receipt of bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of bids.
    - a. If the proposed substitution is approved prior to receipt of bids, such approval will be stated in an addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
  - 3. After receipt of Bids: No substitutions will be considered after receipt of Bids and before award of the Contract.
  - 4. After award of Contract: No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

### 1.10 ELECTRONIC DRAWING FILES

- A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of 200 for a drawing set up to 12 sheets and 15 per sheet for each additional sheet.
- B. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form.

- C. Contact the Contract Administrator for written authorization.
- D. The following must be received before electronic drawing files will be sent:
  - 1. Contract Administrator's written authorization
  - 2. Engineer's release agreement form
  - 3. Payment

### 1.11 QUALITY ASSURANCE

- A. Execute all work under this Division in a thorough and professional manner by competent and experienced workmen duly trained to perform the work specified.
- B. Install all work in strict conformance with all manufacturers' requirements and recommendations, unless these Documents exceed those requirements. Install all equipment and materials in a neat and professional manner, aligned, leveled, and adjusted for satisfactory operation, in accordance with NECA guidelines.
- C. Unless indicated otherwise on the Drawings, provide all material and equipment new, of the best quality and design, free from defects and imperfections and with markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Provide all material and equipment of the same type from the same manufacturer whenever practicable.
- D. Unless specified otherwise, manufactured items of the same types specified within this Division shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this Project.

### 1.12 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 01 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.
- B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.
- C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.
- D. Prior to Substantial Completion of the project, furnish the Operation and Maintenance Manuals to the Contract Administrator, for Engineer's review, and for the Owner's use.
  - 1. Refer to Division 01 for acceptance of electronic manuals for this project. If not specified in Division 1, provide manuals in the form of a multiple file composite electronic PDF file for each manual type required. Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size. Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
    - a. Contractor shall notify the Contract Administrator and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 01, Contractor shall include the website, username and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Contract Administrator's and Engineer's designated representatives.
  - 2. If Division 01 requires paper manuals, provide four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings.

- E. Each manual shall contain equipment data, approved submittals, shop drawings, diagrams, capacities, spare part numbers, manufacturer service and maintenance data, warranties and guarantees. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

#### **1.13 SPARE PARTS**

- A. Provide to the Owner the spare parts specified in the individual sections of this Division

#### **1.14 RECORD DRAWINGS**

- A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.
- B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.
- C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Contract Administrator.

#### **1.15 DELIVERY STORAGE AND HANDLING**

- A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.
- B. Deliver equipment and material to the job site in their original containers with labels intact, fully identified with manufacturer's name, make, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.
- C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, including the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which becomes rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Contract Administrator.
- D. Be responsible for the safe storage of tools, material and equipment.

#### **1.16 WARRANTIES**

- A. Refer to Division 01 and General Conditions for Warranties in addition to requirements specified herein.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- C. Warrant each system and each element thereof against all defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in these Construction Documents or manufacturer's

standard warranty exceeds 12 months. Remedy all defects, occurring within the warranty period(s), as stated in the General Conditions and Division 01.

- D. Also warrant the following additional items:
  - 1. All raceways are free from obstructions, holes, crushing, or breaks of any nature.
  - 2. All raceway seals are effective.
  - 3. The entire electrical system is free from all short circuits and unwanted open circuits and grounds.
- E. The above warranties shall include labor and material. Make repairs or replacements without any additional costs to the Owner.
- F. Perform the remedial work promptly, upon written notice from the Contract Administrator or Owner.
- G. At the time of Substantial Completion, deliver to the Owner all warranties, in writing and properly executed, including term limits for warranties extending beyond the one year period, each warranty instrument being addressed to the Owner and stating the commencement date and term.

#### **1.17 TEMPORARY FACILITIES**

- A. Refer to Division 01 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.
- B. Temporary Utilities: The types of services required include, but are not limited to, electricity, telephone, and internet. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.
- C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.
  - 1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.
  - 2. Heating: Provide heat, as necessary, to protect work, materials and equipment from damage due to dampness and cold. In areas where building is occupied, maintain a temperature not less than 65 degrees F. Use steam, hot water, or gas from piped distribution system where available. Where steam, hot water or piped gas are not available, heat with self-contained LP gas or fuel oil heaters, bearing UL, FM or other approval labels appropriate for application. Use electric-resistance space heaters only where no other, more energy-efficient, type of heater is available and allowable.
    - a. Vent and exhaust fuel-burning heaters per SMACNA Guidelines for Source Control and equip units with individual-space thermostatic controls.
    - b. If permanent HVAC systems are used during construction, provide HVAC Protection and replace all filtration prior to occupancy in accordance with SMACNA Guidelines.

#### **1.18 FIELD CONDITIONS**

- A. Conditions Affecting Excavations: The following project conditions apply:
  - 1. Maintain and protect existing building services that transit the area affected by selective demolition.
  - 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.

- B. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.
- C. Use of explosives is not permitted.
- D. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits specified by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

## **PART 2 - PRODUCTS AND MATERIALS**

### **2.1 SOIL MATERIALS**

- A. Sub base Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand.
- B. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve.
- C. Backfill and Fill Materials: Materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP; free of clay, rock, or gravel larger than two inches in any dimension; debris; waste; frozen materials; and vegetable and other deleterious matter.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION GENERAL**

- A. Install in accordance with manufacturer's instructions.

### **3.2 EXISTING CONDITIONS**

- A. Existing conditions indicated on the Drawings are taken from the best information available from the Owner, existing record drawings, and from limited, in-situ, visual site observations; and, they are not to be construed as "AS BUILT" conditions. The information is shown to help establish the extent of the new work.
- B. Verify all actual existing conditions at the project site and perform the Work as required to meet the existing conditions and the intent of the Work indicated.
- C. Notify Contract Administrator immediately of any dangerous conditions that exist on the job site, as they are discovered, before demolition, during selective demolition or before remodel work begins.

### **3.3 PERMITS**

- A. Secure and pay for all permits required in connection with the installation of the Electrical Work. Arrange with the various utility companies for the installation and connection of all required utilities for this facility and pay all charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

### **3.4 TEMPORARY ELECTRICAL SERVICE AND WIRING**

- A. Provide 208Y/120 volt, three-phase, four-wire, temporary electrical service and temporary lighting system to facilitate construction.

- B. In existing facilities, with Owner's approval, Contractor may utilize the existing electrical system as the source of temporary power. Coordinate the point of connection and method of connection to the existing system with the Owner's Representative.
- C. Pay all charges made by the Electric Utility, with respect to installation and energy charges for temporary services.
- D. Work for the temporary power shall consist of all labor and materials, including, but not limited to conduit, wiring, panelboards, fuse blocks, fused disconnecting switches, fuses, pigtails, receptacles, wood panel switch supports, and other miscellaneous materials required to complete the power system.
- E. Install all temporary wiring in accordance with applicable codes, and maintain in an OSHA-approved manner.
- F. Provide an adequate number of GFCI type power distribution centers, rated 208Y/120V, four-wire, and not less than 60A, with sufficient fuse blocks or breakers for lighting and hand tool circuits, 60A four-wire feeders, all mounted within pre-fabricated enclosures UL listed for this application or on suitable wood panels bolted to columns or upright wood supports as required.
- G. Install circuits to points on each level of each building so that service outlets can be reached by a 50-foot extension cord for 120V power and a 100-foot extension cord for 208V power (or as required by OSHA or local authorities).
- H. Provide one lighting outlet per 30 linear feet of corridor and at least one light in each room and for every 800 square feet of floor area. Temporary lighting shall comply with OSHA requirements.
- I. If additional service is required for cranes, electrical welders or for electric motors over 1/2 HP per unit, such additional service shall become the responsibility of the trade involved.
- J. When the permanent wiring for lighting and power is installed, with approval of the Contract Administrator and Owner, the permanent system may be used, provided the Contractor assumes full responsibility for all electrical material, equipment, and devices contained in the systems and provided that roof drainage system and roofing are complete.
- K. When directed by the Contract Administrator, remove all temporary services, lighting, wiring and devices from the property.

### **3.5 ACCESS TO EQUIPMENT**

- A. Locate all pull boxes, junction boxes and controls to provide easy access for operation, service inspection and maintenance. Provide an access door where equipment or devices are located above inaccessible ceilings. Refer to Division 26 Section "Common Work Results for Electrical".
- B. Maintain all code required clearances and clearances required by manufacturers.

### **3.6 PENETRATIONS**

- A. Unless otherwise noted as being provided under other divisions, provide sleeves, box frames, or both, for openings in floors, walls, partitions and ceilings for all electrical work that passes through construction. Refer to Division 26 Section "Common Work Results for Electrical".
- B. Provide sleeves, box frames, or both, for all conduit, cable, and busways that pass through masonry, concrete or block walls.
- C. The cutting of new and/or existing construction will not be permitted except by written approval of the Contract Administrator.

**3.7 EXCAVATION AND BACKFILLING**

- A. Refer to Division 01, Division 02 and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.
- B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this division. Excavation shall be in conformance with applicable Divisions and sections of the Specifications.
- C. Restore roads, alleys, streets and sidewalks damaged during this work to the satisfaction of Authorities Having Jurisdiction.
- D. Do not excavate trenches close to walks or columns without prior consultation with the Contract Administrator.
- E. Erect barricades around excavations, for safety, and place an adequate number of amber lights on or near the work and keep those burning from dusk to dawn. Be responsible for all damage that any parties may sustain in consequence of neglecting the necessary precautions in prosecuting the work.
- F. Slope sides of excavations to comply with local, state, and federal codes and ordinances. Shore and brace as required for stability of excavation.
- G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state, and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
  - 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- H. Install sediment and erosion control measures in accordance with local codes and ordinances.
- I. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
  - 1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
  - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.
- J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
  - 1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
  - 2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- K. Excavation for Underground Tanks and Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
  - 1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of one inch in diameter and larger with emulsified asphalt tree paint.
  - 2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.
- L. Trenching: Excavate trenches for electrical installations as follows:
  - 1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of six to nine inches clearance on both sides of raceway and cables.

2. Excavate trenches to depth indicated or required for raceway and cables to establish slope, away from buildings and indicated elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
  3. Limit the length of open trench to that in which raceway and cables can be installed, tested, and the trench backfilled within the same day.
  4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceway and cables. Provide a minimum of six inches of stone or gravel cushion between rock bearing surface and raceway and cables.
  5. Excavate trenches for raceway, cables, and equipment with bottoms of trench to accurate elevations for support of raceway and cables on undisturbed soil.
- M. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.
- N. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
  2. Under building slabs, use drainage fill materials.
  3. Under raceway and cables, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
  4. For raceway and cables less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support. After installation and testing of raceway and cables, provide a 4-inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
  5. Other areas use excavated or borrowed materials.
- O. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
  2. Removal of concrete formwork.
  3. Removal of shoring and bracing, and backfilling of voids.
  4. Removal of trash and debris.
- P. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
1. For vertical and diagonal raceway installations, thoroughly support raceways from permanent structures or undisturbed earth at no less than 10-foot intervals, while placing backfill materials, so that raceways are not deflected, crushed, broken, or otherwise damaged by the backfill placement.
- Q. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- R. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.
- S. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below:
1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).



- a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
  - b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
  - c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.
- T. Subsidence: Where subsidence occurs at mechanical installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

### 3.8 CUTTING AND PATCHING

- A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.
- B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.
- C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work.
- D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.
- E. Patch around openings to match adjacent construction, including fire ratings, if applicable.
- F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.

### 3.9 PAINTING

- A. Refer to Division 09 Section "Painting" for painting requirements.
- B. Paint exposed ferrous surfaces, including, but not limited to, hangers, equipment stands and supports using materials and methods as specified under individual sections and Division 09 of the Specifications; colors shall be as selected by the Contract Administrator.
- C. Re-finish all field-threaded ends of galvanized conduits and field-cut ends of galvanized supports with a cold-galvanizing compound approved for use on conductive surfaces. Follow closely manufacturer's instructions for pre-cleaning surfaces and application.
- D. Factory finishes and shop priming and special finishes are specified in the individual equipment Specification sections.
- E. Where factory finishes are provided and no additional field painting is specified, touch up or refinish, as required by, and to the acceptance of, the Contract Administrator, marred or damaged surfaces so as to leave a smooth, uniform finish. If, in the opinion of the Contract Administrator, the finish is too badly damaged to be properly re-finished, replace the damaged equipment or materials at no additional costs to the Owner.

**3.10 CLEANING**

- A. Remove dirt and refuse, resulting from the performance of the Work, from the premises as required to prevent accumulation. Cooperate in maintaining reasonably clean premises at all times.
- B. Immediately prior to the final inspection, the Electrical Contractor shall clean material and equipment installed under the Electrical Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment.
- C. Damaged finishes shall be touched-up and restored to their original condition

**3.11 ADJUSTING ALIGNING AND TESTING**

- A. Adjust, align and test all electrical equipment furnished and/or installed under this Division.
- B. Check motors for alignment with drive and proper rotation, and adjust as required.
- C. Check and test protective devices for specified and required application, and adjust as required.
- D. Check, test and adjust adjustable parts of all light fixtures and electrical equipment as required to produce the intended performance.
- E. Verify that completed wiring system is free from short circuits, unintentional grounds, low insulation impedances, and unintentional open circuits.
- F. After completion, perform tests for continuity, unwanted grounds, and insulation resistance in accordance with the requirements of NFPA 70 and NETA.
- G. Be responsible for the operation, service and maintenance of all new electrical equipment during construction and prior to acceptance by the Owner of the complete project under this Contract. Maintain all electrical equipment in the best operating condition including proper lubrication.
- H. Notify the Contract Administrator immediately of all operational failures caused by defective material, labor or both.
- I. Maintain service and equipment for all testing of electrical equipment and systems until all work is approved and accepted by the Owner.
- J. Keep a calibrated voltmeter and ammeter (true RMS type) available at all times. Provide service for test readings when and as required.
- K. Refer to individual sections for additional and specific requirements.

**3.12 START-UP OF SYSTEMS**

- A. Prior to start-up of electrical systems, check all components and devices, lubricate items appropriately, and tighten all screwed and bolted connections to manufacturers' recommended torque values using appropriate torque tools.
- B. Each power, lighting and control circuit shall be energized, tested and proved free of breaks, short-circuits and unwanted grounds.
- C. Adjust taps on each transformer for rated secondary voltages.
- D. Balance all single phase loads at each panelboard, redistributing branch circuit connections until balance is achieved to plus or minus 10 percent.
- E. Replace all burned-out lamps. Replace the lamps of all light fixtures that use incandescent, halogen or quartz lamp sources that are installed as part of the finished building, but are used by the Contractor during construction, with new lamps of appropriate type and wattage prior to turning the facility over to the Owner.

- F. After all systems have been inspected and adjusted, confirm all operating features required by the Drawings and Specifications and make final adjustments as necessary.
- G. Demonstrate that all equipment and systems perform properly as designed per Drawings and Specifications.
- H. At the time of final review and tests of the power and lighting systems, all equipment and system components shall be in place and all connections at panelboards, switches, circuit breakers, and the like, shall be complete. All fuses shall be in place, and all circuits shall be continuous from point of service connections to all switches, receptacles, outlets, and the like.

### 3.13 TEST REPORTS

- A. Perform tests as required by these Specifications and submit the results to the Contract Administrator, for Engineer's review. Record the results, date and time of each test and the conditions under which the test was conducted. Include a copy of the finalized test results, with corrections made, in the operations and maintenance manuals. The tests shall establish the adequacy, quality, safety, and reliability for each electrical system installed. Notify the Contract Administrator and Engineer two working days prior to each test.
- B. For specific testing requirements of special systems, refer to the Specification section that describes that system. The Contractor shall provide the following to facilitate the testing of the electrical systems:
  - 1. Perform tests as described in the individual sections;
- C. Upon completing each test, record the results, date and time of each test and the conditions under which the test was conducted. Submit to the Contract Administrator, for Engineer's review, in duplicate, the test results for the following electrical items:
  - 1. Building service entrance voltage and amperes at each phase.
  - 2. Electrical service grounding conditions and grounding resistance.
  - 3. Proper phasing throughout the entire system.
  - 4. Voltages (phase-to-phase and phase-to-neutral) and amperes at each phase for each panelboard, switchboard, and the like.
  - 5. Phase voltages and amperes at each three-phase motor.
  - 6. Test all wiring devices for electrical continuity and proper polarity of connections.
- D. Promptly correct all failures or deficiencies revealed by these tests in accordance with the manufacturer's recommendations and as determined by the Engineer.

### 3.14 SUBSTANTIAL COMPLETION REVIEW

- A. Prior to requesting a site observation for "CERTIFICATION OF SUBSTANTIAL COMPLETION", complete the following items:
  - 1. Submit complete Operation and Maintenance Data.
  - 2. Submit complete Record Drawings.
  - 3. Perform all required training of Owner's personnel.
  - 4. Turn over video recordings of training sessions to the Owner.
  - 5. Turn over all spares and extra materials to the Owner, along with a complete inventory of spares and extra materials being turned over.
  - 6. Perform start-up tests of all systems.
  - 7. Remove all temporary facilities from the site.
  - 8. Comply with all requirements for Substantial Completion in the Division 01 and General Conditions.
- B. Request in writing a review for Substantial Completion. Give the Contract Administrator at least seven (7) days notice prior to the review.
- C. State in the written request that the Contractor has complied with the requirements for Substantial Completion.

- D. Upon receipt of a request for review, the Contract Administrator will either proceed with the review or advise the Contractor of unfilled requirements.
- E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above-mentioned items the Contractor shall reimburse the Contract Administrator and Engineer for time and expenses incurred for the visit.
- F. Upon completion of the review, the Contract Administrator will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.
- G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.
- H. Prior to requesting a final review, submit a copy of the final list of items to be completed or corrected. State in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION

**SUBSTITUTION REQUEST FORM**

To Project Engineer: \_\_\_\_\_ Request # (GC Determined): \_\_\_\_\_

Project Name: \_\_\_\_\_

Project No/Phase: \_\_\_\_\_ Date: \_\_\_\_\_

Specification Title: \_\_\_\_\_

Section Number: \_\_\_\_\_ Page: \_\_\_\_\_ Article/Paragraph: \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_

Manufacturer: \_\_\_\_\_ Model No.: \_\_\_\_\_

Address: \_\_\_\_\_ Phone: \_\_\_\_\_

History:  New product  1-4 years old  5-10 years old  More than 10 years old

Differences between proposed substitution and specified Work: \_\_\_\_\_

Point-by-point comparative data attached – REQUIRED BY ENGINEER  
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached:  Drawings  Product Data  Samples  
 Tests  Reports  Other: \_\_\_\_\_

Reason for not providing specified item: \_\_\_\_\_

Similar Installation:  
Project: \_\_\_\_\_ Architect: \_\_\_\_\_

Address: \_\_\_\_\_ Owner: \_\_\_\_\_

\_\_\_\_\_ Date Installed: \_\_\_\_\_

Proposed substitution affects other parts of Work:  No  Yes; explain: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

**Substitution Certification Statement:**

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

- ▲ A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
- B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
- C. Proposed substitution does not affect dimensions and functional clearances.
- D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
- E. Same warranty will be furnished for proposed substitution as for specified Work.
- F. Same maintenance service and source of replacement parts, as applicable, is available.
- G. Proposed substitution will not adversely affect other trades or delay construction schedule.
- H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor	Date	Company
-----------------------	------	---------

**Manufacturer's Certification of Equal Quality:**

I \_\_\_\_\_ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative	Date	Company
-------------------------------	------	---------

**Engineer Review and Recommendation Section**

Recommend Acceptance       Yes       No  
 Additional Comments:       Attached       None

**Acceptance Section:**

Contractor Acceptance Signature	Date	Company
Owner Acceptance Signature	Date	Company
Architect Acceptance Signature	Date	Company
Engineer Acceptance Signature	Date	Company

**SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. This Section includes limited scope general construction materials and methods, electrical equipment coordination, and common electrical installation requirements as follows:
1. Access doors in walls, ceilings, and floors for access to electrical materials and equipment.
  2. Sleeves and seals for electrical penetrations.
  3. Joint sealers for sealing around electrical materials and equipment, and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
  4. Sealing penetrations through noise critical spaces.
  5. Fire protective wrap for use as a listed fire rated electrical circuit protective system.

**1.2 DEFINITIONS**

- A. The following abbreviations apply to this and other Sections of these Specifications:
1. AHJ: Authority(ies) having Jurisdiction
  2. ATS: Acceptance Testing Specifications
  3. EPDM: Ethylene-propylene-diene monomer rubber
  4. MC: Metal Clad
  5. N/A: Not Available or Not Applicable
  6. NBR: Acrylonitrile-butadiene rubber
  7. NRTL: Nationally Recognized Testing Laboratory
  8. PCF: Pounds per Cubic Foot
- B. The following definitions apply to this and other Sections of these Specifications:
1. Homerun: That portion of an electrical circuit originating at a junction box, termination box, receptacle or switch with termination at an electrical panelboard. Note: Where MC Cable is utilized for receptacle and/or lighting branch circuiting loads, the originating point of the homerun shall be at the first load in the circuit or at a junction box in an accessible ceiling space immediately above the first load.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  3. To allow right of way for piping, ducts, and other systems installed at required slopes and/or elevations.
  4. So connecting raceways, cables, and wireways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.
- D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

## 1.4 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements":
1. Product data for the following products:
    - a. Sleeve seals.
    - b. Through and membrane penetration firestopping systems.
    - c. Joint sealers
    - d. Acoustical sealers
    - e. Endothermic rap
  2. Shop drawings for:
    - a. Detailed fabrication drawings of access panels and doors.
  3. Through and Membrane Penetration Firestopping Systems Product Schedule: Provide UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.
    - a. Where Project conditions require modification to qualified testing and inspecting agency's illustrations for a particular firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
    - b. Qualifications data for testing agency.
  4. Endothermic Wrap drawings and system details: Provide UL listing, assembly rating and installation drawing for each case specific installation. Include installation instructions indicating layers of wrap required and securing method.
    - a. Where Project conditions require modifications to qualified testing and inspecting agency's installation requirements for a particular listed fire rated electrical circuit protective system, submit illustration with modifications marked and approved by Endothermic Wrap manufacturer's fire protection engineer as an engineering judgement or equivalent fire-resistive-rated assembly.
  5. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26
    - a. Accurately record actual locations of firestopped penetrations and access panel/door locations. Indicate dimensions from fixed structural elements.

## 1.5 NOISE CRITICAL SPACES

- A. Many areas of the building, referred to as "noise-critical spaces", require special attention (special acoustical provisions and restrictions). The table below designates the noise-critical spaces that will require application of sound attenuating measures and acoustical sealants.
1. Offices
  2. Conference Rooms
  3. Teleconference Rooms
  4. Meeting/Banquet Rooms
  5. Sound/Lighting Control Rooms
  6. TV Production Studio
  7. Stage
  8. A/V Spaces
  - 9.

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 ACCESS TO EQUIPMENT

- A. Manufacturers:



1. Bar-Co., Inc.
  2. Elmdor Stoneman.
  3. JL Industries
  4. Jay R. Smith Mfg. Co.
  5. Karp Associates, Inc.
  6. Milcor
  7. Nystrom Building Products
  8. Wade
  9. Zurn
- B. Access Doors:
1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section "Identification for Electrical Systems" for labeling of access doors.
  2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
  3. Access doors must be of the proper construction for type of construction where installed.
  4. The exact location of all access doors shall be verified with the Contract Administrator prior to installation.
  5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
  6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
    - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
    - b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
    - c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
  7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
  8. Locking Devices:
    - a. Flush, screwdriver-operated cam locks.
    - b. Where indicated on the drawings or where access panels are installed in locations accessible to the public, provide 5-pin or 5-disc type cylinder locks, all access panels keyed alike.

## 2.2 SLEEVES

- A. Steel sleeves for raceways and cables:
1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends and drip rings.
- B. Cast iron wall pipe sleeves for raceways and cables:
1. Manufacturers
    - a. Josam Mfg. Co.
    - b. Smith (Jay R) Mfg. Co.
    - c. Tyler Pipe/Wade Div.; Subs of Tyler Corp.
    - d. Watts Industries, Inc.
    - e. Zurn Industries, Inc.; Hydromechanics Div.
  2. Cast-iron sleeve with integral clamping flange with clamping ring, and nuts for membrane flashing.
    - a. Underdeck Clamp: Clamping ring with setscrews.
  3. Sleeves for rectangular openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

4. Coordinate sleeve selection and application with selection and application of firestopping to be used.

## 2.3 SEALANTS

### A. SLEEVE SEALS

1. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
2. Manufacturers:
  - a. Advance Products & Systems, Inc.
  - b. Calpico, Inc.
  - c. Metraflex Co.
  - d. O-Z/Gedney
  - e. Pipeline Seal and Insulator, Inc.
3. Sealing Elements: Interlocking or solid sealing links shaped or pre-drilled to fit surface of cable or raceway. Include type and number required for material and size of raceway or cable.
  - a. EPDM
  - b. NBR
  - c. Neoprene
4. Pressure Plates: Include two for each sealing element. For multi-phase circuits, use slotted pressure plates if metal.
  - a. Plastic
  - b. Carbon steel
  - c. Stainless steel
  - d. PVC-coated steel
5. Connecting Bolts and Nuts: Provide bolts of length required to secure pressure plates to sealing elements. Include one for each sealing element.
  - a. Carbon steel with corrosion-resistant coating
  - b. Stainless steel

### B. JOINT SEALERS

1. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
2. Colors: As selected by the Contract Administrator from manufacturer's standard colors.
3. Elastomeric Joint Sealers: Provide the following types:
  - a. Silicone Joint Sealants, One-part nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer. Provide one of the following:
    - 1) Dow Corning, Dowsil 790
    - 2) Dow Corning, Dowsil 795
    - 3) GE, Silglaze II SCS 2350
    - 4) GE, Silpruf SCS 2000
    - 5) Owens Corning, Energy Complete
    - 6) Pecora, 864 NST
    - 7) Tremco, Spectrem 1
    - 8) Tremco, Spectrem 2
  - b. Mildew Resistant Sealants, one-part mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, metal or porcelain plumbing fixtures and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes. Provide one of the following:
    - 1) Dow Corning, Dowsil 786
    - 2) GE, Momentum SCS 1700

- 3) Pecora, 898 Silicone NST
- c. Hybrid Joint Sealants: One-part, nonsag, paintable complying with ASTM C 920, Type S, Grade NS, Class 50 recommended for exposed applications on interior and exterior locations involving joint movement of not more than plus or minus 50 percent. Subject to compliance with requirements, provide one of the following:
  - 1) BASF, MasterSeal NP 100
  - 2) Pecora, DyanTrol I-XL
  - 3) Tremco, Dymonic FC

#### C. FIRESTOPPING

1. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E 814, by Underwriters' Laboratories, Inc., or other NRTL acceptable to AHJ. Subject to compliance with requirements, provide one of the following:
  - a. Manufacturers:
    - 1) 3M Corp., Fire Barrier Sealant
    - 2) Hilti, Inc.
    - 3) Tremco, Tremstop Fyre-Sil
    - 4) Pecora, AC-20 FTR
    - 5) RectorSeal
    - 6) Specified Technologies Inc. Firestop
    - 7) USG, SHEETROCK Firecode Compound
    - 8) Owens Corning Firestopping Insulation

#### D. ACOUSTICAL SEALANTS

1. General: Penetrations by conduit through surfaces that are around and between noise critical spaces shall be sleeved, packed and sealed airtight with foam rod, non-hardening sealant and/or packing material as described herein.
2. Foam Backer Rod: Closed cell polyethylene suitable for use as a backing for non-hardening sealant.
3. Non-Hardening Sealant: Sealant for penetrations shall be non-hardening, permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.
4. Packing Material: Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 PCF (40 kg/m<sup>3</sup>).
5. Acoustical Joint Sealant: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90. Meeting ASTM E 84 for a smoke flame spread index of less than 25 / 50. Subject to compliance with requirements, provide one of the following:
  - 1) Pecora, AC-20 FTR
  - 2) Pecora, AIS-919
  - 3) USG, SHEETROCK Acoustical Sealant.

### 2.4 FIRE RATED PROTECTIVE WRAPS

#### A. Endothermic Wrap

1. General: Protective wrap, designed to provide fire protection of critical feeders and circuits in accordance with ASTM E1725. Subject to compliance with requirements, provide one of the following:
  - 1) 3M Corp., Interam Endothermic Mat
  - 2) Specified Technologies Inc., E-Wrap

**PART 3 - EXECUTION****3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".
- C. Coordinate seals with wall, ceiling, roof or floor materials and rating of the surface (sound, fire, waterproofing, etc.)
- D. Comply with NECA 1.
- E. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items, unless indicated otherwise.
- F. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- G. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- H. Right of Way: Yield to raceways and piping systems installed at a required slope.

**3.2 ACCESS DOORS**

- A. Verify the exact location, sizes, and types of all access doors with the Contract Administrator prior to purchase.
- B. Provide access doors for all concealed electrical equipment, except where above lay-in ceilings.
- C. Coordinate with architectural finishes to set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- D. Adjust hardware and panels after installation for proper operation.
- E. Label all access doors with a nameplate as described in Division 26 Section "Identification for Electrical Systems".

**3.3 SLEEVES AND SLEEVE SEALS**

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Provide sleeves for required openings in all concrete and masonry construction and fire, smoke, or both, partitions, for all electrical work that passes through such construction. Coordinate with all other trades and divisions to dimension and lay out all such openings.
- C. Only those openings specifically indicated on the Architectural or Structural Drawings will be provided under other divisions.
- D. New Construction:
  - 1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support raceway penetrations.
- E. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls. Do not cut or core drill new construction without written approval from the Contract Administrator and Structural Engineer.

- F. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- G. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
  - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- H. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- I. Install pipe and rectangular sleeves in above-grade walls and slabs, where penetrations are not subject to hydrostatic water pressures. Ensure that drip ring is fully encased and sealed within the wall or slab.
- J. Sleeve Length:
  - 1. Sleeves through walls: Cut sleeves to length for mounting flush with both surfaces of walls.
  - 2. Sleeves through floors: Extend sleeves 2 inches above finished floor level.
- K. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
- L. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- M. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint
- N. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.
- O. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- P. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (or larger, if required by the seal manufacturer) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- Q. Above Grade Concrete or Masonry Penetrations
  - 1. Provide sleeves for cables or raceways passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:
    - a. Install schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
    - b. Install galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 0.138 inches.
    - c. Install galvanized sheet metal for rectangular sleeves
    - d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.
  - 2. Seal elevated floor, exterior wall and roof penetrations watertight and weather tight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of 1/2" of sealant.
- R. Underground, Exterior-Wall Penetrations: Install cast-iron wall pipes for sleeves. Size sleeves to allow for 1-inch (or larger, if required by the mechanical sleeve manufacturer) annular clear space between sleeve and cable or raceway. Provide mechanical sleeve seal.
  - 1. Use type and number of sealing elements recommended by manufacturer for pipe material and size. Position pipe in center of sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

2. Inspect installed sleeve and sleeve-seal installation for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade to seal against hydrostatic pressure.
- S. Concrete Slab on Grade Penetrations:
1. Provide ½" thick cellular foam insulation around perimeter of raceway passing through concrete foundation. Installation shall extend to 2" above and below the concrete slab.
- T. Elevated Floor Penetrations of waterproof membrane:
1. Provide cast-iron wall pipes for sleeves. Size wall pipe for minimum ½" annular space between wall pipe and cable or raceway.
  2. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant.
  3. Secure waterproof membrane flashing between clamping flange and clamping ring.
  4. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.
- U. Interior Foundation Penetration: Provide sleeves for horizontal raceway passing through or under foundation. Sleeves shall be cast iron soil pipe two normal pipe sizes larger than the pipe served.
- V. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and cable or raceway, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of sealant.
- W. Exterior Wall Penetrations: Seal annular space between sleeve and raceway or duct, using joint sealant for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant.
- X. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- Y. Sleeve-Seal Installation
1. Install sleeve seals for all underground raceway penetrations through walls at elevations below finished grade. Additionally, install seals inside raceways, after conductors or cables have been installed, in all raceway penetrations through walls at elevations below finished grade.
  2. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Z. Inspect installed sleeve and sleeve-seal installations for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade and above grade where installed to seal against hydrostatic pressure.
- AA. Sleeves shall be protected throughout the course of construction, and when damaged shall be replace and/or repaired to a satisfactory condition.

### 3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire/smoke-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

### 3.5 JOINT SEALERS

- A. Preparation for Joint Sealers
1. Clean surfaces of penetrations, sleeves, or both, immediately before applying joint sealers, to comply with recommendations of joint sealer manufacturer.

2. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.
- B. Application of Joint Sealers
1. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
    - a. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
    - b. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
  2. Tooling: Immediately after sealant application and prior to time shining or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

### 3.6 ACOUSTICAL PENETRATIONS

- A. Do not allow direct contact of raceways with shaft walls, floor slabs and/or partitions. Sleeve, pack and seal airtight with foam rod, non-hardening sealant and/or packing material, as described herein, for all penetrations by raceway, through surfaces that encompass or are between noise critical spaces. Seal and pack with caulking for the full depth of the penetration all openings around raceways in the structure surrounding the electrical equipment and surrounding noise-critical spaces. This includes all slab penetrations and penetrations of noise critical walls.
- B. Where a raceway passes through a wall, ceiling or floor slab of a noise critical space, cast or grout a metal sleeve into the structure. The internal diameter or dimensions of the sleeve shall be 2 inches larger than the external diameter or dimensions of the raceway passing through it. After all of the raceways are installed in that area, check the clearances and correct, if necessary, to within 1/2-inch. Pack the voids full depth with packing material sealed at both ends, 1-inch deep, with non-hardening sealant backed by foam rod.

### 3.7 FIRE RATED PROTECTIVE WRAP

- A. Where indicated on the Drawings or required by code, provide fire rated protective wrap around raceways and equipment.
- B. Install and secure fire protective wrap per manufacturer's written installation documents. Wrap shall be layered as required by the manufacturer to provide 1-, 2-, or 3-hour fire rating required by code for the application.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 26 05 02 - EQUIPMENT WIRING SYSTEMS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. This Section includes limited scope for electrical connections to equipment specified under other sections or divisions, or furnished under separate contracts or by the Owner.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Unless otherwise noted, perform all electrical work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this contract.
- A. Coordinate with work described in Division 11 Sections for equipment requiring electrical connection.
- B. Coordinate with work described in Division 23 Section "Common Work Results for HVAC".
- C. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.
- D. Determine connection locations and rough-in requirements based on shop drawings.
- E. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- F. Sequence electrical connections to coordinate with start-up schedule for equipment.

**1.3 SUBMITTALS**

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements".
- B. Product data for the following products for:
  - 1. Special connectors
  - 2. Special conductors or cable assemblies.
- C. Shop drawings for:
  - 3. Detailing electrical characteristics, wiring diagrams, fabrication and installation for wiring systems.

**1.4 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories:
  - 4. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to Authorities Having Jurisdiction.
  - 5. Marked for intended use.
- B. Comply with NFPA 70.

**PART 2 - PRODUCTS AND MATERIALS****2.1 CORDS AND CAPS**

- A. Attachment Plugs: Conform to NEMA WD 1.
- B. Configuration: NEMA WD 6, matching receptacle configuration at outlet provided for equipment, or as required by the equipment manufacturer.
- C. Cord: See Paragraph "Flexible Cords" in Division 26 Section "Low-voltage Electrical Power Conductors and Cables".
- D. Provide cord size suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Verify conditions of equipment and installation prior to beginning work.
- B. Verify that equipment is ready for connecting, wiring, and energizing.

**1.2 INSTALLATION GENERAL**

- A. Install in accordance with manufacturer's instructions.
- C. Provide fire-resistive protective assembly or an electrical circuit protective system for feeders and control circuit conductors and cables having a fire-resistance rating of not less than 2 hours where required by NFPA or local building codes. Types of systems requiring a fire-resistive protective assembly include, but are not limited to:
  - 1. Feeders for Emergency Power systems
  - 2. Smokeproof Enclosure Pressurization systems
  - 3. Smoke Removal systems
  - 4. Fire service and Occupant Evacuation Elevator systems

**3.2 ELECTRICAL DEVICES**

- A. Install disconnect switches, controllers, control stations, and control devices (other than temperature control devices) as indicated, specified in other divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

**3.3 ELECTRICAL CONNECTIONS**

- A. Make electrical connections in accordance with equipment manufacturers' instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with watertight connectors in damp or wet locations.
- C. Make wiring connections using conductors and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated on the Drawings.
- E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- F. Provide interconnecting conduit and wiring between devices and equipment where indicated on the Drawings.

**3.4 EQUIPMENT**

- A. When equipment is delivered in separate parts and field assembled, internal wiring, indicated on Shop Drawings as field wiring, will be provided by the equipment supplier, unless otherwise noted.
- B. Provide power connection to all equipment as required and as indicated in the equipment supplier's installation drawings.
- C. Provide all control and interlock wiring for all equipment that is not included within the responsibility of Division 22 or 23.
- D. Motorized Damper: Provide lockable toggle, pilot lighted disconnect switch in an accessible location at each motor actuator, or group of motor actuators.

**3.5 FOOD SERVICE (SERVERY) EQUIPMENT**

- A. Provide power connection to all equipment as indicated or as otherwise required to accommodate the equipment indicated in the food service equipment drawings and specifications.
- B. Coordinate and provide the appropriate receptacle for equipment being installed as required for proper operation. Coordinate the required quantity of conductors prior to pulling wire to outlet box.
- C. Provide a local recessed non-fused equipment disconnect for kitchen equipment as required by the applicable codes and jurisdictions. Coordinate exact location prior to rough-in and maintain all code required clearances.
- D. Provide control wiring and conduit for all equipment that is not indicated as being within the responsibility of the equipment manufacturer or installer.
- E. When equipment is delivered in separate parts and field assembled, internal wiring, indicated on Shop Drawings as field wiring, shall be provided by the equipment installer, unless otherwise noted.
- F. Coolers and Freezers: Cut conduit openings in freezer and cooler walls, floor, and ceilings, in accordance with manufacturers' instructions, when openings are not provided by the manufacturers. Seal around conduit penetrations air tight with an approved pliable material suitable for low temperatures. Effectively seal interiors of conduits, by installing a conduit fitting at the boundary of the two spaces, and filling it with an approved pliable material, after conductors or cables have been installed and tested.
- G. Provide all grounding systems as required by the equipment supplier.

**3.6 DOOR OPERATORS AND HARDWARE**

- A. Provide electrical connections to automatic entry doors, automatic corridor doors, electrically held door latches, remote release doors, and all other required electrical connections for door systems included in other sections of these specifications.
- B. Provide power connection to all equipment as required and as indicated in the equipment supplier's installation drawings.
- C. Provide all control wiring and conduit for all equipment that is not included within the responsibility of the door hardware installer. Provide connection from junction boxes to the door operators or hardware and from door operators to actuation devices as required. Install key operated switches, push pad switches, and other electrically controlled door operation devices furnished by other divisions within this contract.
- D. Provide fire alarm devices and wiring as required for proper operation of door systems in accordance with the NFPA codes.

**3.7 SIGNAGE AND WAYFINDING**

- A. Provide junction boxes, disconnect switches and grounding per manufacturer's installation drawings.
- B. Coordinate rough-in requirements with signage installation instructions.
- C. Coordinate box locations and conduit routing with parapets and roof elevations.
- D. Provide labelling on all junction boxes and disconnects in accordance with Division 26 section "Identification for Electrical Systems"

END OF SECTION

**SECTION 26 05 04 - PROVISIONS FOR ELECTRIC UTILITY SERVICE****PART 1 - GENERAL****1.1 SUMMARY**

- A. Provisions for Underground Secondary Electrical Service.

**1.2 GENERAL REQUIREMENTS**

- A. Utility service voltage:
  - 1. 480Y/277 volts, three-phase, four-wire, 60Hz.
- B. Utility service ampacity: As indicated on the Drawings.
- C. The extent of Work for the secondary electrical service includes providing the following:
  - 1. Raceways
  - 2. Provisions for Metering
  - 3. Grounding and Bonding
  - 4. Concrete pad for service transformer
  - 5. Primary raceways

**1.3 SUBMITTALS**

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements".
- B. Product Data: For the following products:
  - a. Meter bases
  - b. Current transformer cabinets
- C. Shop Drawings: For the following:
  - a. Utility Company prepared installation drawings
  - b. Cast-in-place concrete pads
- D. Field quality-control test reports:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
  - 4. Utility voltage adjustment request.
- E. Where equipment or materials are specified to comply with utility standards and are listed above as required submittals, obtain approval from the serving utility before submitting to the Contract Administrator.
- F. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section "General Electrical Requirements":
  - 1. Accurately record actual routing of interior conduits two-inch and larger trade size and all exterior buried raceway, including coordination with other surrounding utilities and underground structures. Provide scaled plans and sections that indicate dimensions from finished grade or other fixed structural elements.

**1.4 QUALITY ASSURANCE**

- A. Perform all work in accordance with Utility Company installation drawings and service standards.
- B. Maintain one copy of Utility Company installation drawings and service standards at the site.

- C. Prior to commencing work in this Section, meet with the Utility Company representative to review service entrance requirements and details.
- D. Verify that field measurements are as indicated on Utility Company drawings.
- E. Electrical Components, Devices, and Accessories:
  - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that are acceptable to authorities having jurisdiction.
  - 2. Marked for intended use.
- F. Comply with NFPA 70.

## **PART 2 - PRODUCTS AND MATERIALS**

(Not Used)

## **PART 3 - EXECUTION**

### **3.1 SECONDARY SERVICE ENTRANCE UNDERGROUND**

- A. Provide an underground secondary service lateral from the pad mounted transformer in accordance with NFPA 70 Article 230 and the Utility Company standards. Reference the Drawings for service lateral conductor and raceway quantities, sizes, and types.
- B. The Utility Company will provide the service transformer.
- C. Provide a concrete pad, complying with the Utility Company standards, for transformer mounting, and set coated GRS conduit elbows and riser(s), with grounding bushing(s), to receive primary and secondary raceways. Where direct burial primary is used, set coated GRS conduit elbow(s) and riser(s), with grounding bushing(s), to receive primary cables.
- D. Make connections to the secondary terminals of the transformer as required and in conformance with Utility Company requirements. Utility Company will provide primary conductors and terminal connections unless otherwise directed by the Utility Company.
- E. Provide underground raceways for primary cables from the transformer pad to the utility medium voltage switchgear, and provide pull cord, per Utility Company standards, for the Utility Company's use in pulling primary conductors. Install raceways a minimum of 24 inches below finished grade line unless otherwise indicated on the Drawings or directed by the Utility Company. Provide excavation and backfill as required to accomplish the installation.

### **3.2 SECONDARY SERVICE ENTRANCE OVERHEAD**

- A. Provide overhead secondary service drop from the pole-mounted transformer in accordance with NFPA 70 Article 230 and the Utility Company standards. Reference the Drawings for service drop conductor quantities, sizes, and type.
- B. The Utility Company will provide the service transformer.
- C. Coordinate connection with Utility Company and make connections to service drop from transformers in accordance with Utility Company standards.

### **3.3 METERING**

- A. Provide a 1-1/4-inch empty GRS conduit, with pull cord, from the secondary compartment of the pad-mounted service transformer to the meter location shown on the Drawings, or as directed by Utility Company.
- B. Install the meter base furnished by the Utility Company.
- C. The Utility Company will provide the meter and meter wiring.

**3.4 UTILITY SERVICE CHARGES**

- A. It shall be the responsibility of the Division 26 contractor to apply for the electrical service, including the preparation and completion of all forms. Submit the completed application along with all other required documentation for the new or modified service.
- B. Pay all Utility Company charges for providing electric service, including all charges for bringing primary service conductors to the site.

**3.5 FIELD QUALITY CONTROL**

- A. Voltage Monitoring and Adjusting: After Substantial Completion, if requested by Owner, but not more than six months after Final Acceptance, perform the following voltage monitoring:
  - 1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at the outgoing section of each secondary unit substation. Use voltmeters with calibration traceable to the National Institute of Science and Technology standards. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from the nominal value by more than plus or minus 5 percent during the test period, is unacceptable.
  - 2. Corrective Action: If test results are unacceptable, perform the following corrective action, as appropriate:
    - a. Rebalance loads.
    - b. Prepare written request for voltage adjustment by electric utility.
  - 3. Retests: Repeat monitoring, after corrective action has been performed, until satisfactory results are obtained. Submit results in writing.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Conductors, cables, and cords rated 600V and less.
- B. Connectors and terminations rated 600V and less.

**1.2 DEFINITIONS**

- A. The following abbreviations apply to this and other Sections of these specifications:
  - 1. MC: Metal Clad
  - 2. NBR: Acrylonitrile-butadiene rubber
  - 3. NETA ATS: Acceptance Testing Specification.
- B. The following definitions apply to this and other Sections of these Specifications:
  - 1. HOMERUN: That portion of an electrical circuit beginning at a junction box, termination box, receptacle or switch with termination at an electrical panelboard.
    - a. Note: Where MC Cable is allowed to be utilized for receptacle and/or lighting branch circuiting loads, the originating point of the homerun shall be at the first load in the circuit or at a junction box in an accessible ceiling space immediately above the first (most upstream) load.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop and temperature deration.
  - 2. Coordinate routing of power, low-voltage, and control conduits requiring fire-resistive protective assembly or electrical circuit protective system. Fire-resistive protective assembly or electrical circuit protective system for power, low-voltage, and control circuit conductors and cables shall have a fire-resistance rating of not less than 2 hours and shall be provided where required by NFPA or local building codes. Types of systems requiring a fire-resistive protective assembly include, but are not limited to:
    - a. Feeders for Emergency Power systems where in areas not protected by an automatic fire suppression system.
    - b. Smokeproof Enclosure Pressurization systems
    - c. Smoke Control systems
    - d. Smoke Removal systems
    - e. Fire service and Occupant Evacuation Elevator systems
  - 3. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
  - 4. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.
- B. Notify Contract Administrator of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

**1.4 SUBMITTALS**

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements":
  - 1. Product data for the following products:
    - a. Conductors, cables, and cords rated 600V and less.
    - b. Metal Clad (MC) cable and fittings.
  - 2. Shop drawings for:
    - a. Fire-Resistive cables, including UL 2196 certification.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Sustainable Design Documentation: Submit manufacturer's product data on conductor and cable showing compliance with specified lead content requirements.
- D. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
- F. Qualification Data: For testing agency.
- G. Field quality-control test reports in accordance with NETA ATS:
  - 1. Submit all system and component test results.
- H. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.
- I. Operation and Maintenance Data: For cable and all accessories to include in operation and maintenance manuals.
- J. Follow-up service reports.

**1.5 QUALITY ASSURANCE**

- A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.
- B. Provide products listed and classified by Underwriters Laboratories, Inc (UL) as suitable for the purpose specified and indicated.
- C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- D. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with NFPA 70.

**1.6 PROJECT CONDITIONS**

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Contract Administrator and obtain direction before proceeding with work.

- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner, or others, unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Contract Administrator and the Owner no fewer than 7 days in advance of proposed interruption of electrical service.
  - 2. Do not proceed with interruption of electrical service without Contract Administrator and the Owner's written permission.
  - 3. Owner reserves the right to require Contractor to cease work in any area Owner requires access to on an emergency basis.
- C. Make every effort to schedule outages during non-business or off-peak business hours to minimize disruptions to business operations.

## 1.7 DELIVERY STORAGE AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

## 1.8 SEISMIC REQUIREMENTS

- A. Seismic bracing, restraints, and controls for all electrical systems specified herein shall be designed and installed as required by Division 26 Section "Seismic Controls for Electrical Systems" and Division 20 Section "Seismic Controls for MEP/F/T Systems".

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 CONDUCTORS AND CABLES - GENERAL

- A. Conductor Material: Annealed (soft) copper complying with ICEA S-95-658/NEMA WC70 and UL Standards 44 or 83, as applicable.
  - 1. Solid conductors for No. 10 AWG and smaller; concentric, compressed stranded for No. 8 AWG and larger
  - 2. Stranded conductors
  - 3. Stranded for all flexible cords, cables, and control wiring.
  - 4. As noted otherwise below.
- B. Conductor Material: Compact stranded, aluminum alloy (AA-8000 Series), complying with ICEA S-95-658/NEMA WC70; No. 1 AWG or larger only
- C. Conductor Insulation: Type THHN/THWN-2, THW, or XHHW-2 complying with ICEA S-95-658/NEMA WC70 or as noted otherwise below.
- D. Sizes of conductors and cables indicated or specified are American Wire Gage (Brown and Sharpe).
- E. Conductors shall not be smaller than No. 12 AWG, with the exception of wiring for signal and pilot control circuits; and pre-manufactured whips for light fixtures which may be No. 14 AWG.
- F. Conductors installed for site electrical work shall be no smaller than No. 10 AWG CU. All site electrical branch circuit wiring shall be sized such that the maximum branch circuit voltage drop is less than 3 percent.
- G. Unless indicated otherwise, special purpose conductors and cables, such as low voltage control and shielded instrument wiring, shall be as recommended by the system equipment manufacturer.
- H. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

**2.2 SINGLE CONDUCTORS**

- A. Manufacturers:
1. Alan Wire
  2. Cerrowire
  3. Colonial Wire & Cable Co., Inc.
  4. Encore Wire Corporation
  5. General Cable (Prysmian Group)
  6. Northern Cables Inc.
  7. Okonite Company
  8. Southwire Company
- B. 600V, insulated conductors as noted above shall be color-coded as follows, unless noted otherwise:

PHASE	208Y/120V	480Y/277V
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	Gray
Equipment Ground	Green	Green
Isolated Ground	Green/Yellow Stripe	Green/Yellow Stripe

Except as provided in NFPA 70.

**2.3 TWO-HOUR FIRE RESISTIVE CABLES (INDIVIDUAL CONDUCTORS).**

- A. Manufacturers:
1. Radix Wire & Cable (DuraLife)
- B. Certified to UL2196 for Two-Hour Fire Resistive Cable.
- C. Cable shall be NFPA 70 compliant for use in a listed fire-resistive cable assembly and must be installed in a system meeting Electrical Circuit Integrity System (FHIT) No. 28C or 28E of the UL Fire Resistance Directory.
- D. Two-hour Certified for both vertical and horizontal installations.
- E. Conductors: Stranded soft-drawn copper, Thermal/fire barrier tape, silicone inner layer, LSZH XLPO outer layer, Rated 90 degree C.

**2.4 METAL CLAD CABLE TYPE MC**

- A. General:
1. Shall not be used for life safety or critical systems.
- B. MC Cable (with insulated green grounding conductor, no bonding conductor):
1. Manufacturers:
    - a. Atkore/AFC Cable Systems
    - b. Cerrowire
    - c. Encore Wire Corporation (MC)
    - d. Kaf-Tech
    - e. Northern Cables, Inc.
    - f. Southwire Company (Amorlite)
  2. 600V, Unjacketed and/or PVC-jacketed UL Standard 83, UL Standard 1569 for Type MC, UL Standard 1685, Federal Specification A-A59544, IEEE 1202 Vertical Cable Tray Flame Test and NFPA 70. Type MC Cable shall be listed for use in UL 1, 2, and 3 Hour Through-Penetration Firestop Systems.

3. Armor Assembly: Aluminum interlocked armor (aluminum color).
  4. Phase Conductors: Solid soft-drawn copper, THHN-insulated single conductors, color code: ICEA Method 1.
  5. Grounding Conductor: Solid soft-drawn copper, THHN/THWN-2 green insulated grounding conductor sized per NFPA 70.
  6. Marking: Cable markings shall comply with the requirements of NFPA 70.
- C. MC Cable (with 0-10V dimming control wiring):
1. Manufacturers:
    - a. Atkore/AFC Cable Systems
    - b. Cerrowire
    - c. Encore Wire Corporation (MC- LED)
    - d. Southwire Company (MC – PCS Duo)
  2. 600V, Unjacketed and/or PVC-jacketed UL Standard 83, UL Standard 1569 for Type MC, UL Standard 1685, Federal Specification A-A59544, IEEE 1202 Vertical Cable Tray Flame Test and NFPA 70. Type MC Cable shall be listed for use in UL 1, 2, and 3 Hour Through-Penetration Firestop Systems.
  3. Armor Assembly: Aluminum interlocked armor (aluminum color).
  4. Phase Conductors: Solid soft-drawn copper, THHN-insulated single conductors, color code: ICEA Method 1.
  5. Grounding Conductor: Solid soft-drawn copper, THHN/THWN-2 green insulated grounding conductor sized per NFPA 70.
  6. Control Conductors: Color-coded Class 2/Class 3 twisted jacketed pairs
  7. Marking: Cable markings shall comply with the requirements of NFPA 70.
- D. MC Cable (Two-Hour Fire Resistive Cables)
1. Manufacturers:
    - a. Prysmian Group (Lifeline MC)
    - b. VITALink (VITALink MC)
  2. Cable shall be NFPA 70 and NFPA 101 compliant for use as a listed fire-resistive cable assembly and shall meet Electrical Circuit Integrity System (FHIT) No. 50 of the UL Fire Resistance Directory.
  3. 600V, Unjacketed UL Standard 83, UL Standard 1569 for Type MC, UL Standard 1685, Federal Specification A-A59544, IEEE 1202 Vertical Cable Tray Flame Test and the NEC, classified to UL 2196 Standard for Test for Fire Resistive Cables for two-hour installations. Type MC Cable shall be listed for use in UL 1, 2, and 3 Hour Through-Penetration Firestop Systems.
  4. Armor Assembly: Continuously welded corrugated copper armor meeting equipment grounding conductor requirements of NEC.
  5. Phase Conductors: Solid or stranded soft-drawn copper, THHN-insulated single conductors, color code: ICEA Method 1, Rated 90 degree C.
  6. Marking: Cable markings shall comply with the requirements of NEC Art 310.
  7. Cable insulation and inner binder jacket: Ceramifiable Silicone Zero Halogen (LSZH).
- E. MC Cable Fittings:
1. Manufacturers:
    - a. ABB/T&B
    - b. Arlington
    - c. Eaton/Crouse-Hinds
    - d. Emerson/O-Z Gedney
  2. Fittings used for connecting Type MC cable to boxes, cabinets, or other equipment shall be UL listed and identified for such use with an MCI-A marking on the fitting carton or package.
  3. Fittings shall be insulated type not requiring the use of anti-short bushings.
  4. Romex style, clamp type fittings are not acceptable.

**2.5 VARIABLE-FREQUENCY DRIVE CABLE**

- A. Manufacturers:
  - 1. Belden
  - 2. Service Wire Co.; ServiceDrive
- B. Flexible motor supply cable listed and labeled as complying with UL 2277 in accordance with NFPA 79; specifically designed for use with variable frequency drives and associated nonlinear power distortions.
  - 1. Insulation shall be thermoset types. Thermoplastic insulation types are not permitted.
  - 2. Grounding: Full-size integral equipment grounding conductor or symmetrical arrangement of multiple conductors of equivalent size.
  - 3. Provide 100% coverage copper tape shielding.
  - 4. Jacket: PVC or Chlorinated Polyethylene (CPE).

**2.6 FLEXIBLE CORDS**

- A. Manufacturers:
  - 1. Cerrowire
  - 2. Southwire
- B. 600V, multi-conductor (2, 3, or 4 as indicated on the Drawings), oil-resistant black jacket, extra-hard-usage; Type SEO, SO, or STO for indoor dry and damp locations; SEOW, SOW, or STOW for damp, wet, and outdoor locations; or as required by the manufacturer of the equipment to which the cords are connected.
- C. 300V, multi-conductor (2, 3, or 4 as indicated on the Drawings), oil-resistant black jacket, hard-usage; Type SJEO, SJO, or SJTO for indoor dry locations; SJEOW, SJOW, or SJTOW for damp, wet, and outdoor locations; or as required by the manufacturer of the equipment to which the cords are connected.

**2.7 CONTROL WIRING**

- A. Refer to Division 23 Section "Direct-Digital Control for HVAC"
- B. Unless otherwise noted, all control wiring will be the responsibility of the Section or Division in which the control system is specified.

**2.8 CONNECTORS**

- A. Manufacturers:
  - 1. AMP; Tyco
  - 2. FCI-Burndy
  - 3. Gould
  - 4. Ideal Industries, Inc.
  - 5. IlSCO
  - 6. NSI Industries, Inc.
  - 7. O-Z/Gedney
  - 8. Panduit
  - 9. Thomas and Betts
  - 10. 3-M Electrical Products Division
- B. Compression connectors for conductors No. 8 AWG and larger: Long-barreled, UL 486-listed, circumferential compression type (Burndy "Hylug", or equal), insulated with clamp-on, cold-shrink, or molded covers, or wrapped with multiple over-lapping layers of 3-M Scotch electrical tape.
  - 1. Termination fittings for copper conductors: Bare copper, 1 or 2-hole pad and inspection port.

2. Termination fittings for aluminum conductors: Tinned aluminum, 1 or 2-hole pad.
- C. Mechanical connections for conductors No. 8 AWG and larger: UL-listed, dual-rated, mechanical type, insulated with clamp-on, cold-shrink, or molded covers, or wrapped with multiple overlapping layers of 3-M Scotch electrical tape.
  1. Termination fittings: Bare copper, 1 or 2-hole pad and inspection port.
- D. Connectors for solid conductors No. 10 AWG and smaller: Insulated winged wire nuts. Color-coded for size, except use green only for grounding connections.
- E. Connectors for stranded conductors No. 10 AWG and smaller: Tinned copper, insulated-sleeve, compression type, UL-listed, with wire insulation grip. Terminations: ring-tongue type.
- F. Connectors and terminations for aluminum conductors and cables No. 1 and larger: UL 486B listed and marked AL7CU for 75 deg C rated conductors and AL9CU for 90 deg C rated conductors.
- G. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- H. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

### **PART 3 - EXECUTION**

#### **3.1 PREPERATION**

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".
- B. Coordinate seals with wall, ceiling, roof or floor materials and rating of the surface (sound, fire, waterproofing, etc.)
- C. Electrical conductor and cable work is schematically represented on the Drawings. Unless otherwise indicated, conductor sizes shown on the Drawings are based on not more than three single current-carrying conductors in a raceway in free air. Current ratings are based on copper at 75 degrees C temperature rating for all power circuits. Modify raceway and conductor sizing as may be necessitated by any deviation from these conditions. Do not decrease the indicated conductor size due to the use of conductors having a temperature rating of 90 degrees C.
- D. Conductor sizes shown are minimum based on code requirements, voltage drop, and/or other considerations. Where approved by the Engineer and at no extra cost to the Owner, larger conductor sizes may be installed at Contractor's option in order to utilize stock sizes, provided raceway sizes are increased where necessary to conform with NFPA 70 (determine the effect of the use of larger conductors on the short circuit current ratings of the electrical equipment, and provide increased short circuit current rated equipment as required).
- E. Where anticipated conductor installed lengths exceed the lengths indicated on the Drawings, notify Contract Administrator. Provide tabulated list of exceeded lengths for review. Increase conductor size, circuit ground size, and conduit size accordingly to meet maximum voltage drop indicated within the calculations.

#### **3.2 INSTALLATION**

- A. General
  1. Unless otherwise indicated on the Drawings or in other Sections, install all conductors in raceway. Install continuous conductors between outlets, devices and boxes without splices or taps. Do not pull connections into raceways. Leave at least 12 inches of conductor at outlets for fixture or device connections.
  2. Install in accordance with manufacturer's instructions.

3. Use manufacturer-approved pulling compound or lubricant where necessary; compound used shall not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
4. Use pulling means, including fish tape, cable, rope, and basket weave conductor/cable grips that will not damage conductors/cables or raceway.
5. Where parallel conductors are shown, install each set of conductors in separate raceways of essentially the same length.
6. Seal around cables penetrating fire-rated elements according to Division 07 Section "Penetration Firestopping".
7. Wiring at Outlets: Install conductors at each outlet with at least 12 inches of slack.
8. Common or Shared Neutrals are not allowed unless shown on the plans or specifically noted to be allowed.
9. Multi-wire branch circuits are not allowed unless noted otherwise on the drawings.
10. Where multi-wire branch circuits are utilized (i.e., shared neutral), shall be provided with a means that will simultaneously disconnect all ungrounded conductors at the point the branch circuit originates. Multi-pole breakers or 3 single pole breakers with a handle tie are two examples.
11. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
12. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
13. When multiple home runs are combined into a single raceway such that the number of conductors exceeds four (conductor count is made up of any combination of phase and neutral conductors), the following restrictions apply, which are in addition to those in NFPA 70:
  - a. Emergency Power Circuits – includes all circuits covered under Articles 700, 701 and 702.
    - 1) Maximum of eight conductors in a single raceway. Minimum raceway size:  $\square$ -inch. Do not install any other type of circuit in this raceway.
    - 2) Only 15A and 20A branch circuit homeruns may be combined into one raceway.
  - b. Normal or Non-Essential circuits.
    - 1) Maximum of 16 conductors in a single raceway. For up to eight conductors in a raceway, minimum raceway size: 3/4 inch. For greater than eight conductors, minimum raceway size: 1 inch. Do not install any other type of circuit in this raceway.
    - 2) The minimum wire size for all conductors in this raceway: No. 10 AWG.
    - 3) Only 15A and 20A branch circuit homeruns may be combined into one raceway.
  - c. GFCI-protected circuits.
    - 1) Do not use multi-conductor circuits, with a shared neutral, for any GFCI circuit breaker or receptacle circuit.
14. For branch circuits fed from GFCI circuit breakers, limit the one-way conductor length to 250 feet between the panelboard and the most remote receptacle or load on the GFCI circuit per basis of design manufacturer, Schneider Electric. Contractor shall confirm that final manufacturer awarded project can meet requirement and notify engineer of any discrepancies.
15. Where the number of conductors for branch circuits is not shown on the Drawings, determine the number of conductors in accordance with NFPA 70. Provide adequate conductors so as to allow performance of all functions of the device.
16. Branch circuit conductors shall be copper.
17. All essential power systems circuits shall be copper.
18. Provide all conductors with 600V insulation of the following types, unless otherwise noted on the Drawings or in these Specifications:
  - a. Wet or dry locations, in raceways:
    - 1) Service entrance: Type THWN, THHN/THWN-2, or XHHW-2.



- 2) Feeders and branch circuits: Type THWN, THHN/THWN-2, or XHHW-2.
  - 3) Conductors No. 6 AWG and smaller: Types THWN or THHN/THWN-2.
  - 4) Conductors used between a variable frequency drive (VFD) and associated motor: Type XHHW-2.
- b. Conductors within three feet of high temperature equipment such as heaters: Type THHN, XHHW, or higher temperature insulation as required for the use.
- B. Aluminum Conductor Option:
1. Terminations: Tinned, mechanical or compression type only; UL-listed for copper and aluminum conductors at 75 degrees C minimum.
  2. Increase the raceway size as required, at no additional cost to the Owner, to accommodate the increased size of the aluminum conductors.
  3. Aluminum conductor size shall meet or exceed the ampere rating of the scheduled copper conductors at 75 degrees C.
  4. Aluminum option applies only for the following feeders or services with minimum size as indicated in "Conductors and Cables" materials section above. All feeders and services smaller than the minimum size or those not listed below shall be copper:
    - a. Service and feeder conductors may be aluminum unless prohibited below.
      - 1) Exceptions:
        - a) Feeders connecting directly to motors including, but not limited to, chillers and fire pumps shall be copper to minimize loosening of connectors due to cyclical thermal expansion.
    - b. Service entrance conductors
    - c. Feeders to switchboards
    - d. Feeders to panelboards
      - 1) Exception: Apartment unit load center feeder conductors shall be copper; aluminum is not acceptable.
    - e. Feeders to motor control centers
    - f. Feeders to transformers
  5. Where aluminum conductors terminate existing panelboards, switchboards or switchgear that utilize compression connections use hydraulic-compression type connectors with a zinc base, anti-oxidizing compound. Use compression tools of the type that will not release unless the correct pressure has been applied.
  6. Measure the temperature of all aluminum conductors at all splices and terminations. Make each test under typical building load conditions after the building is occupied and in operation for a minimum of two weeks. Replace all joints or splices indicating excessive heating.
  7. Take measurements with a non-contact type infrared thermometer, with target size not exceeding one inch at five feet and an accuracy of two percent or better. Submit the meter specifications and calibration date with the test results.
- C. Two-Hour Fire Resistive Cables (Individual Conductors).
1. Cable shall be installed in a system meeting Electrical Circuit Integrity System (FHIT) No. 28C or 28E of the UL Fire Resistance Directory.
  2. Two-Hour Fire-Resistive cable may only be used:
    - a. For feeders and branch circuits where indicated on the Drawings or where a listed fire-resistive cable system is required by NFPA 70, the IBC, or other applicable codes.
  3. Two-Hour Fire-Resistive cable shall not be used for any use not listed in the paragraph above. Examples of those uses include, but are not limited to:
    - a. In locations not permitted by the NEC.
    - b. When specifically not allowed by the local AHJ and/or Owner.
- D. Metal Clad Type MC Cable:
1. Securing and Supporting:
    - a. Support per NFPA 70 for MC cable
    - b. Secure cable within 12 inches of every box or fitting.

- c. Secure/supporting intervals shall not exceed six (6) feet for MC cable.
  - d. Utilize steel cable hangers, Arlington SMC series or equivalent, for MC cable support wherever possible so as to provide for cable routing in a neat and workmanship like manner.
2. Type MC cable may only be used:
- a. In lieu of flexible conduit and wiring from light fixtures in accessible ceilings to junction boxes (attached to building structure) above the ceiling. Provide cable whips of sufficient lengths to allow for relocating each light fixture within a 5-foot radius of its installed location, but not exceeding 6 feet in unsupported lengths.
  - b. For vertical drops and horizontal wiring in stud walls.
3. MC cable shall not be used for any use not listed in the paragraph above. Examples of those uses include, but are not limited to:
- a. Unjacketed MC:
    - 1) In locations not permitted by NFPA 70.
    - 2) When specifically not allowed by the local AHJ and/or Owner.
    - 3) Homeruns to panelboards.
    - 4) Where exposed to view.
    - 5) Where subject to physical damage.
    - 6) Corrosive or Hazardous locations.
    - 7) Wet locations.
    - 8) Branch circuits serving HVAC, elevator/escalator, medical and kitchen equipment loads.
    - 9) Within mechanical, electrical or telecommunication equipment rooms.
    - 10) Emergency circuits covered by NFPA 70, unless specifically noted for use as a fire-resistive cable system.
  - b. PVC Jacketed MC:
    - 1) In locations not permitted by NFPA 70.
    - 2) When specifically not allowed by the local AHJ and/or Owner.
    - 3) Homeruns to panelboards.
    - 4) Where exposed to view.
    - 5) Where subject to physical damage.
    - 6) Branch circuits serving HVAC, elevator/escalator, medical and kitchen equipment loads.
    - 7) Within mechanical, electrical or telecommunication equipment rooms.
    - 8) Emergency circuits covered by NFPA 70.
- E. Metal Clad Type MC Cable (Fire-Resistive):
- 1. Securing and Supporting:
    - a. Install, support, and terminate Fire-Resistive MC cable per manufacturer's installation instructions and per applicable codes and standards.
    - b. Support MC cable per NFPA 70 and requirements of UL Electrical Circuit Integrity System FHIT 50.
    - c. Secure cable within 12 inches of every box or fitting.
    - d. Secure/supporting intervals shall not exceed six (6) feet for MC cable in non-fire rated installations or (4) feet in fire rated installations per UL FHIT 50.
    - e. Utilize steel cable hangers, Arlington SMC series or equivalent, for MC cable support wherever possible in non-fire rated installations.
    - f. Utilize steel slotted support systems with two-piece clamps in fire rated installations per UL FHIT 50 installations.
    - g. Where multiple multi-conductor cables are installed maintain adequate spacing between cables to avoid reduction in allowable ampacities as per NFPA 70 requirements.
    - h. Provide non-metallic barrier between MC cable armor and metallic supports to prevent contact between dissimilar metals.
    - i. Route cabling in a neat and workmanship like manner.
  - 2. Type MC Fire-Resistive cable may only be used:

- a. For feeders and branch circuits where indicated on the Drawings or where a listed fire-resistive cable system is required by NFPA 70, NFPA 101, the IBC, or other applicable codes.
  3. Type MC Fire-Resistive cable shall not be used for any use not listed in the paragraph above. Examples of those uses include, but are not limited to:
    - a. In locations not permitted by the NEC.
    - b. When specifically not allowed by the local AHJ and/or Owner.
    - c. Where subject to physical damage.
    - d. Corrosive or Hazardous locations.
- F. Variable-Frequency Drive Cable:
  1. Use for conductors run between variable-frequency drive (VFD) and motor when distance exceeds 200 feet.
  2. Terminate shielding at both variable-frequency motor controller and associated motor using glands or termination kits recommended by manufacturer.
- G. Flexible Cords
  1. Refer to Division 26 Section, "Equipment Wiring Systems", for electrical connections to equipment.
- H. Control Wiring
  1. Unless otherwise indicated on the Drawings or in other sections, install all control wiring in raceway, regardless of voltage. A qualified Electrician shall install all control wire operating at 120V nominal and above. Control wiring operating at less than 120V (e.g., 12V and 24V) may be installed under the Division furnishing it.
  2. Open wiring in air-handling plenums: UL listed and classified for use in air plenums without raceway. Where indicated on the Drawings or otherwise specified, and permitted by local codes, only cable for communication or fire alarm systems and low voltage control wiring may be installed without raceways.
    - a. Low voltage wiring not routed in a race way shall be supported by cable tray or j-hooks secured independently of ceiling supports. Cabling shall not be supported directly by the ceiling system.
- I. Connections:
  1. Apply a zinc based, anti-oxidizing compound to connections.
  2. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
  3. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  4. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
  5. Use only resin pressure splices and splicing kits that totally encapsulate the splice for splices in underground junction boxes. Arrange the splicing kit to minimize the effects of moisture.
  6. Use connectors as indicated in equipment schedules. Where not indicated use connections as noted below.
    - a. Compression – Conductors No. 8 AWG and larger to panelboards, switchboards and apparatus
    - b. Compression – splices, terminals
    - c. Mechanical – where temporary removal is required
  7. Do not use terminals on wiring devices to feed through to the next device.

### 3.3 IDENTIFICATION

- A. General: Provide all identification per Division 26 "Identification for Electrical Systems".
- B. Single Conductors: Identify and color-code conductors to indicate voltage and phase according to Part 2 of this Section. Identification method shall be either:

1. Factory provided colored insulation
  2. Color-Coding Conductor Tape.
  3. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- C. Power-Circuit Conductor Identification: For primary and secondary conductors 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes identify voltage, source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in the same junction or pull box identify each ungrounded conductor according to voltage, source and circuit number.
- E. Conductors to Be Extended in the Future: Attach identification device to conductors and list source and circuit number.
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- G. Conductors for controls (lighting, controls): Label each conductor with Markers for Conductor and Control Cables. – identify conductors using method as noted in Division 26 Section "Identification for Electrical Systems". Note conductor identification on record Drawings.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
- I. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- J. Low voltage cable sheath labels and related manufacturer information shall remain apparent in all exposed applications.
1. Protect exposed cabling labels from painting and overspray (this includes protection of cables in cable tray)

### 3.4 FIELD QUALITY CONTROL

- A. Do not perform insulation resistance tests of the distribution wiring to equipment with the surge protective devices installed. Disconnect surge protective device before conducting insulation resistance tests and reconnect immediately after the testing is over.
- B. Testing: Perform the following field quality-control testing:
1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements. Test all wiring prior to energizing to ensure that it is free from unintentional grounds and shorts, is properly phased, and that all connectors are tight.
  2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3. Certify compliance with test parameters.
- C. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
  2. Test results that comply with requirements.
  3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. This Section includes:
  - 1. Grounding Electrodes
  - 2. Ground Bars
  - 3. Grounding Conductors
  - 4. Connector Products
  - 5. Miscellaneous Grounding Materials and Products

**1.2 DEFINITIONS**

- A. The following apply to this and other Sections of these Specifications:
  - 1. Ground ring: Bare underground grounding conductor encircling the building or structure.
  - 2. NETA ATS: Acceptance Testing Specification.
  - 3. PSF: Pounds per Square Foot
  - 4. EMT: Electrical metallic tubing.
  - 5. ENT: Electrical nonmetallic tubing.
  - 6. FMC: Flexible metal conduit.
  - 7. GRS: Galvanized Rigid Steel Conduit
  - 8. IMC: Intermediate metal conduit.
  - 9. LFMC: Liquidtight flexible metal conduit.
  - 10. LFNC: Liquidtight flexible nonmetallic conduit.
  - 11. RAC: Rigid Aluminum Conduit
  - 12. RMC: Rigid Metal Conduit
  - 13. RNC: Rigid nonmetallic conduit.

**1.3 SUBMITTALS**

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements":
  - 1. Product data for the following products:
    - a. Electrodes, mechanical and compression connectors, and exothermic connectors .
- B. Qualification Data: For Contractor.
- C. Quality-Control Test Reports:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section "General Electrical Requirements":
  - 1. Accurately record actual locations of all buried electrodes, bonding conductors and ground rings. Indicate dimensions from fixed structural elements.

## 1.4 QUALITY ASSURANCE

- A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.
- B. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."
- C. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
  - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- D. Electrical Components, Devices, and Accessories:
  - 1. Listed and labeled as defined in NFPA 70, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
  - 2. Marked for intended use.
  - 3. Comply with UL 467.
- E. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.
- F. Comply with NFPA 70.

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 GROUNDING CONDUCTORS CONNECTORS AND ELECTRODES

- A. Manufacturers:
  - 1. ABB, Inc.
  - 2. Advanced Lightning Technology (ALT)
  - 3. AFL Global
  - 4. Boggs, Inc.
  - 5. Burndy; Hubbell.
  - 6. Cooper Power; Eaton.
  - 7. Copperweld Corp.
  - 8. ECN/Korns; Division of Robroy Industries.
  - 9. Erico; nVent.
  - 10. Galvan Industries, Inc.
  - 11. Greaves Corp.
  - 12. Harger.
  - 13. Hastings Fiber Glass Products, Inc.
  - 14. Heary Brothers Lightning Protection Co.
  - 15. Ideal Industries, Inc.
  - 16. ILSCO.
  - 17. Lightning Master Corp.
  - 18. Lyncole XIT Grounding; Division of VFC.
  - 19. O-Z/Gedney Co.; Emerson.
  - 20. Panduit, Inc
  - 21. RACO; Hubbell, Inc.
  - 22. Robbins Lightning, Inc.
  - 23. Superior Grounding Systems, Inc.

### 2.2 GROUNDING ELECTRODES

- A. Ground Rods: UL-listed:



1. Copper-clad steel; bonded copper electrolytically-applied to minimum thickness of 10 mils.
  2. Hot-dip galvanized steel; minimum zinc thickness specified per ASTM A-123.
  3. Stainless steel; Type 304.
  4. Size: 5/8 inch by 8 feet.
- B. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a bare conductor sized, at a minimum, for the size of the connecting grounding electrode conductor.
- C. Ground Plates: UL-listed, rectangular, bare solid copper plate; minimum 0.032-inch thick.
- D. Ground Ring:
1. Bare copper grounding conductor, size as noted on Drawings but not less than #2/0 AWG.

### 2.3 GROUND BARS

- A. General
1. Ground bars described in this section are intended to be wall mounted bars used for grounding and bonding. Equipment ground buses for switchboards, panelboards and miscellaneous equipment are described in the individual equipment sections.
  2. Supports: Minimum of two each 1-1/2-inch insulators and 1-inch stainless steel offset mounting brackets.
- B. Electrical Room Ground Bars
2. Rectangular Ground Bars: bare,  $\frac{1}{4}$  inch thick, electrolytic, tough pitch copper bar, 4 inches wide. Length as indicated on the Drawings but not less 24 inches long. Hole spacing as required for conductor lugs.

### 2.4 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
- B. Material:
3. Aluminum.
  4. Copper-clad aluminum.
  5. Copper.
- C. Equipment Grounding Conductors: Insulated and identified as indicated in Part 3 of this section.
- D. Isolated Ground Conductors: Insulated and identified as indicated in Part 3 of this section.
- E. Grounding Electrode Conductors: Bare, stranded, unless otherwise indicated.
- F. Underground Conductors:
6. Tinned-copper conductor.
  7. No. 2/0 AWG minimum
  8. Stranded, unless otherwise indicated.
- G. Bare Copper Conductors:
1. Solid Conductors: Comply with Conductors: ASTM B 8.
  2. Tinned Conductors: Comply with ASTM B 33.
- H. Copper Bonding Conductors:
1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
  2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
  3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

- I. Aluminum Bonding Conductors:
  - 1. Bonding Cable: 10 strands of No. 14 AWG aluminum conductor, 1/4 inch in diameter.
  - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded aluminum conductor.
  - 3. Bonding Jumper: Aluminum tape, braided bare aluminum conductors, terminated with aluminum ferrules; 1-5/8 inches wide and 1/16 inch thick.
- J. Ground Ring:
  - 9. Bare copper grounding conductor, size as noted on Drawings but not less than #2/0 AWG.
- K. Ground Conductor and Conductor Protector for Wood Poles: As follows:
  - 1. No. 4 AWG minimum, soft-drawn copper conductor.
  - 2. Conductor Protector: Half-round PVC or wood molding. If wood molding is utilized, use pressure-treated fir, or cypress or cedar.

## 2.5 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors.
- C. Compression Connectors: Burndy Hyground, or equal, permanent, pure, wrought copper, meeting ASTM 8 1 87, essentially the same as the conductors being connected; clearly and permanently marked with the information listed below:
  - 10. Company symbol and/or logo.
  - 11. Catalog number.
  - 12. Conductors accommodated.
  - 13. Installation die index number or die catalog number is required.
  - 14. Underwriters Laboratories "Listing Mark:".
  - 15. The words "Suitable for Direct Burial" or, where space is limited, "Direct Burial" or "Burial" per UL Standard ANSI/UL467.
- D. Cast connectors: copper base alloy according to ASTM B 30.
- E. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

## 2.6 MISCELLANEOUS

- A. Test Wells:
  - 1. Traffic Areas: Polymer concrete reinforced with heavy weave fiberglass; H-20 load rating; minimum 24 inches deep.
  - 2. Non-traffic Areas: High density polyethylene; 350 PSF minimum load rating; minimum 10.25 inches deep.
  - 3. Cover: Factory-identified by permanent means with word "GROUND".
- B. Ground Enhancing Backfill: Provide low-resistivity, ground-enhancing backfill material recommended by the electrode manufacturer.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Examine areas and conditions under which electrical grounding connections are to be made and notify the Contract Administrator and the Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with Work until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

#### A. General:

16. Provide all materials, labor and equipment for an electrical grounding system in accordance with applicable portions of NFPA 70 and NECA. Coordinate electrical work as necessary to interface installation of electrical grounding systems with other work.
17. Accomplish grounding and bonding of electrical installations and specific requirements for systems, circuits and equipment required to be grounded for both temporary and permanent construction.
18. Where the size of the grounding conductors are not shown, size in accordance with NFPA 70 Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

#### B. Application:

19. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
20. Underground Grounding Conductors: Unless noted otherwise, bury at least 24 inches below grade, or 6 inches below the official frost line, whichever is greater, or when crossing a duct bank, bury 12 inches above duct bank.

#### B. Grounding Electrode System: Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.

1. Provide continuous grounding electrode conductors without splice or joint.
2. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
3. Ground Rod Electrodes:
  - a. Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
  - b. Unless otherwise indicated, install ground rod electrodes vertically.
    - 1) Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
    - 2) Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
  - c. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70. If depth is unachievable, notify Contract Administrator and Engineer.
  - d. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
  - e. Verify that final backfill and compaction has been completed before driving rod electrodes.
  - f. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade, pavement, or floor.
4. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches. Use exothermic weld to secure grounding electrode conductor.
5. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare, tinned copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor above footer and foundation and connect to building structural steel or other grounding electrode external to concrete.
6. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect

- grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
7. Ground Ring Electrode (Counterpoise):
    - a. Provide a ground ring encircling the building or structure, in direct contact with earth., installed at a depth of not less than 18 inches or 6 inches below the official frost line, whichever is greater.
    - b. Locate ground ring conductor at least 24 inches outside building perimeter foundation, unless noted otherwise on the Drawings.
    - c. Provide ground enhancement material around conductor where indicated.
  8. Metal In-Ground Support Structures: Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
  9. Metal Poles Supporting Outdoor Luminaires: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.
- C. Equipment Grounding Conductors:
1. Comply with NFPA 70, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
  2. Install equipment grounding conductors in all feeders and branch circuits.
  3. Install equipment grounding conductor with circuit conductors for the following items, in addition to those required by NFPA 70:
    - a. Feeders and branch circuits.
    - b. Lighting circuits.
    - c. Receptacle circuits.
    - d. Single-phase motor and appliance branch circuits.
    - e. Three-phase motor and appliance branch circuits.
    - f. Flexible raceway runs.
    - g. Armored and metal-clad cable runs.
    - h. Feeders and branch circuits installed in non-metallic raceways.
  4. In branch circuit and feeder raceways, use insulated equipment grounding conductors.
  5. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
  6. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components. On water heaters, bond metal hot and cold water pipes together, across the heater tank.
  7. Busway Supply Circuits: Install an insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panelboard to the equipment grounding bar terminal on the busway, if a direct bus-to-bus connection is not factory provided.
  8. Metallic Cable Tray Systems: Install equipment grounding conductor in each cable tray. Do not use metal cable tray system as sole equipment grounding conductor.
    - a. Equipment Grounding Conductor for Steel Cable Tray: Use bare or insulated copper conductor.
    - b. Equipment Grounding Conductor for Aluminum Cable Tray: Use insulated copper conductor only; do not use bare copper conductor.
    - c. Minimum Equipment Grounding Conductor Size: 6 AWG copper.
  9. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- D. Ground Bars:
1. Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated on the Drawings.
    - a. Use insulated spacers and mounting brackets, and support from wall 2 feet above finished floor, unless otherwise indicated.

- C. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
  - 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a ground bar.
  - 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- D. Separately Derived Systems: Bond the derived neutral (grounded) conductor of all separately derived system (e.g., transformers, generators, UPS) to the nearest available grounding electrode, or back to the service grounding electrode if no approved electrodes are readily available. Size the grounding electrode conductor and bonding jumpers as indicated on the Drawings or as required by NFPA 70, whichever is larger.
- E. Bonding: Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70:
  - 1. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
  - 2. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
  - 3. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
  - 4. Bond metallic elements likely to become energized or where indicated on the Drawings, including but not limited to fences around electrical equipment and metal drain bodies near pools or electrical equipment.
  - 5. Bond raised flooring systems and static control flooring.
  - 6. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
  - 7. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in PVC conduit.
  - 8. Pole Mounted Luminaires: Bond metal enclosures and components of pole mounted luminaires to the grounding system per the Manufacturer's requirements.
  - 9. Bond the components within the following systems to the building grounding system:
    - a. Metallic Cable Tray Systems.
    - b. Photovoltaic Systems.

### 3.3 CONNECTIONS

- F. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible. Provide electrical bonding plates, connectors, terminals, lugs and clamps as recommended by the manufacturers for indicated applications. Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, and bonding straps as recommended by the manufacturers for types of service indicated.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.

3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
  5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- G. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Replace welds that are puffed up or that show convex surfaces indicating improper cleaning. Use exothermic welded connections for the following:
1. Connecting conductors together.
  2. Connecting conductors to ground rods, except at test wells.
  3. Connecting conductors to building steel.
  4. Connecting conductors to plates.
- H. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
1. Compression Fittings: Permanent compression-type fittings may be used for the following rather than exothermic connections:
    - a. Connecting conductors together.
    - b. Connecting conductors to building steel.
    - c. Connecting conductors to ground rods, except at test wells.
- I. Mechanical Pressure-Type Connections: Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
1. Mechanical Pressure Fittings: Use bolted mechanical (removable) pressure-type clamps for the following:
    - a. Connecting conductors to ground rods at test wells.
    - b. Connecting conductors to pipes.
- J. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- K. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- L. Connections at Test Wells: Use compression-type connectors on conductors and make bolted-and clamped-type connections between conductors and ground rods.
- M. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

### 3.4 GROUND RING

- N. Ground the steel framework of the building with a buried electrode at the base of every corner column and at intermediate exterior columns at distances not more than 60 feet apart. Provide a grounding conductor (counterpoise), electrically connected to each ground rod and to each steel column, extending around the perimeter of the building. Protect taps for steel framing connections from physical damage at foundations and transitions to steel columns.

### 3.5 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

- O. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- P. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 6 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- Q. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise encircling the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade, or 6 inches below the official frost line, whichever is greater, and 6 inches from the foundation.

### 3.6 IDENTIFICATION

- A. Provide identification as specified in Division 26 "Low-Voltage Electrical Power Conductors and Cables" and "Identification for Electrical Systems".

### 3.7 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
  - 1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
  - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the fall-of-potential method according to IEEE 81.
  - 3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
  - 4. Inspect and test in accordance with NETA ATS, except Section 4.
  - 5. Perform inspections and tests listed in NETA ATS, Section 7.13.
  - 6. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
  - 7. Perform point-to-point megohmmeter tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
  - 8. Test Values:
    - a. The resistance between the main grounding electrode and earth ground shall be no greater than 5 ohms.

- b. Equipment Rated 500 kVA and Less: 10 ohms.
  - c. Equipment Rated 500 to 1000 kVA: 5 ohms.
  - d. Equipment Rated More Than 1000 kVA: 3 ohms.
  - e. Substations and Pad-Mounted Switching Equipment: 5 ohms.
  - f. Manhole Grounds: 10 ohms.
9. Minimum system neutral-to-ground insulation resistance: one megohm.
  10. Investigate point-to-point resistance values that exceed 0.5 ohms.
    - a. Check for loose connections.
    - b. Check for absent or broken connections.
    - c. Check for poor quality welds.
    - d. Consider other reasons.
  11. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements
  12. Excessive Grounding Electrode Resistance: If measured resistance to earth ground value exceeds specified values, add grounding electrodes and additional conductors as required to obtain the specified value.
  13. Submit detailed reports indicating inspection and testing results and corrective actions taken.

### 3.8 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 31 and 32. Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION



**SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.

**1.2 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 5. Notify Contract Administrator of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
  - 6. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
  - 7. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."
- B. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Structural members in path of conduit groups with supports.
  - 2. HVAC items, plumbing items and architectural features in the paths of conduit groups with common supports.
- C. Sequencing:
  - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
  - 1. Submit fabrication drawings and product literature.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

### 1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel slotted support systems.
  - 2. Rooftop support systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze hangers. Include Product Data for components.
  - 2. Steel slotted channel systems. Include Product Data for components.
  - 3. Equipment supports.
- C. Welding certificates.

### 1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70 and applicable building code.
- C. Installer Qualifications for Powder-Actuated Fasteners: Certified by fastener system manufacturer with current operator's license.

## PART 2 - PRODUCTS

### 2.1 SUPPORT ANCHORAGE AND ATTACHMENT COMPONENTS

- A. General:
  - 1. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
- B. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly. Use corrosion resistant materials suitable for the environment where installed.
  - 1. Manufacturers:
    - a. Allied Tube & Conduit; Atkore International.
    - b. Eaton
    - c. Erico; nVent.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Atkore International.
    - g. Wesanco, Inc.
  - 2. Metallic Coatings:
    - a. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
    - b. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
  - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 5. Channel Dimensions: Selected for applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

- D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
1. Conduit Straps: One-hole or two-hole type.
  2. Conduit Clamps: Bolted type unless otherwise indicated.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder or Battery-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers:
      - 1) Hilti Inc.
      - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
      - 4) Powers Fasteners, Inc;
      - 5) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
    2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
      - a. Manufacturers:
        - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
        - 2) Empire Tool and Manufacturing Co., Inc.
        - 3) Hilti Inc.
        - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        - 5) MKT Fastening, LLC.
      3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
      4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
      5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
      6. Toggle Bolts: All-steel springhead type.
      7. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

H. Wire Rope Hanging Systems:

    1. Manufacturers:
      - a. Gripple.
    2. General: Wire rope hanger system shall have a minimum 5 to 1 safety factor based upon the applied working load being supported.
    3. Source Limitations: Furnish associated fittings, accessories, and hardware produced by a single manufacturer.
    4. Wire Rope: Zinc coated, stainless steel or galvanized steel, with wire thread type as required to support the applied working load being supported. Provide same size wire for all applications based on worst case loading.
    5. Accessories: Hanger attachments and structural attachments shall be compatible with wire rope hanger system and shall be by the same manufacturer as the wire rope hanger system.

**2.2 FABRICATED METAL CONDUIT OR EQUIPMENT SUPPORT ASSEMBLIES**

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.
- C. Rooftop support assemblies: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane.
  - 1. Conduit supports: Unless noted otherwise, surface mounted fittings not requiring any attachment to the roof structure and not penetrating the roofing assembly with support fixtures.
  - 2. Equipment supports: Attachment fittings for connection to roof structure.
- D. Base Sizes: As required to prevent overturning and to distribute load sufficiently to prevent indentation of roofing assembly.
- E. Mounting Height: Provide minimum clearance of 6 inches under supported components to top of roofing.

**PART 3 - EXECUTION****3.1 APPLICATION**

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Unless specifically indicated or approved by the Contract Administrator and Structural Engineer, do not support from roof deck.
- C. Where support wires are permitted, identify independent electrical component support wires above accessible ceilings with color distinguishable from ceiling support wires in accordance with NFPA 70.
- D. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
  - 1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
  - 2. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
- E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway:
  - 1. Minimum rod size shall be 1/4 inch (6 mm) in diameter, unless otherwise indicated.
    - a. Equipment Supports: 1/2 inch diameter minimum.
    - b. Busway Supports: 1/2 inch diameter minimum.
    - c. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter minimum.
    - d. Trapeze Support for Multiple Conduits: 3/8 inch diameter minimum.
  - 2. Space supports for EMT, IMC, and RMC as required by NFPA 70.
- F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with:
    - a. two-bolt conduit clamps
- G. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

- H. The use of wire rope hanging systems is an acceptable alternate hanging method when installed in strict accordance with manufacturer's instructions. Supported load shall not exceed manufacturer's recommended load rating.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Install in accordance with manufacturer's instructions.
- E. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- F. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
  - 1. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 1.5. Include consideration for vibration, equipment operation, and shock loads where applicable.
- G. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
- H. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- I. Remove temporary supports when no longer required.
- J. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- K. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
    - a. Instead of expansion anchors, powder or battery-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
  - 5. To Steel:
    - a. Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts
    - b. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
    - c. Spring-tension clamps.
  - 6. To Light Steel: Sheet metal screws.
  - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

- L. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.
- D. Minimize overhanging materials and protrusions, and provide protective caps and fittings on exposed material ends where:
  - 1. Accessible to untrained personnel.
  - 2. Located within confined spaces.
- E. Rooftop support assemblies:
  - 1. Conduit supports: Unless noted otherwise, coordinate installation of support system after roofing materials are complete. Provide adhesive materials to secure conduit supports where required. Where attachment to roof structure is required or otherwise specified, coordinate installation of supports with roofing material installation.
  - 2. Equipment supports: Coordinate installation of supports with roofing material installation.

### 3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 "Concrete".
- C. Anchor equipment to concrete base.
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Comply with requirements in Division 09 "Finishes" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.
- D. Inspect support and attachment components for damage and defects. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

**SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL REQUIREMENTS****1.1 SECTION INCLUDES**

- A. This Section includes:
1. Raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

**1.2 DEFINITIONS**

- A. Terminology used in this specification is as defined below:
1. EMT: Electrical Metallic Tubing
  2. FMC: Flexible Metal Conduit
  3. GRS: Galvanized Rigid Steel Conduit
  4. IMC: Intermediate Metal Conduit
  5. LFMC: Liquidtight Flexible Metal Conduit
  6. LFNC: Liquidtight Flexible Nonmetallic Conduit
  7. RAC: Rigid Aluminum Conduit
  8. RMC: Rigid Metal Conduit
  9. RNC: Rigid Nonmetallic Conduit
  10. RTRC: Reinforced Thermosetting Resin Conduit

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
1. Coordinate the work with other trades to avoid placement of raceway, boxes, or other potential obstructions within the dedicated equipment spaces and working clearances for equipment installed by other trades in accordance with the codes and manufacturer requirements.
  2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
  4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
  5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
  6. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated. Coordinate the work with other trades to preserve insulation integrity.
  7. Coordinate routing of power, low-voltage, and control conduits requiring fire-resistive protective assembly or electrical circuit protective system. Fire-resistive protective assembly or electrical circuit protective system for power, low-voltage, and control circuit conductors and cables shall have a fire-resistance rating of not less than 2 hours and shall be provided where required by NFPA or local building codes. Types of systems requiring a fire-resistive protective assembly include, but are not limited to:
    - a. Feeders for Emergency Power systems where in areas not protected by an automatic fire suppression system.
    - b. Smokeproof Enclosure Pressurization systems
    - c. Smoke Control systems
    - d. Smoke Removal systems
    - e. Fire service and Occupant Evacuation Elevator systems

**1.4 SUBMITTALS**

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements".
- B. Product data for the following products:
  - 1. Floor boxes
  - 2. Poke-Through Outlets
- C. Shop drawings for:
  - 1. Detailing fabrication and installation for custom enclosures.
- D. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Structural members in path of conduit groups with supports.
  - 2. HVAC items, plumbing items and architectural features in the paths of conduit groups with common supports.
- E. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section "General Electrical Requirements":
  - 1. Accurately record actual routing of all exterior buried raceway and all interior raceways three inches and larger. Indicate dimensions from fixed structural elements.

**1.5 QUALITY ASSURANCE**

- A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.
- B. Electrical Components, Devices, and Accessories:
  - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.
  - 2. Marked for intended use.
- C. Comply with NFPA 70.

**PART 2 - PRODUCTS AND MATERIALS****2.1 CONDUITS SURFACE MOUNTED RACEWAYS AND ACCESSORIES**

- A. Metal Conduit and Tubing
  - 1. Manufacturers:
    - a. ABB, Inc.
    - b. Atkore
    - c. American Conduit
    - d. Anamet Electrical, Inc.
    - e. Electri-Flex Co.
    - f. Hubbell (Fittings).
    - g. Nucor Tubular Products.
    - h. O-Z/Gedney Co.; Emerson.
    - i. Southwire Company, LLC
    - j. Western Tube and Conduit Corporation.
    - k. Wheatland Tube Co.
  - 2. RMC:
    - a. GRS: Hot-dip galvanized: ANSI C80.1, UL 6.
      - 1) Plastic-Coated GRS and Fittings: NEMA RN 1, UL-listed. Coating thickness of 0.04 inches (1mm), minimum.
    - b. RAC: ANSI C80.5, UL6A.
  - 3. IMC: ANSI C80.6, UL 1242.



- a. Plastic-Coated IMC and Fittings: NEMA RN 1, UL-listed.
  4. EMT and Fittings: ANSI C80.3, UL 797. Only steel products allowed. Reduced wall EMT is not allowed.
    - a. Fittings: Set-screw or Compression type.
  5. FMC: Aluminum or Zinc-coated steel: UL 1. Reduced wall FMC is not allowed.
  6. LFMC: Flexible steel raceway with PVC jacket: UL 360.
    - a. Fittings: NEMA FB 1; compatible with raceway and tubing materials.
- B. Nonmetallic Raceway
  1. Manufacturers:
    - a. ABB, Inc.
    - b. American Pipe and Plastics, Inc.
    - c. Anamet Electrical, Inc.
    - d. Atkore
    - e. Cantex Inc.
    - f. Carlon
    - g. Champion Fiberglass, Inc.
    - h. Electri-Flex Co.
    - i. Hubbell Inc. (Fittings)
    - j. IPEX USA, LLC.
    - k. Prime Conduit.
    - l. Southwire Corporation.
    - m. Superflex Ltd.
    - n. United Fiberglass of America, Inc.
  2. RNC: Schedule 40 and 80 PVC: NEMA TC 2, UL 651.
    - a. Fittings: match to raceway and tubing type and material: NEMA TC 3, NEMA TC 6, UL 651, as applicable.
  3. LFNC: UL 1660.
    - a. Fittings: match to tubing type and material: NEMA TC 3, NEMA TC 6, UL 651, as applicable.
  4. RTRC (Fiberglass): UL 2420 UG, UL 2515 AG, NEMA TC 14; SW (Standard Wall), HW (Heavy Wall) or XW (Extra Heavy Wall)
  5. Phenolic Conduit (RTRC) for use in UL 2196 2-Hour Fire Resistive systems: UL 2515 AG, NEMA TC 14
    - a. Must be used as part of a UL-certified FHIT 2-hour listed fire resistive system.
- C. Metal Wireways
  1. Manufacturers:
    - a. BEL Products, Inc.
    - b. Cooper B-Line; Eaton.
    - c. EPI-Electrical Enclosures
    - d. Hoffman.
    - e. Square D.
  2. Material and Construction: 14 gauge (minimum) sheet steel, sized and shaped as indicated, NEMA 1, 3R, 12, or 4X.
  3. Fittings and Accessories: Include couplings, offsets, elbows, expansion/deflection joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70. Where indicated, provide a barrier to divide wireway into compartments.
  4. Wireway Covers:
    - a. Hinged type
    - b. Screw-cover type
    - c. Flanged-and-gasketed type
  5. Finish: Manufacturer's standard phosphate pre-treatment and baked enamel finish.
- D. Surface Metal Raceways

1. Manufacturers:
  - a. ABB, Inc.
  - b. Hubbell, Inc.
  - c. Legrand.
  - d. Mono-Systems; Niedax Group
  - e. Panduit Inc.
2. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
3. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

## 2.2 BOXES ENCLOSURES AND CABINETS

### A. General

1. Manufacturers:
  - a. ABB, Inc.
  - b. American Midwest Power
  - c. Appleton/O-Z Gedney Co.; Emerson.
  - d. BEL Products, Inc.
  - e. Cooper Crouse-Hinds; Eaton.
  - f. Erickson Electrical Equipment Co.
  - g. FSR, Inc.
  - h. Hoffman.
  - i. Hubbell, Inc.
  - j. Legrand.
  - k. Molex; Koch Industries.
  - l. Robroy Industries, Inc.; Enclosure Division.
  - m. Spring City Electrical Manufacturing Co.
2. Provide products listed, classified, and labeled as suitable for the purpose intended. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
3. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

### B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
2. Cast Metal Boxes: Comply with NEMA FB 1, Type FD, with gasketed cover. Furnish with threaded hubs.
  - a. List and label as complying with UL 514A for non-hazardous locations;.
  - b. List and label as complying with UL 886 for hazardous locations, where required.
3. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
4. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
5. Boxes for Ganged Devices: Use multi-gang boxes of single-piece construction. Do not use field-connected gangable boxes.
6. Minimum Box Size, Unless Otherwise Indicated:
  - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.

- b. Communications Systems Outlets: Comply with Section 27 10 05.
  - c. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
  - d. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
7. Do not use "through-wall" boxes designed for access from both sides of wall.
8. Wall Plates: Comply with Division 26 Section "Wiring Devices".
- C. Boxes for telephone, data, telecommunications and audio-video outlets, refer to:
- 1. Division 27 Section "Common Work Results for Communications"
- D. Junction and Pull Boxes Larger Than 100 cubic inches:
- 1. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1, and list and label as complying with UL 514A.
  - 2. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast iron or aluminum with gasketed cover.
  - 3. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
  - 4. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
- E. Floor Boxes
- 1. General:
    - a. Floor Box Schedule on drawings: Refer to Drawings for specific floor box requirements.
    - b. Provide a complete Floor Box Assembly.
    - c. UL514A listed for scrub water exclusion for all floor types.
    - d. Floor boxes for on or below grade installation shall be watertight, fully adjustable cast iron or epoxy coated steel.
    - e. Floor boxes for above grade shall be concrete-tight, fully adjustable, stamped galvanized steel box.
    - f. Provide shallow boxes where necessitated by slab depth. Conduits shown on plans are minimum size, select appropriate floor box based on slab type, thickness, and minimum conduit size.
    - g. Non-metallic PVC construction, watertight floor boxes may be used where specifically listed in schedule or specified on drawings.
    - h. Receptacles:
      - 1) Provide receptacles complying with requirement of Division 26 "Wiring Devices"
      - 2) Duplex: Include a minimum of one convenience receptacle, or quantity as indicated on schedule, with features as noted on schedule.
      - 3) GFCI: Include quantity of GFCI Receptacles as indicated on schedule, with features as noted on schedule.
      - 4) Special: Include quantity of Special/Miscellaneous Devices as indicated on schedule, with features as noted on schedule.
    - i. Communications:
      - 1) Provide dedicated mounting space (gang) for each communication device type indicated on schedule. Include provisions for mounting devices in accordance with the requirements of the communication systems provider.
      - 2) The following items are not provided per this specification section:
        - a) Telecommunications outlet termination plate and termination connectors shall be provided per Division 27 Section "Communications Horizontal Cabling". Coordinate all other Assembly components to ensure compatibility.
        - b) Audio Video custom termination plates and connectors shall be provided per Division 27 Section "Audio Video Systems" and/or "Audio Video Systems Equipment". Coordinate all other assembly components to ensure compatibility.

## F. Poke-Through Outlets

1. General:
  - a. Poke-Through Schedule on drawings: Refer to Drawings for specific floor box requirements.
  - b. Provide a complete Poke through assembly.
  - c. UL listed for scrub water exclusion for all floor types.
  - d. UL listed and UL Fire Classified, with one- to four-hour fire rating, as required by floor rating and type.
  - e. Provide with cover plate, with individual device covers, and floor flange for specific floor material for all types. Provide color as directed by the Contract Administrator.
2. Receptacles:
  - a. Provide receptacles complying with requirement of Division 26 section "Wiring Devices"
  - b. Duplex: Include a minimum of one Convenience Receptacle, or quantity as indicated on schedule, with features as noted on schedule.
  - c. GFCI: Include quantity of GFCI Receptacles as indicated on schedule, with features as noted on schedule.
  - d. Isolated Ground: Include quantity of Isolated Ground Receptacle as indicated on schedule, with features as noted on schedule.
  - e. Special: Include quantity of Special/Miscellaneous Devices as indicated on schedule, with features as noted on schedule.
3. Communications:
  - a. Provide dedicated mounting space (gang) for each communication device type indicated on schedule. Include provisions for mounting devices in accordance with the requirements of the communication systems provider. Communication devices to be defined and provided under specification of other divisions.

## G. Cabinets and Enclosures:

1. General:
  - a. Compliance: NEMA 250, and list and label as complying with UL 50 and UL50E or 508A, as applicable.
  - b. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes: Shall be keyed. Provide 2 keys for each enclosure.
    - 1) All locks shall be keyed alike.
  - c. NEMA 250 Environment ratings:
    - 1) NEMA Type 1: Code-gauge phosphatized steel with continuously welded seams; non-gasketed removable hinged front cover, with flush latch and concealed hinge; collar studs.
    - 2) NEMA Type 3R: Code-gauge galvanized steel with drip shield top, seam-free front, side, and back; non-gasketed continuous-hinged door, with stainless steel pin; captive, plated steel cover screws; hasp and staple for padlocking; collar studs.
  - d. Removable painted steel interior panel mounted on standoffs; metal barriers to separate wiring of different systems and voltages.
  - e. Provide enclosures wider than 36 inches with double doors; removable center posts; internal bracing, supports, or both, as required to maintain their structural integrity; and, accessory feet where required for freestanding equipment.
  - f. Provide clamps, grids, slotted wireways, or similar devices to which or by which wiring may be secured. Provide DIN-rail mounted terminal strips for terminating all incoming and outgoing control wiring, and power terminal blocks for incoming/outgoing power wiring. Provide wire management troughs where practicable.
  - g. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power and higher-voltage control wiring.

**2.3 FACTORY FINISHES**

- A. Interior Finish: All interior components shall be factory finished; manufacturer's standard grey unless otherwise noted.
- B. Exterior Finish: For metal wireway and surface raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.
- C. Exterior Finish: For metal wireway and surface raceway, enclosure, or cabinet components, provide manufacturer's standard paint applied to factory-assembled metal wireway and surface raceways, enclosures, and cabinets before shipping.

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. General
  - 1. Install in accordance with manufacturer's instructions.

**3.2 RACEWAYS**

- A. General
  - 1. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on drawings or in this article are stricter.
  - 2. Provide sizes and types of raceways as indicated on the Drawings. Sizes are based on THWN insulated copper conductors, except where noted otherwise. Where sizes are not shown on the Drawings or in the Specifications, size raceways in accordance with NFPA 70 requirements for the number, size and type of conductors installed. Minimum raceway size: 1/2 inch (concealed and exposed); 1 inch (underground and under slab).
    - a. 1/2-inch conduit shall contain maximum (5) #12AWG conductors or (3) #10AWG conductors.
    - b. 3/8-inch flexible conduit may be used for light fixture whips.
  - 3. Provide all raceways, fittings, supports, and miscellaneous hardware required for a complete electrical system as described by the Drawings and Specifications.
  - 4. Install a green-insulated, equipment-grounding conductor, which is bonded to the electrical system ground, in all raceways, with the exception of Service Entrance raceways.
  - 5. Install grounding bushings or other code compliant connections on all conduit terminations and bond to the enclosure, which connects to the equipment grounding conductor and electrical system ground.
  - 6. Install raceways concealed in walls or above suspended ceilings in finished areas. When approved by the Contract Administrator, raceways may be installed concealed in elevated floor slabs. Do not install raceways horizontally within slabs on grade.
  - 7. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
  - 8. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
  - 9. Make bends and offsets so inside diameters are not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
  - 10. Install raceways:
    - a. To meet the requirements of the structure and the requirements of all other Work on the Project.
    - b. To clear all openings, depressions, ducts, pipes, reinforcing steel, and so on.
    - c. Within or passing through the concrete structure in such a manner so as not to adversely affect the integrity of the structure. Become familiar with the Architectural and the Structural Drawings and their requirements affecting the raceway installation. If necessary, consult with the Contract Administrator.

- d. Parallel or perpendicular to building lines or column lines.
  - e. Tight to structure.
  - f. When concealed, with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
11. Raceways Embedded in Slabs:
- a. Raceways may only be embedded in concrete slabs with written permission from, and only where directed, by the Structural Engineer.
  - b. Install in middle 1/3 of slab thickness, where practical. At a minimum, concrete shall provide at least 2 inches of concrete cover for raceways.
  - c. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
  - d. Space raceways laterally to prevent voids in concrete.
  - e. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
  - f. Change from RNC to coated GRS or IMC before rising above the floor.
12. Where masonry, brick, CMU or concrete walls are left unfinished, coordinate raceway installations with other trades so that the raceways and boxes are concealed and the wall will have a neat and smooth appearance.
13. Where masonry, brick, CMU or concrete walls in public spaces are left unfinished, coordinate raceway installations with other trades so that the raceways and boxes are concealed and the wall will have a neat and smooth appearance.
14. Support raceways from structural elements of the building as required by NFPA 70, Division 26 Section "Hangers and Supports for Electrical Systems". Do not support raceways by hangers used for any other systems foreign to the electrical systems; and, do not attach to other foreign systems. Do not lay raceways on top of the ceiling system.
- a. Raceways on roof shall be supported from structure not from the roof deck.
15. Provide support spacing in accordance with NFPA 70 requirements, and at a minimum in accordance with NEMA standards. Support by the following methods:
- a. Attach single raceway directly to structural steel with beam clamps.
  - b. Attach single raceway directly to concrete with one-hole clamps or clips and anchors. Outdoors and wherever subject to dampness or moisture, offset raceways from the surface by using galvanized clamps and clamp backs, to mitigate moisture entrapment between raceways and surfaces.
  - c. Attach groups of raceways to structural steel with slotted support system attached with beam clamps. Attach raceway to slotted channel with approved raceway clamps.
  - d. Attach groups of raceways to concrete with cast-in-place steel slotted channel fabricated specifically for concrete embedment. Attach raceway to steel slotted channel with approved raceway clamps.
  - e. Hang plumb horizontally suspended single raceway using a threaded rod. Attach threaded rods to concrete with anchors and to structural steel with beam clamps. Attach raceway to threaded rod with approved raceway clamps.
  - f. Hang horizontally suspended groups of raceways using steel slotted support system suspended from threaded rods. Attach threaded rods to concrete with anchors and to structural steel with beam clamps. Attach raceway to steel slotted channel with approved raceway clamps.
  - g. Support conductors in vertical raceway in accordance with NFPA 70 requirements.
  - h. Cross-brace suspended raceway to prevent lateral movement during seismic activity.
  - i. Use pre-fabricated non-metallic spacers for parallel runs of underground or under-slab conduits, either direct buried or encased in concrete.
16. Install electrically and physically continuous raceways between connections to outlets, boxes, panelboards, cabinets, and other electrical equipment with a minimum possible

- number of bends and not more than the equivalent of four 90-degree bends between boxes. Make bends smooth and even, without flattening raceway or flaking the finish.
17. Protect all electrical Work against damage during construction. Repair all Work damaged or moved out of line after rough-in, to meet the Contract Administrator's approval, without additional cost to the Owner. Cover or temporarily plug openings in boxes or raceways to keep raceways clean during construction. Clean all raceways prior to pulling conductors or cables.
  18. Align and install raceway terminations true and plumb.
  19. Complete raceway installation before starting conductor installation.
  20. Install a pull cord in each empty raceway that is left empty for installation of wires or cables by other trades or under separate contracts. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull cord.
  21. Install approved expansion/deflection fittings where raceways pass through or over building expansion joints; or where structures providing a means of support are subject to relative movement greater than acceptable by the raceway manufacturer.
  22. Route raceway through roof openings for piping and ductwork or through roof seals approved by the Contract Administrator, the roofing contractor, or both. Obtain approval for all roof penetrations and seal types from the Contract Administrator, Owner, roofing contractor, or all three as required to maintain new or existing roofing warranties.
  23. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
    - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces or from building exterior to building interior.
    - b. Where otherwise required by NFPA 70.
  24. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment as required by other requirements of the construction documents.; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
  25. Maintain 2" minimum spacing from bottom of roof deck to prevent raceway penetrations from above.
  26. Do not route conduits across skylights, access panels, hatched tiles, HVAC diffusers, or equipment working space.
  27. Route conduits serving rooftop equipment concealed inside the equipment curb and minimize roof penetrations and exterior conduit runs where practicable.
  28. Install all underground conduits/raceways a minimum of 24" below the bottom of slab/paving/grade, unless noted otherwise, where practicable.
  29. Provide boxes and raceways for the fire protection system low voltage wiring as required. This includes low voltage wiring exposed less than 96" AFF.
    - a. At a minimum, provide 3/4" conduit.
    - b. Coordinate requirements and locations with system installer and fire alarm specifications.

B. RMC

1. Use GRS or IMC in the following areas:
  - a. Where indicated.
  - b. For Emergency Feeders.
  - c. Exterior applications where above grade and exposed.
  - d. Below grade when concrete-encased, plastic-coated, or provided with a corrosion resistant approved mastic coating.

- e. All raceways penetrating slabs on grade (use plastic-coated raceway or provide with a corrosion resistant approved mastic coating). This shall include the 90-degree elbow below grade and the entire vertical transition to above grade.
  - f. Conductors over 600 volts.
  - g. Concealed within masonry walls.
  - h. Damp or wet locations.
  - i. Elevator pits.
  - j. Crawl spaces
  - k. Interior spaces where exposed to damage. Includes but is not limited to the following areas.
    - 1) Loading dock
    - 2) Corridors used for traffic of mechanized carts, forklifts and pallet handling units.
- 2. Use RAC in the following areas:
    - a. Indoors above grade.
    - b. Interior wet or damp locations.
    - c. For circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
  - 3. Do not use RAC:
    - a. Below grade.
    - b. Imbedded in concrete or other areas corrosive to RAC.
- C. EMT
- 1. Use EMT in the following areas:
    - a. Where indicated.
    - b. Interior concealed locations for:
      - 1) Branch circuits.
      - 2) Feeders.
      - 3) Emergency branch circuits.
      - 4) Low-voltage control, security, and fire alarm circuits
    - c. Exposed where not subject to physical damage
      - 1) Mechanical rooms
  - 2. Do not use EMT:
    - a. Below grade.
    - b. In exterior applications when exposed.
- D. FMC and LFMC
- 1. Use FMC or LFMC:
    - a. For the final 24 inches of raceway to all motors, transformers, and other equipment subject to vibration or movement.
    - b. From outlet boxes (attached to building structure) to recessed light fixtures. Install sufficient length to allow for relocating each light fixture within a 5-foot radius of its installed location.
    - c. Use FMC only in dry locations
    - d. Use LFMC in damp, wet, corrosive, outdoor locations, and food service and kitchen areas.
  - 2. Do not use FMC or LFMC:
    - a. For branch circuits, homeruns or feeders.
    - b. In lengths exceeding 6 feet.
- E. RNC
- 1. Solvent-weld RNC fittings and raceway couplings per the manufacturer's instructions and make all connections watertight. Use solvent of the same manufacturer as the raceway.
  - 2. Where installed exposed outdoors or other areas subject to temperature variations, install expansion fittings per NFPA 70, to accommodate thermal expansion in straight runs.
  - 3. RNC is only allowed to be used in the following locations:
    - a. Where specifically indicated.



- 1) If an adopted code prevents use of RNC in a location where the contract documents specifically allow its use, contractor shall utilize other types of conduit allowed by the specification.
  - 2) Allowed does not mean required.
  - b. Underground, single and grouped, in lieu of GRS or IMC, when indicated.
    - 1) Direct buried
    - 2) Concrete-encased (use approved rigid PVC interlocking spacers, selected to provide minimum duct spacing and cover depths indicated while supporting ducts during concreting and backfilling; produced by the same manufacturer as the ducts).
  4. Phenolic Conduit (RTRC) listed for use in UL 2196 2-Hour Fire Resistive systems may be used as part of a FHIT 2-hour listed fire resistive system where a 2-hour listing is required.
- F. Telephone and Signal/Data System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

### 3.3 RACEWAY FITTINGS

- A. Compatible with raceways and suitable for use and location.
- B. RMC and IMC: Use threaded rigid steel conduit fittings, unless otherwise indicated.
- C. PVC Externally Coated, Rigid Steel Conduits: Use only fittings and installation tools approved by the manufacturer for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits. Replace all fittings and conduits that have any portion of the coating scraped off to bare metal, at no additional cost to the Owner.
- D. Join raceways with fittings designed and approved for that purpose and make joints tight.
- E. Use insulating bushings to protect conductors at raceway terminations:
  1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
  2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

### 3.4 WIREWAYS

- A. Use flat head screws, clips and straps to fasten wireways to surfaces. Mount plumb and level.
- B. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- C. Close ends of wireway and unused raceway openings.

### 3.5 BOXES

- A. General
  1. Verify locations of device boxes prior to rough in.
  2. Set boxes at elevations to accommodate mounting heights as specified or indicated on the Drawings.
  3. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box locations to accommodate intended purpose.
  4. Install boxes to preserve fire ratings of walls, floors, and ceilings.
  5. Install flush wall-mounted boxes without damaging wall insulation or reducing its effectiveness.
  6. Support boxes independently of raceway.

7. Clean the interior of boxes to remove dust, debris, and other material. Clean exposed surfaces and restore finish.
  8. Adjust flush-mounted boxes to make front edges flush with finished wall material.
  9. Provide boxes of the depth required for the service, device and the application, and with raised covers set flush with the finished wall surface for boxes concealed in plaster finishes. Select covers with the proper openings for the devices being installed in the boxes. Install boxes flush unless otherwise indicated.
  10. Install outlet boxes in firewalls complying with UL requirements, with box surface area not exceeding 16 square inches; and, when installed on opposite sides of the wall, separate by a distance of at least 24 inches.
- B. NEMA Enclosure ratings, Suitable for the environment in which it is installed. At a minimum, provide the following ratings:
1. NEMA 250, type 3R
    - a. Provide at exterior locations
  2. NEMA 250, type 1
    - a. Provide at interior and dry locations
  3. NEMA 250 type 4 stainless steel
    - a. Provide at interior damp or wet locations
    - b. Provide at interior locations where associated device is labeled as Weather Proof and/or Weather Resistant, unless requirement below already requires box to be rated otherwise.
  4. NEMA 250 type 4X
    - a. Provide at interior locations subject to corrosion
- C. Outlet Boxes
1. Locations of outlets on Drawings are approximate; and, except where dimensions are shown, determine exact dimensions for locations of outlets from plans, details, sections, or elevations on Drawings, or as directed by Contract Administrator. Locate outlets generally from column centers and finish wall lines or to centers or joints of wall or ceiling panels.
  2. Locate outlet boxes so they are not placed back-to-back in the same wall, and in metal stud walls, so they are separated by at least one stud space, to limit sound transmission from room to room. Install outlet boxes in accessible locations and do not install outlets above ducts or behind furring.
  3. Install all electrical devices, such as plug receptacles, lamp receptacles, light switches, and light fixtures in or on outlet boxes Use sheet-steel boxes for dry locations unless otherwise indicated or required.
  4. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
  5. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
  6. Use cast aluminum boxes where aluminum rigid metal conduit is used.
  7. Use nonmetallic boxes where exposed rigid PVC conduit is used.
  8. Use suitable concrete type boxes where flush-mounted in concrete.
  9. Use suitable masonry type boxes where flush-mounted in masonry walls.
  10. Use raised covers suitable for the type of wall construction and device configuration where required.
  11. Use shallow boxes where required by the type of wall construction.
  12. Install extension and plaster rings as required by NFPA 70.
  13. Carefully set outlet boxes concealed in non-plastered block walls so as to line up with wall joints. Coordinate the box and raceway installation with the wall construction as required for a flush and neat appearing installation. Outlet box extensions may be used where necessary.
  14. Do not exceed allowable fill per NFPA 70.
  15. Where multiple devices are shown grouped together, gang mount with a common cover plate.

- D. Junction and Pull Boxes
  - 1. Install junction and pull boxes above accessible ceilings and in unfinished areas.
  - 2. Provide boxes set flush in painted walls or ceilings with primer coated cover.
  - 3. Where junction and pull boxes are installed above an inaccessible ceiling, locate so as to be easily accessible from a ceiling access panel.
  - 4. Boxes for exterior use shall be:
    - a. PVC with a UV-stabilized PVC cover sealed and gasketed watertight.
    - b. Cast aluminum with a cast aluminum cover sealed and gasketed watertight.
    - c. Cast iron with cast iron cover sealed and gasketed watertight in vehicular traffic areas. Provide box and cover UL listed for use in vehicular traffic areas.
    - d. Install buried boxes so that box covers are flush with grade, unless indicated otherwise.
- E. Floor Boxes
  - 1. Use cast or non-metallic floor boxes for installations in slab on grade. Unless otherwise indicated, formed steel boxes are acceptable for slabs above grade.
  - 2. Set metal floor boxes level and flush with finished floor surface.
  - 3. Set non-metallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.6 CABINETS AND ENCLOSURES

- A. Unless otherwise indicated on the Drawings, provide
  - 1. NEMA 1 construction for indoor, dry locations
  - 2. NEMA 12 for indoor, damp and dusty locations
  - 3. NEMA 3R for outdoor locations
  - 4. NEMA 4X for indoor wet and corrosive locations
- B. Install flush mounted in the wall in finished spaces, with the top 78 inches above finished floor. The front shall be approximately 3/4-inch larger than the box all around.
- C. Install surface mounted in unfinished spaces, with the top 78 inches above finished floor. The front shall be the same height and width as the box.
- D. Electrically ground all metallic cabinets and enclosures. Where wiring to cabinet or enclosure includes a grounding conductor, provide a grounding lug in the interior of the cabinet or enclosure. Cabinets and enclosures specified in this Section are intended to house miscellaneous electrical components assembled in a custom arrangement, such as contactors and relays.
- E. All components that are specified or indicated for assembly in cabinets and enclosures shall each be individually UL listed and labeled. Arrange wiring so that it can be readily identified. Support wiring no less than every 3 inches. Install gauges, meters, pilot lights and controls on the face of the door.
- F. Do not provide cabinets and enclosures smaller than the sizes indicated. Where sizes and types are not indicated, provide cabinets and enclosures of the size, type and classes appropriate for the use and location per the guidelines of the NEC. Provide all items complete with covers and accessories required for the intended use.

### 3.7 IDENTIFICATION

- A. Refer to Division 26 Section "Identification for Electrical Systems" for identification materials.
- B. Raceway Identification:
  - 1. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size. Use the following means of identification:
    - a. Spray paint at boxes.
    - b. Self-Adhesive Vinyl Labels
    - c. Snap-Around Labels

- d. Snap-Around, Color-Coding Bands
- e. Self-Adhesive Vinyl Tape
2. Color for Printed Legend:
  - a. Power Circuits: Black letters on an orange field.
  - b. Legend: Indicate system or service and voltage, if applicable
- C. Raceways and Duct Banks More Than 600 V Concealed within Buildings: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high black letters on 20-inch (500-mm) centers. Stop stripes at legends. Apply to the following finished surfaces:
  1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
  2. Wall surfaces directly external to raceways concealed within wall.
  3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- D. Accessible Raceways and Metal-Clad Cables More Than 600 V: Identify with "DANGER-HIGH VOLTAGE" in black letters at least 2 inches (50 mm) high. Repeat legend at 10-foot (3-m) maximum intervals.
- E. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identification device shall be:
  1. Self-adhesive vinyl label
  2. Snap around label
  3. Self-adhesive vinyl tape applied in bands.
- F. Accessible Raceways of Auxiliary Systems: Identify the following systems using the same identification device as other accessible raceways 600V or less, and with the indicated color scheme for each system:
  1. Fire Alarm System: Red.
  2. Fire-Suppression Supervisory and Control System: Red and yellow.
  3. Combined Fire Alarm and Security System: Red and blue.
  4. Security System: Blue and yellow.
  5. Mechanical and Electrical Supervisory System: Green and blue.
  6. Telecommunication System: Green and yellow.
  7. Control Wiring: Green and red.
- G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
- H. Junction Boxes and Pull Boxes:
  1. Junction box and pull box covers shall be spray painted to identify the voltage and system. Circuit numbers and the panel they originate from shall be listed on the cover using permanent, waterproof, black ink marker.
  2. The junction box where a homerun ends and the circuit is distributed shall be marked. Junction boxes shall be marked approximately every 100 feet along homerun path to panel.

END OF SECTION

**SECTION 26 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL REQUIREMENTS****1.1 SECTION INCLUDES**

- A. Raceways, fittings, boxes for underground electrical site distribution
- B. Hand holes and pull boxes
- C. Manholes
- D. Components for direct buried electrical distribution
- E. Components for concrete-encased electrical distribution

**1.2 DEFINITIONS**

- A. Terminology used in this specification is as defined below:
  - 1. GRS: Galvanized Rigid Steel Conduit
  - 2. RMC: Rigid Metal Conduit
  - 3. RNC: Rigid Nonmetallic Conduit
  - 4. RTRC: Reinforced Thermosetting Resin Conduit

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
  - 2. Coordinate elevations of ducts and duct-bank entrances into manhole, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by the Contract Administrator.

**1.4 SUBMITTALS**

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements":
  - 1. Product data for the following products:
    - a. Raceways, Raceway fittings, separators, duct-bank materials, manholes, handholes, boxes, solvent cement, warning tape and warning planks.
  - 2. Shop drawings for:
    - a. Detailing fabrication and installation for custom manholes or handholes including duct entry provisions, reinforcing details, frame and cover design, manhole frame support rings, ladder details, grounding details, sump details, joint details, and cable racks, pulling irons, lifting irons.
- B. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section "General Electrical Requirements":
  - 1. Accurately record actual routing of all exterior buried raceway including coordination with other surrounding utilities and underground structures. Provide scaled plans and sections that Indicate dimensions from finished grade or other fixed structural elements.

**1.5 QUALITY ASSURANCE**

- A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.
- B. Electrical Components, Devices, and Accessories:
  - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.
  - 2. Marked for intended use.
- C. Comply with NFPA 70 and ANSI C2.
- D. Test and inspect pre-cast concrete utility structures according to ASTM C 1037.
- E. Non-concrete Handhold and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
  - 1. Tests of materials shall be performed by a independent testing agency.
  - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

**1.6 DELIVERY STORAGE AND HANDLING**

- A. Deliver ducts to project site with ends capped and store nonmetallic ducts with supports to prevent bending, warping, and deformation.
- B. Store pre-cast and other factory –fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings, if present, are visible.
- C. Lift and support pre-cast concrete units only at designated lifting or supporting points.

**PART 2 - PRODUCTS AND MATERIALS****2.1 RACEWAYS AND FITTINGS**

- A. Metal Conduit
  - 1. Manufacturers:
    - a. ABB, Inc.
    - b. Atkore
    - c. Nucor Tubular Products.
    - d. O-Z/Gedney Co.; Emerson.
    - e. Western Tube and Conduit Corporation.
    - f. Wheatland Tube Co.
  - 2. RMC:
    - a. GRS: Hot-dip galvanized: ANSI C80.1, UL 6
  - 3. Plastic-Coated GRS and Fittings: NEMA RN 1, UL-listed. Coating thickness of 0.40 inches (1 mm), minimum.
  - 4. Fittings: NEMA FB 1; compatible with raceway and tubing materials.
- B. Nonmetallic Raceway
  - 1. Manufacturers:
    - a. ABB, Inc.
    - b. American Pipe and Plastics, Inc.
    - c. Anamet Electrical, Inc.;
    - d. Atkore

- e. Cantex Inc.
  - f. Carlon
  - g. Champion Fiberglass, Inc.
  - h. IPEX USA, LLC.
  - i. Prime Conduit.
  - j. Southwire Corporation.
  - k. Superflex Ltd.
  - l. United Fiberglass of America, Inc.
  - 2. RNC: Schedule 40 and 80 PVC: NEMA TC 2, UL 651.
    - a. a. Fittings: match to raceway type and material: NEMA TC 3, NEMA TC 6, UL 651, as applicable.
  - 3. RTRC: UL 2420 UG NEMA TC 14 SW (Standard Wall), HW (Heavy Wall) or XW (Extra Heavy Wall)
- C. DUCT ACCESSORIES
- 1. Duct Separators shall be factory-fabricated rigid interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
  - 2. Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."
  - 3. Concrete warning planks shall be nominal 12 by 24 by 3 inches in size, manufactured from 6000-psi concrete.
    - a. Color: Red dye added to concrete during batching.
    - b. Labeling: Mark each plank with "ELECTRICAL" in 2-inch high, 3/8-inch deep letters.

## 2.2 PRE-CAST CONCRETE HANDHOLES AND BOXES

- A. General
- 1. Manufacturers:
    - a. Carder Concrete Products.
    - b. Christy Concrete Products
    - c. Elmhurst-Chicago Stone Co.
    - d. Oldcastle Pre-cast Group
    - e. Riverton Concrete Products; a division of Cretex Companies, Inc.
    - f. Utility Concrete Products, LLC
    - g. Utility Vault Co.
    - h. Wausau Title, Inc.
- B. Comply with ASTM C858 for design and manufacturing process.
- C. Pre-cast concrete handholes and boxes shall be factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of the handhole or box.
- 1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
  - 2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
  - 3. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
    - a. Cover Hinges: Concealed, with hold-open ratchet assembly.
    - b. Cover Handle: Recessed.
  - 4. Frame and Cover: Weatherproof aluminum frame, with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.
    - a. Cover Hinges: Concealed, with hold-open ratchet assembly.

- b. Cover Handle: Recessed.
5. The cover finish shall be a nonskid finish with a minimum coefficient of friction of 0.50.
6. The cover shall have the following legend lettering molded into the cover:
  - a. "ELECTRICAL"
7. Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
8. Extensions and slabs shall be designed to mate with bottom of enclosure and shall be same material as enclosure.
  - a. Extension shall provide increased depth of 12 inches.
  - b. Slab shall be same dimensions as bottom of enclosure, and arranged to provide closure.
9. Windows shall be included as pre-cast openings in walls arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
  - a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
  - b. Window openings shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie into concrete envelopes of duct banks.
  - c. Window openings shall be framed with at least two additional No.4 steel reinforcing bars in concrete around each opening.
10. Duct entrances into handhole walls shall have cast end-bell or duct-terminating fittings in the wall for each entering duct.
  - a. Type and size shall match fittings to duct or conduit to be terminated.
  - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
11. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

### **2.3 HANDHOLES AND BOXES OTHER THAN PRE-CAST CONCRETE**

#### **A. General**

1. Description: Comply with SCTE 77.
2. Color of Frame and Cover: Gray where installed in concrete or other paved area; Green where installed in grass area.
3. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
4. Load Ratings:
  - a. Boxes and covers installed in sidewalks and other areas not subject to normal vehicular traffic shall be rated for a design load of 8,000 lbs. minimum.
  - b. Boxes and covers installed in driveways, parking lots, and other off-roadway applications shall be rated for a design load of 15,000 lbs. minimum.
  - c. Boxes and covers installed in roadways and other high vehicular traffic areas shall be rated for a design load of 28,800 lbs.
5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, applicable logo from the following:
  - a. "ELECTRIC"
8. Duct Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pull-in irons.



- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armorcast Products Company.
    - b. Carson Industries LLC.
    - c. CDR Systems Corporation.
    - d. NewBasis.
    - e. Strongwell
- C. Fiberglass Handholes and Boxes with Polymer-Concrete frame and cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armorcast Products Company.
    - b. Carson Industries LLC.
    - c. Christy Concrete Products.
    - d. Synchron Tech Moulded Products, Inc.; a division of Oldcastle Precast.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION GENERAL**

- A. Install in accordance with manufacturer's instructions.

#### **3.2 UNDERGROUND ENCLOSURE INSTALLATION**

- A. Handholes and Boxes for 600 volts and Less, Including Telephone, Communications, and Data Wiring:
  - 1. Units in roadways and Other Deliberate Traffic Paths: Pre-cast concrete. AASHTO HB 17, H-20 structural load rating.
  - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Non-deliberate Loading by Heavy Vehicles: Pre-cast Concrete, AASHTO HB 17, H-20 structural load rating.
  - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Non-deliberate loading by Vehicles: Polymer Concrete Units, SCTE 77, Tier 8 structural load rating.

#### **3.3 UNDERGROUND DUCT APPLICATION**

- A. Ducts for Electrical Cables over 600 V: RNC, NEMA Type EPC-40 or RTRC SW or HW PVC, in concrete-encased duct bank, unless otherwise indicated.
- B. Ducts for Electrical Feeders 600volts and Less: RNC, NEMA Type EPC-40 or RTRC SW or HW PVC, in concrete-encased duct bank, unless otherwise indicated.
- C. Ducts for Electrical Feeders 600 volts and Less: RNC, NEMA Type EPC-80 or RTRC HW or XW PVC, in direct- buried duct bank, unless otherwise indicated.
- D. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-80 or RTRC HW or XW PVC, indirect-buried duct bank, unless otherwise indicated.
- E. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40 PVC or RTRC, in concrete-encased or direct-buried duct bank, unless otherwise indicated.

- F. Underground Ducts Crossing Paved Paths, Walks and Roadways: RNC, NEMA Type EPC-40 PVC or RTRC, encased in reinforced concrete.

### 3.4 EARTHWORK

- A. Excavation and Backfilling: Comply with Division 31 Section "Earth Moving" but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling and compaction is complete.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses and "Plants"
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

### 3.5 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48-inches, both horizontally and vertically, at other locations, unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.
- D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10-inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
  - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell with out reducing duct line slope and without forming a trap in the line.
  - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
  - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."
- F. Sealing: Provide temporary closure at termination of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf test nylon cord in ducts, including spares.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
  - 1. Separator installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and ducts to prevent floating during concreting. Stagger separators approximately 6-inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or

- reinforcing steel that may form conductive or magnetic loops around the ducts or duct group.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
    - a. Start at one end finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to the manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
    - b. If more than one pour is necessary, terminate each pour in a vertical plane and install □-inch reinforcing rod dowels 18-inches into concrete on both sides of joint near corners of envelope.
  3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct bank application.
  4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
  5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured with out soil inclusions; otherwise, use forms.
  6. Minimum Space between Ducts: 3-inches between ducts and exterior envelope wall, 2-inches between ducts for like services, and 4-inches between power and signal ducts.
  7. Depth: Install top of duct bank at least 24-inches below finished grade in areas not subject to deliberate traffic, and at least 30-inches below finished grade in deliberate traffic paths of vehicles, unless otherwise indicated.
  8. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3-inches of concrete.
    - b. Stub-ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60-inches from edge of base. Install insulated grounding bushings on terminations at equipment.
  9. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3-inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18-inches. Space additional tapes 12-inches apart, horizontally.
- I. Direct-Buried Duct Banks:
1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
  2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6-inches between tiers.
  3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6-inches in nominal diameter.
  4. Install backfill as specified in Division 31 Section "Earth Moving."
  5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4-inches over ducts and hand tamp. Firmly

tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

6. Install ducts with a minimum of 3-inches between ducts for like services and 6-inches between power and signal ducts.
7. Depth: Install top of duct bank at least 36-inches below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3-inches of concrete.
  - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60-inches from edge of base. Install insulated grounding bushings on terminations at equipment.
10. Warning Planks: Bury warning planks approximately 12 inches above all direct-buried ducts in a duct bank placing them 24-inches on centers. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18-inches. Space additional planks 12-inches apart, horizontally.

### **3.6 INSTALLATION OF CONCRETE MANHOLES HANDHOLES AND BOXES**

- A. Precast Concrete Handhole and Manhole Installation:
  1. Comply with ASTM C891, unless otherwise indicated.
  2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
  3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- B. Elevations:
  1. Manhole Roof: Install with rooftop at least 15-inches below finished grade.
  2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1-inch above finished grade.
  3. Install handholes with bottom below the frost line.
  4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1-inch above grade.
  5. Where indicated, cast handhole cover frame integrally with handhole structure.
- C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
- D. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Division 07 Section "Elastomeric Sheet Waterproofing." After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
- E. Hardware: Install removable hardware, including pulling eye, cable stanchions, cable arms, and insulators, as required for installation and support of cable and conductors and as indicated.
- F. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

- G. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8-inches for manholes and 2-inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.
- H. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

### **3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRE-CAST CONCRETE**

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install handholes and boxes with bottom below the frost line.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box frame. Bottom of ring shall rest on compacted earth.
  - 1. Concrete: 3000psi, 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
  - 2. Dimensions: 10-inch wide by 12-inches deep

### **3.8 GROUNDING**

- A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

### **3.9 INSTALLATION ACCEPTANCE**

- A. Prior to final acceptance of the duct bank and associated structures, pull an aluminum or wood test mandrel through the duct to prove joint integrity and to verify ducts have not been deformed. Provide mandrel equal to 80 percent fill of the duct. Test duct bank, manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems." Correct any deficiencies and retest as specified above. Clean internal surfaces of manholes (including sumps) and handholes and remove foreign materials.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. This Section includes the following:
  - 1. Nameplates.
  - 2. Labels for raceways and metal-clad cable.
  - 3. Labels for junction boxes and pull boxes.
  - 4. Labels for wiring devices and lighting control devices.
  - 5. Markers for conductors, and control cables.
  - 6. Tags.
  - 7. Underground-line warning tape.
  - 8. Warning labels and signs.
  - 9. Arc Flash Warning Labels.
  - 10. Instruction signs.
  - 11. Miscellaneous identification products.
  - 12. Painted Identification.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Where a facility identification standard already exists, that standard shall be continued. Where an identification standard does not exist, color-coding and identification shall be as described herein.
- B. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- C. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- D. Coordinate installation of identifying devices with location of access panels and doors.
- E. Install identifying devices before installing acoustical ceilings and similar concealment.

**1.3 QUALITY ASSURANCE**

- A. Electrical Equipment, Components, Devices, and Accessories:
  - 1. Listed and labeled as defined in NFPA 70, by an NRTL as defined by OSHA in 29 CFR 1910.7 and that are acceptable to authorities having jurisdiction.
  - 2. Marked for intended use.
- B. Comply with ANSI A13.1 and ANSI C2.
- C. Comply with requirements of NFPA 70.
- D. Comply with 29 CFR 1910.145.

**PART 2 - PRODUCTS AND MATERIALS****2.1 GENERAL**

- A. Location, text, and method of identification to be used is noted in individual sections. Refer to other sections for additional identification requirements.

**2.2 NAMEPLATES**

- A. Comply with UL RP 9691, Recommended Practice for Nameplates for Use in Electrical Installations.
- B. Engraved, Laminated Acrylic or Melamine Label: Non-conductive phenolic with beveled edges.
1. Adhesive backed.
  2. Minimum 1/16 inch (1.6 mm) thick for nameplates with both dimension 4 inches (102 mm) or less and 1/8 inch (3.2 mm) thick for larger sizes.
- C. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
- D. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
- E. Text: Minimum text height shall be 1/8 inch (3.2 mm) unless otherwise required by local jurisdiction or owner standards. For elevated components, increase sizes of labels and letters to those appropriate for viewing from the floor.
- F. Colors:
1. Normal systems - white letters on a black background.
  2. Emergency systems - white letters on a red background.
- G. Label Requirements:
1. Service Equipment Label  
 LINE 1: NOMINAL VOLTAGE AND FREQUENCY IN HERTZ  
 LINE 2: SERVICE EQUIPMENT BUS RATING IN AMPS  
 LINE 3: SCCR OF SERVICE EQUIPMENT IN AMPS  
 LINE 4: MAXIMUM AVAILABLE FAULT CURRENT IN AMPS  
 LINE 5: DATE CALCULATED

EXAMPLE:

208Y/120V, 60HZ 800A SCCR 65,000A MAX AVAILABLE FAULT CURRENT 58,815A CALCULATED: 01/01/2018
--

2. Panelboard/Switchboard Label:  
 LINE 1: PANELBOARD/SWITCHBOARD DESIGNATION  
 LINE 2: VOLTAGE, PHASE, WIRES, AMPS  
 LINE 3: FED FROM " "

EXAMPLES:

H1A 480Y/277V, 3PH, 4W, 200A FED FROM MDB
L1A 208Y/120V, 3PH, 4W, 225A FED FROM H1A VIA XFMR T1

3. Transformer Label:  
 LINE 1: TRANSFORMER DESIGNATION  
 LINE 2: FED FROM " "  
 LINE 3: SUPPLIES " "

EXAMPLE:

T1 FED FROM H1A SUPPLIES L1A
------------------------------------



4. Disconnect Switch Label:  
 LINE 1: DESIGNATION OF EQUIPMENT SERVED BY DISCONNECT  
 LINE 2: VOLTAGE, PHASE, WIRES, AMPS  
 LINE 3: FED FROM “ “

EXAMPLES:

WATER HEATER WH1 480V, 3PH, 3W, 100A FED FROM MDB
---

### 2.3 LABELS FOR RACEWAYS AND METAL-CLAD CABLE

- A. Factory Painted Raceways:
1. Metal Raceways: Continuous, rust-inhibiting paint factory applied.
  2. Non-Metallic Raceways: Factory dyed or colored PVC sleeve.
- B. Factory Painted Metal-Clad Cable: 2-inch wide, factory painted bands at a maximum of 6-foot on center spacing.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

### 2.4 LABELS FOR JUNCTION BOXES AND PULL BOXES

- A. Junction box and pull box covers shall be spray painted to identify the voltage and system. Circuit numbers and the panel they originate from shall be listed on the cover using permanent, waterproof, black ink marker.

### 2.5 LABELS FOR WIRING DEVICES AND LIGHTING CONTROL DEVICES

- A. Self-laminating Computer Printable Labels: Clear over-laminate to protect legend for permanent, clean identification. Self-laminating Polyester material with white print-on area.
- B. Engraved, Laminated Acrylic or Melamine Label: adhesive backed. Minimum letter height shall be 3/16 inch (4.76 mm).
1. Normal systems - white letters on a black background.
  2. Emergency systems - white letters on a red background
- C. Engraved cover plates: Provide with white letters. White or ivory cover plates shall have black letters.

### 2.6 MARKERS FOR CONDUCTOR AND CONTROL CABLES

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- C. Self-laminating Computer Printable Labels: Clear over-laminate to protect legend for permanent, clean identification. Self-laminating Polyester material with white print-on area.
- D. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- (0.35-mm-) thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.
- E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking nylon tie fastener.

## 2.7 TAGS

- A. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

## 2.8 UNDERGROUND-LINE WARNING TAPE

- A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Foil-backed Detectable Type Tape: 6 inches (152 mm) wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color: Tape for Buried Power Lines: Black text on red background.

## 2.9 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145. Attachment method shall be acceptable to the manufacturers of the equipment to which the nameplates are being applied and shall not compromise any NRTL listing or labeling criteria.
- B. Self-Adhesive Warning Labels: Factory pre-printed or machine-printed multicolor self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
  - 1. Use thermal transfer process printing machines and accessories recommended by label manufacturer.
  - 2. Do not use labels designed to be completed using handwritten text.
- C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
  - 1. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).
- D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
  - 1. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).
- E. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning (208 Volts): "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
3. Workspace Clearance Warning (480 Volts): "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 48 INCHES (915 MM)."

## 2.10 ARC FLASH WARNING LABELS

- A. General: All labels will be based on recommended overcurrent device settings and will be printed after the results of the analysis have been presented and after any system changes, upgrades, or modifications have been incorporated in the system. Refer to Division 26 section "Power System Studies" for additional requirements.
- B. Materials: Use machine-printed, high adhesion, polyester label; UV, chemical, water, heat, and abrasion resistant, for each work location analyzed.
- C. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer. Labels shall be machine printed, with no field markings. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
- D. Minimum Size: 3.5 inch by 5 inch (89 mm by 127 mm), unless otherwise noted by Owner.
- E. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment. The label shall include the following information, at a minimum:
  1. Location designation
  2. Nominal voltage
  3. Available fault current
  4. Limited approach boundary
  5. Arc flash boundary
  6. Restricted approach boundary
  7. Hazard risk category
  8. Incident energy
  9. Working distance
  10. Site-specific PPE (personnel protective equipment) requirements.
  11. Date calculations were performed.
  12. Engineering report number, revision number and issue date.

## 2.11 INSTRUCTION SIGNS

- A. Engraved, Laminated Acrylic or Melamine plastic: Non-conductive phenolic. Unless indicated otherwise, provide with minimum 3/8-inch- (10-mm-) high letters. For elevated components, increase sizes of labels and letters to those appropriate for viewing from the floor.
  1. Minimum 1/16 inch (1.6 mm) thick for nameplates with either dimension greater than 4 inches (102 mm) and 1/8 inch (3.2 mm) thick for larger sizes.
  2. Punched or drilled for mechanical fasteners.
  3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
  4. Normal systems: Engraved legend with white letters on black face.
  5. Essential Systems: Engraved legend with white letters on red face.
- B. Stainless Steel Nameplates: Minimum thickness of 1/32 inch ; engraved or laser-etched text.
- C. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text
- D. Colors:
  1. General Information and Operating Instructions – Black letters on white background.
  2. Normal systems - white letters on a black background.

3. Emergency systems - white letters on a red background.

## 2.12 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
  1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength: 50 lb (22.6 kg), minimum.
  3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  4. Color: Black, except where used for color-coding.
- B. Fasteners for Nameplates, Labels and Signs
  1. Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat lock washers unless otherwise noted.

## 2.13 PAINTED IDENTIFICATION

- A. Paint materials and application requirements are specified in Division 09 painting Sections.
  1. Exterior Concrete, Stucco, and Masonry (Other Than Concrete Unit Masonry):
    - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
      - 1) Primer: Exterior concrete and masonry primer.
      - 2) Finish Coats: Exterior semi-gloss acrylic enamel.
  2. Exterior Concrete Unit Masonry:
    - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
      - 1) Block Filler: Concrete unit masonry block filler.
      - 2) Finish Coats: Exterior semi-gloss acrylic enamel.
  3. Exterior Ferrous Metal:
    - a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
      - 1) Primer: Exterior ferrous-metal primer.
      - 2) Finish Coats: Exterior semi-gloss alkyd enamel.
  4. Exterior Zinc-Coated Metal (Except Raceways):
    - a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
      - 1) Primer: Exterior zinc-coated metal primer.
      - 2) Finish Coats: Exterior semi-gloss alkyd enamel.
  5. Interior Concrete and Masonry (Other Than Concrete Unit Masonry):
    - a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
      - 1) Primer: Interior concrete and masonry primer.
      - 2) Finish Coats: Interior semi-gloss alkyd enamel.
  6. Interior Concrete Unit Masonry:
    - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
      - 1) Block Filler: Concrete unit masonry block filler.
      - 2) Finish Coats: Interior semi-gloss acrylic enamel.
  7. Interior Gypsum Board:
    - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
      - 1) Primer: Interior gypsum board primer.
      - 2) Finish Coats: Interior semi-gloss acrylic enamel.
  8. Interior Ferrous Metal:
    - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
      - 1) Primer: Interior ferrous-metal primer.
      - 2) Finish Coats: Interior semi-gloss acrylic enamel.
  9. Interior Zinc-Coated Metal (Except Raceways):
    - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
      - 1) Primer: Interior zinc-coated metal primer.
      - 2) Finish Coats: Interior semi-gloss acrylic enamel.

**PART 3 - EXECUTION****3.1 PREPARATION**

- A. Verify identity of each item before installing identification products.
- B. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.
- C. Provide identification product listed for the location in which it is to be installed.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Painted Identification: Prepare surface and apply paint according to Division 09 painting sections.

**3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. For surfaces that require finish work, apply identification devices after completing finish work. Do not install identification products until final surface finishes and painting are complete.
- C. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed. Replace labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.
- D. Location: Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance without interference with operation and maintenance of equipment. Unless otherwise indicated, locate products as follows:
  - 1. Surface-Mounted Equipment: Enclosure front.
  - 2. Flush-Mounted Equipment: Inside of equipment door.
  - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
  - 4. Elevated Equipment: Legible from the floor or working platform.
  - 5. Branch Devices: Adjacent to device.
  - 6. Interior Components: Legible from the point of access.
  - 7. Conduits: Legible from the floor.
  - 8. Boxes: Outside face of cover.
  - 9. Conductors and Cables: Legible from the point of access.
  - 10. Devices: Outside face of cover.
- E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
  - 1. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
- G. Equipment Nameplates and Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual.
  - 1. Indoor Clean, Dry Locations: Use plastic nameplates, unless noted otherwise.
  - 2. Outdoor Locations: Use stainless steel nameplates suitable for exterior use.

- H. Install identification products centered, level, and parallel with lines of item being identified.
- I. Mark all handwritten text, where permitted, to be neat and legible.
- J. For refrigeration systems: Neatly bundle circuits and clearly tag and label each circuit with panelboard, branch circuit designation and refrigeration system number at each termination.

END OF SECTION

**SECTION 26 05 73 - POWER SYSTEM STUDIES****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. This Section includes computer-based studies for the following:
  - 1. Short-circuit analysis.
  - 2. Protective device coordination study.
  - 3. Arc flash and shock risk assessment, including arc flash hazard labels.
  - 4. Harmonic study.
- B. Criteria for selection and adjustment of equipment and associated protective devices not specified in this section, as determined by the studies performed.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. The AIC ratings indicated on the Drawings are preliminary and will be finalized based on the results of the short-circuit study. Device ratings for furnished equipment shall be as required by the results of the short-circuit study at no additional cost.
- B. Coordination:
  - 1. Existing Installations: Coordinate with equipment manufacturer(s) to obtain data necessary for completion of studies.
  - 2. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
  - 3. Notify Contract Administrator of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- C. Pre-Study Meeting: Conduct meeting with Owner to discuss system operating modes and conditions to be considered in studies.
- D. Sequencing:
  - 1. Initial Study:
    - a. Study must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. Do not order equipment until matching study reports and product submittals have both been evaluated by the Contract Administrator.
    - b. If study has not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the Contractor at no additional cost to the project.
  - 2. Final Study:
    - a. Study must be completed and submitted for review prior to substantial completion. Do not print arc flash labels until final study has been evaluated by the Contract Administrator.
    - b. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels.
- E. Scheduling:
  - 1. Arrange access to existing facility for data collection with Owner.
  - 2. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner. Refer to Division 26 section "General Electrical Requirements" for additional requirements.

**1.3 SUBMITTALS**

- A. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
  - 1. Product data for computer software program to be used for studies.
  - 2. Include characteristic time-current trip curves for protective devices.
  - 3. Include impedance data for busway.
  - 4. Include impedance data for engine generators.
  - 5. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
  - 6. Include documentation of listed series ratings upon request.
  - 7. Identify modifications made in accordance with studies to meet the results of the study.
- B. Product Certificates: For coordination-study and short-circuit-study computer software programs, certifying compliance with IEEE 399.
- C. Qualification Data:
  - 1. Study Preparer Specialist qualifications.
  - 2. Field Testing Agency qualifications.
- D. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.
- E. Other Action Submittals:
  - 1. Initial Study report, stamped or sealed and signed by study preparer, including:
    - a. Cover page including date of study, study methodology, assumptions made and software products used.
    - b. Study input data, including completed computer program input data sheets.
    - c. Short-circuit study report.
    - d. Equipment evaluation report.
    - e. Coordination-study report.
    - f. Settings report.
    - g. Harmonic analysis report.
  - 2. Final Study report, stamped or sealed and signed by study preparer, including:
    - a. Cover page including date of study, study methodology, assumptions made, software products used, and summary of changes between initial and final studies.
    - b. Study input data, including completed computer program input data sheets.
    - c. Short circuit study report.
    - d. Equipment evaluation report.
    - e. Coordination-study report.
    - f. Settings report.
    - g. Harmonic analysis report.
    - h. Arc-Flash Hazard Analysis, including labels.
  - 3. Certification that field adjustable protective devices have been set in accordance with requirements of studies.
- F. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section "General Electrical Requirements":
  - 1. Accurately record on the One-Line Diagram actual ratings and settings for all overcurrent devices, both adjustable and non-adjustable, including all changes made during construction, due to the study, or both.
  - 2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.
  - 3. Include copies of previous studies and existing drawings that were obtained during the data collection phase of the study.



## 1.4 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Study Preparer Qualifications: An organization experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
  - 1. Professional engineer, licensed in the state in which the Project is located, shall be responsible for the study and with a minimum five years experience in the preparation of studies of similar type and complexity using the specified computer software. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 399 for general study procedures.
- D. Comply with IEEE 141, 242 and 551 for short-circuit currents and coordination time intervals.
- E. Comply with IEEE 1584 and NFPA 70E for arc-flash hazard calculations.
- F. Field Testing Agency Qualifications: Independent testing organization specializing in testing, analysis, and maintenance of electrical systems with minimum five years experience; NETA Accredited Company.
  - 1. Field Supervisor: Certified electrical testing technician; NETA ETT Level III.

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Computer Software Developers: Subject to compliance with requirements, use the latest commercially available computer software programs utilizing the specified methodologies developed by one of the following:
  - 1. CYME International, Inc.
  - 2. EDSA Micro Corporation.
  - 3. Electrical Systems Analysis, Inc.
  - 4. SKM Systems Analysis, Inc.
  - 5. Operation Technology, Inc.

### 2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of short-circuit-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399, Table 7-4.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices.
  - 1. Zero-Sequence current.
  - 2. Arcing faults.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

- B. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices not submitted for approval with coordination study may not be used in study.
- C. Short-circuit study and coordination study to be performed prior to the final submittals for any piece of electrical equipment which has an AIC rating or an over-current protective device so that correct equipment gets ordered for the project conditions.
- D. Arc Flash Study must be performed after conductors and equipment have been installed and after the project's utility company confirms the available fault current. A final short-circuit and coordination study with all device settings shall be submitted with the Arc Flash Study. The goal of the revised settings is to minimize the arc flash hazard while maintaining reasonable coordination and selectivity. For the components of emergency and legally required standby system components, full selectivity must be maintained.

### 3.2 SYSTEM COMPONENTS TO BE INCLUDED IN STUDIES

- A. Study shall begin with the utility and each alternate power source overcurrent device(s) serving the Project and end at the last branch circuit overcurrent protective device. This includes studies of the complete paths and operating modes on both sides of any transfer switch, contactor or circuit breaker.
- B. Operating modes shall include, where applicable:
  - 1. Utility as a source.
  - 2. Generator as a source.
  - 3. Utility and generator in parallel.
  - 4. Bus tie breaker open/close positions.
  - 5. Maintenance settings.
- C. Components include, but are not limited to:
  - 1. Switchgear
  - 2. Switchboards
  - 3. Distribution Panelboards
  - 4. Panelboards
  - 5. Motor Control Centers
  - 6. Chiller Controllers
  - 7. Air Handling Equipment
  - 8. Roof Top HVAC equipment
  - 9. Elevator controllers

### 3.3 POWER SYSTEM DATA FOR STUDIES

- A. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling. Gather and tabulate the following input data to support studies:
  - 1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  - 2. Impedance of utility service entrance.
  - 3. Electrical distribution system diagram showing the following:
    - a. Indicate load current that is the basis for sizing continuous ratings of circuits for cables and equipment.
    - b. Protective Devices: Include circuit-breaker and fuse-current ratings and types;
    - c. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.

- d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio. kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
  - e. Generators: Include manufacturer/model, kilovolt amperes, size, voltage, and source impedance.
  - f. Cables: Indicate conduit material, sizes of conductors, conductor insulation, and length.
  - g. Busways: Include bus material, ampacity and impedance.
  - h. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
  - i. Variable frequency drive rating, manufacturer, and model series.
4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram:
- a. Special load considerations, including starting inrush currents and frequent starting and stopping.
  - b. Magnetic inrush current overload capabilities of transformers.
  - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
  - d. Ratings, types, and settings of utility company's overcurrent protective devices.
  - e. Special overcurrent protective device settings or types stipulated by utility company.
  - f. Protective Devices:
    - 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
    - 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
  - g. Time-current-characteristic curves of devices indicated to be coordinated.
  - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
  - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
  - j. Panelboards, switchboards, motor-control center ampacity, and interrupting ratings in amperes rms symmetrical.
5. Existing Installations:
- a. Provide the services of field testing agency or equipment manufacturer's representative to perform field data collection.
  - b. Collect data on existing electrical distribution system necessary for completion of studies, including field verification of available existing data (e.g. construction documents, previous studies). Include actual settings for field-adjustable devices.

### 3.4 SHORT-CIRCUIT STUDY

- A. Source Impedance: Utility company's fault current contribution as provided by utility.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project and use approved computer software program to calculate values. Include studies of system-switching configurations and alternate operation modes that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Comply with IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.

- E. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with the following:
  - 1. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.50.
  - 2. Low-Voltage Fuses: IEEE C37.46.
  - 3. Circuit Breakers: IEEE C37.13.
- F. Study Report:
  - 1. Enter calculated X/R ratios and interrupting (5-cycle) fault currents on electrical distribution system diagram of the report.
  - 2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.
  - 3. List other output values from computer analysis, including momentary (1/2-cycle), interrupting (5-cycle), and 30-cycle fault current values for 3-phase, 2-phase, and phase-to-ground faults.
- G. Equipment Evaluation Report: Prepare a report on the adequacy of overcurrent protective devices and conductors by comparing short-circuit current ratings of these devices with calculated short-circuit current momentary and interrupting duties. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.

### 3.5 COORDINATION STUDY

- A. Perform coordination study and prepare a written report using the results of the short-circuit study and approved computer software program. Comply with IEEE 399.
- B. Comply with NFPA 70 for overcurrent protection of circuit elements and devices.
- C. Comply with IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.
- D. Analyze alternate scenarios considering known operating modes.
- E. Transformer Primary Overcurrent Protective Devices:
  - 1. Device shall not operate in response to the following:
    - a. Inrush current when first energized.
    - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
    - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
  - 2. Device shall protect transformer according to IEEE C57.12.00, for fault currents.
- F. Motors served by voltages more than 600 V shall be protected according to IEEE 620.
- G. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Verify adequacy of phase conductors at maximum three-phase bolted fault currents, equipment grounding conductors, and grounding electrode conductors at maximum ground-fault currents.
- H. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
  - 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
    - a. Device tag.
    - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
    - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
    - d. Fuse-current rating and type.
    - e. Ground-fault relay-pickup and time-delay settings.
  - 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve the level of selective coordination required in the contract documents or by the edition of the National Electrical Code (including any local jurisdiction amendments) the project must comply with. Graphically illustrate that adequate time separation exists

between series devices, including power utility company's upstream devices. Show the following specific information:

- a. For protective Devices:
    - 1) Device tags.
    - 2) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
    - 3) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
    - 4) Include ground fault pickup and delay.
    - 5) Include fuse ratings.
  - b. Voltage and current ratio for curves.
  - c. Three-phase and single-phase damage points for each transformer.
  - d. No damage, melting, and clearing curves for fuses.
  - e. Cable damage curves.
  - f. Generator full load current, overload curves, decrement curves and short-circuit withstand points.
  - g. Transformer inrush points.
  - h. Maximum fault current cutoff point.
  - i. Capacitor full load current and damage curves.
3. Include conclusions and recommendations.
  4. Completed data sheets for setting of overcurrent protective devices.
  5. For emergency, legally required standby and health care essential power systems, such systems must selectively coordinate to the values indicated below unless local amendments to the National Electrical Code require a different value.
    - a. Emergency (NEC article 700) 0.01 seconds
    - b. Legally Required Standby (NEC article 701) 0.01 seconds
    - c. Elevator Systems (NEC article 620) 0.01 seconds
    - d. Health Care Essential Electrical Systems (NEC article 517)
      - 1) Equipment Branch 0.10 seconds
      - 2) Critical Branch 0.01 seconds
      - 3) Life-Safety Branch 0.01 seconds

### 3.6 HARMONIC STUDY

- A. Perform harmonic study and prepare a written report using the results of the harmonic study and approved computer software program.
- B. Comply with IEEE Std. 519 at the Point of Common Coupling (PCC) for allowable individual (odd) harmonic distortion and Total Harmonic Current Distortion (THDi).
- C. Harmonic Study Report: Prepare a written report indicating the following results of the harmonic study:
  1. The following assumptions are to be made for the purposes of determining initial conditions and recommendations.
    - a. All motors, pumps, and mechanical equipment to be in a running, steady-state condition.
    - b. All panelboards to be operating at 25% of rated capacity at 80% power factor.
  2. Tabular form of modeled individual harmonics and THDi under base case (no active harmonic filter correction).
  3. Provide specific recommendations for improving the electrical distribution performance found in the study, to correct to IEEE Std. 519 minimum requirements, including but not limited to:
    - a. Active Harmonic Filter (AHF) location in electrical distribution system, amperage rating, and voltage rating.
    - b. Tabular form of modeled individual harmonics and THDi with recommended option(s).
    - c. Provide voltage and current waveform plots of each case at the PCC.

### 3.7 ARC-FLASH HAZARD ANALYSIS

- A. Determine arc-flash incident energy levels and flash protection boundary distances based on the results of the Short-Circuit and Coordination studies in accordance with IEEE 1584. Perform the analysis under worst-case arc-flash conditions for all modes of operation.
- B. In addition to the requirements outlined in IEEE 1584, the study shall include all equipment rated less than 240 Volts fed by transformers less than 125 kVA in the calculations.
  - 1. Where reasonable, study preparer may assume a maximum clearing time of two seconds in accordance with IEEE 1584, provided that the conditions are such that a worker's egress from an arc flash event would not be inhibited.
  - 2. For single-phase systems, the calculations may be performed assuming a three-phase system in accordance with IEEE 1584, yielding conservative results.
- C. For equipment with main devices mounted in separate compartmentalized sections, perform calculations on both the line and load side of the main device.
- D. Identify all locations and equipment to be included in the arc-flash hazard analysis:
  - 1. Include a copy of the facility one-line in the report.
  - 2. Identify the possible system operating modes including tie-breaker positions, and parallel generation.
  - 3. Calculate the arcing fault current flowing through each branch for each fault location.
  - 4. Determine the time required to clear the arcing fault current using the protective device settings and associated trip curves.
  - 5. Select the working distances based on system voltage and equipment class.
  - 6. Calculate the incident energy at each fault location at the prescribed working distance.
  - 7. Determine the hazard/risk category (HRC) for the estimated incident energy.
  - 8. Calculate the flash protection boundary at each fault location.
  - 9. Document the assessment in reports and one-line diagrams.
  - 10. Provide labels to be placed on each piece of equipment analyzed. Label shall show the calculated incident energy and hazard/risk category for the calculated incident energy.
- E. Results of the arc-flash study shall be summarized in a final report containing the following:
  - 1. Basis, method of hazard assessment, description, purpose, scope, and date of the study.
  - 2. Tabulations of the data used to model the system components and a corresponding one-line diagram.
  - 3. Descriptions of the modes of operation evaluated and identification of the worst case scenario used to evaluate equipment ratings.
  - 4. Tabulations of equipment incident energies, hazard risk categories, and flash protection boundaries. The tabulation shall identify and clearly note equipment that exceeds allowable incident energy ratings.
  - 5. Required arc-flash labeling and placement of labels.
  - 6. Conclusions and recommendations, including recommendations for reducing incident energy at locations where calculated maximum incident energy exceeds 8 calories per sq cm.

### 3.8 OVERCURRENT PROTECTIVE DEVICE SETTING

- A. Manufacturer's Field Service: Engage a factory-authorized service representative, of electrical distribution equipment being set and adjusted, to assist in setting of overcurrent protective devices within equipment.
  - 1. After installing overcurrent protective devices and during energizing process of electrical distribution system, perform the following:
    - a. Verify that overcurrent protective devices meet parameters used in studies.
    - b. Adjust devices to values listed in final study results.
    - c. Adjust devices according to recommendations in Chapter 7, "Inspection and Test Procedures," and Tables 100.7 and 100.8 in NETA ATS.

**3.9 INSTALLATION**

- A. Install arc flash warning labels. Refer to Division 26 section Identification for Electrical Systems for additional requirements.

**3.10 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Inspect and test protective devices in accordance with the NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Overcurrent protection devices will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies protective device settings have been adjusted in accordance with the requirements of the study. Include notation of conflicts with or deviations made from the studies or the contract documents, deficiencies detected, remedial action taken, and observations after remedial action.

**3.11 TRAINING**

- A. Provide training for Owner's personnel on electrical safety pertaining to arc flash and shock hazards.
- B. Use site-specific arc flash and shock risk assessment report as training reference, supplemented with additional training materials as required.
- C. Provide minimum of eight hours of training performed by a representative of the entity performing the study.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 26 09 10 - CENTRALIZED DIMMING SYSTEM****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. Contractor shall install, provide, and test State of Alabama energy code compliant architectural dimming control system(s) as specified herein for the areas indicated on the drawings and load schedules. Contractor shall coordinate all work described in this section with applicable plans and specifications, including but not limited to, wiring diagrams, conduit diagrams, emergency power systems, A/V systems, shade devices, fire alarm, and security systems.
- B. Work within this section shall include low voltage wallbox controls, low voltage wired control devices, architectural dimming panels, interface components, and/or modules, emergency transfer system, and Digital-Network Lighting Control System equipment and software including wired devices for energy code compliance. System to contain internet connected processing Hub with Ethernet connection and dedicated IP address furnished by owner for internet diagnostics and connection to BAS system. System to connect to building Wi-Fi system and to include networked dimming panels for normal and emergency loads as designated and with networked power supply units. Refer to Section 27 for coordination with internet requirements and IP addressing. All network equipment, including routers, network switches, and network cables to be included in base bid, whether supplied by manufacturer or by others that comply with ETC requirements. System to also be compatible with iPad tablet devices already furnished by owner for portable control of entire system with CAD-based footprint of all areas described herein including the exterior facade and site, vestibules and entry lobbies, concourse areas, lounge and suites, and event level tunnel inscribed on iPad for clarity and ease of controlling lighting scenes, individual zone control, and remote visualization and control of rooms. Architect to provide CAD footprints of spaces to manufacturer at their requested schedule in order to imbed spatial footprints into server. Dimming system manufacturer to provide iPad App and license agreement for installing on to owner provided iPads.
- C. System to include a total of nine (9) wired Mosaic/ Pharos Tessera/TPC wall recessed touch screen panels connected via Cat5/6 cable to a remote EXT series single universe controllers and to light fixture's DMX wiring and DMX control boxes. These NINE (9) Pharos/ Tessera DMX touch screens and EXT single universe controllers to be provided as such **1.** Event Level Grand Hall storage area under stair for control of type "RL1A" DMX backbone as indicated per plans. **2.** Event Level Staff offices-room 01.05.04 for control of fixture type "SL1", "SL2", "SL6", "SL7", "SL8", "SL10", and "SL13" only. **3 4 5 6.** Event Level north ballrooms-rooms 01.07.01 to 01.10.01. Each of four (4) rooms to be furnished with Pharos/ Tessera touch screen as indicated per plan for control of type "WL2" fixtures and "RL1A" DMX backbone. Programming of the DMX touch screen to include additional pages for combinations of partitioned rooms typical for other convention center designs. **7.** Event Level west ballroom-rooms 01.31.02. Furnished with Pharos/ Tessera touch screen as indicated per plan for control of type "RL1A" DMX backbone. **8.** Event Level Home Locker Room-01.13.02 for control of fixtures "FL10" and "FL11" within room with separate pages to control color and color temperature. An additional page to control the tunnel experience with fixture type "TL5" and "TL6". **9.** Suite Level Video Production Room-03.21.02 to control fixture types "LL2", "SL2", "SL7", "SL8", "SL9", "SL13", "TL5", "TL6", "TL12", "TL13", "WL4", and "WL7" associated with site lighting poles "SLP1, SLP2, SLP5 series. Programming of the DMX touch screen to include pages for: Plaza Experience so that from the touch screen or through the 3rd party theatrical console, the plaza DMX based fixtures can be manipulated to coincide with arena activities, Arena activities, for fixtures "LL2", "TL12", "TL13", "WL4", and "WL7" for blackout conditions or pre-game festivities, and a final page for player introduction to control fixtures "TL5" and "TL6" of the tunnel area.

- D. Each of these "MTS" designated Mosaic/ Pharos touch screen device to playback scenes or macros as developed during commissioning with programming through computer program and not through TPC device due to complexity of macros. Color to be white as verified by architect. Costs for said devices and all programming time required to develop color scene triggers or macros/ programs at the request of the owner representative to be part of specified dimming system manufacturer's overall Bill of Materials and included in base bid. Time required for days or weeks worth of programming time based on the nine (9) areas to be included in the base bid for dimming system. Dimming system manufacturer to be responsible for DMX interface equipment to allow color and scene "triggers" from Mosaic/Pharos DMX control devices.
- E. At all corners of the catwalk/roof level, contractor to install a wireless DMX antenna connected to Acclaim's Aria wireless DMX transmitter/receiver on the roof and then connected via wired DMX within the building to the Pharos/ Mosaic single universe DMX touch screen designated as station "MTS" in the Event Level administration office. From the southwest antenna and wireless DMX transmitter/ receiver, an additional run of wired DMX running through the building to also connect to the Pharos touch screen noted above. The northwest Acclaim's Aria transmitter/ receiver and antenna to be within field of view of fixture types "SL1" and "SL2" along Civic Center Drive. The six (6) existing poles along Civic Center Drive to support the Acclaim Aria wireless transmitter/ receiver as per manufacturer's requirements so that existing power wiring to these poles can be re-used without additional expense of providing DMX control wiring. The southwest Aria transmitter/receiver and antenna to be within field of view of fixture types "SL6", "SL7", "SL8", "SL10", and lighting poles "SLP1", "SLP2", and "SLP5" series at the circular plaza. The northeast and southeast antennas to control DMX fixtures associated with site lighting poles "SLP5" series. A transmitter/receiver to be mounted to each of the "smart" site lighting poles, types "SLP1", "SLP2", and "SLP5" series which connects to specific fixtures on said poles through wired DMX. The wireless DMX system for Civic Center Drive and within the new southwest plaza and connecting paths allows DMX control without the need to run DMX or Ethernet cable underground.
- F. Within the Control booth/ video Production room-#03.21.02 at the Suite Level, and at the exit corridor of Event Level-room 01.27.10, both a DMX receptacle and Ethernet based receptacle at a designated wall to be provided by contractor for the use of a owner supplied or 3<sup>rd</sup> party temporary theatrical control console for outdoor stage productions with the capability of "take-command" functions. Only fixture types "LL2" at the main concourse with DMX control, type "SL2"-RGBW flood on existing poles along Civic Center Drive, type "SL7" RGBW flood at the new circular plaza, type "SL13" at the roof, and types "TL5" and "TL6" RGBW floods and spots at the player tunnel, types "TL12" and "TL13" mounted to the catwalk to illuminate underside of arena roof, type "WL4" at the south end of the Main Concourse, and type "WL7" along the main concourse to be controlled by this 3<sup>rd</sup> party theatrical control console in the Control booth. For the Event Level corridor location-room #01.27.10, the 3<sup>rd</sup> party temporary theatrical console by theatrical production company to have access to site poles "SLP1" and the temporary pipe clamp mounted fixtures to be provided by the theatrical production company as well as the roof mounted fixtures, type "SL13". Per type "SLP1" specification, the site pole to include a dedicated 120v service to feed 1-1/2" O.D black theatrical pipe permanently secured to these type "SLP1" poles for future theatrical stage lighting with DMX wireless control. The DMX/ Ethernet receptacles to be connected to the ETC or approved centralized architectural dimming system for control of DMX based architectural light fixtures. Only the specific fixtures noted in the schedule and per this section to be controlled at this position. The "take-command" function of the theatrical console to allow network or owner personnel the opportunity for black-out conditions or for the opportunity to control architectural light fixtures for pre-game activities. Control booth/Video Production room to also include an ETC 2-button preset station to control all suites, except the steplights required for egress during blackout, for blackout condition. In addition, said 2-button station to also control type "DL5A" accent fixtures in the suite level and on the arena side of the blackout curtain for control of these non-DMX fixtures for blackout conditions. Only the DMX based lighting equipment on the interior and exterior as defined in Section C. above to be controlled in this room; public areas including restrooms and bars that cannot be affected by blackout conditions for egress needs shall not be controlled from this room.

- G. For A/V integration within the Ballrooms or other designated spaces, the transferring of final, approved programmed scenes, fade rates, and zone intensity levels to the AMX/ Crestron control system as supplied by A/V provider shall be performed by A/V provider as needed. Costs associated with time required to transfer data from ETC or other manufacturers listed to A/V device included in base bid as well as interface devices required.
- H. Manufacturer to submit Shop Drawings as required by Division 1 and the GENERAL CONDITIONS.
- I. Submit riser diagram showing components and interconnecting wiring. Indicate size, type, and number of conductors.
- J. Manufacturer to submit a dimming load schedule with respective control zones and dedicated circuits indicated. Standard cut sheets shall be presented for additional control devices.

## 1.2 QUALIFICATIONS

- A. The architectural dimming system shall have been in production for a minimum of 10 years.

## 1.3 REGULATORY REQUIREMENTS

- A. Provide products listed and classified by Underwriter's Laboratories, Inc. as suitable for purpose intended. Each module shall be specifically listed by U.L. for control of type of load; i.e., incandescent, 0-10v LED, electronic, or magnetic low voltage, or phase-adaptive (PWM).
  - 1. Manufacturer shall be ISO 9001 certified. Provide a copy of the certificate if required.

## 1.4 MAINTENANCE MANUALS

- A. Provide operating instructions for all components.
- B. Provide record wiring diagrams of the system.

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. ETC Electronics shall be the preferred Basis of Design manufacturer for the project. System shall be based on ETC's centralized dimming system with integral Paradigm processor and main lug and feed through dimming panels for 277V normal or normal/emergency service with capabilities to control 0-10v loads or ELV loads as noted in the light fixture schedule or other panels as needed with 120V or 277V ELV/ Phase Adaptive loads as indicated. System to also include wireless ceiling occupancy (vacancy) sensors and daylight sensors with wired mini-hubs to send signals to wireless devices around the mini-hub as well as wired low voltage preset stations. System to include all component parts required for an operational and energy code compliant system. Furthermore, system to include any DMX interface network device and/ or contact closure interfaces to allow a "trigger" that accesses preset color scenes or macros through dimming system iPad devices furnished by dimming system manufacturer. During the installation and programming phase, dimming manufacturer to coordinate with university personnel to ensure communication with existing color-changing lighting equipment for a single point of control. Architectural dimming system manufacturer shall not be responsible for programming of color-changing scenes or effects; only the recall of said scenes and colors. Costs associated with programming time to establish colors and macros associated with color-changing fixtures to be coordinated through the contractor and local programmers as noted in light fixture schedule. As required with an A/V system, manufacturer to also provide network interfaces for coordination with A/V touch screen devices. Comparable systems from Lutron Electronics or Crestron to be an acceptable alternate manufacturer.

## 2.2 COMPONENTS

- B. General: ETC system includes computer-based software that provides control, configuration, monitoring, alerting and reports. Software to be installed within the desktop computer provided by dimming system manufacturer as noted in Section 1.1 System includes:
1. Lighting Management Panel
  2. Light management computer software.
  3. Building Automation System (BAS) communication through network/ IP address interface
  4. Factory assembled dimming and switching panels
  5. Low voltage wired wall stations
  6. Wired occupancy and daylight sensors to link back to central processor
  7. Network Interface Devices for AV integration as required
  8. Computer jacks for remote programming within all electrical closets.
  9. DMX input/ output interface for recall scenes and take-command function from console
  10. iPad control app and licenses by dimming system manufacturer for iPads provided by owner as part of their existing stock. Dimming system manufacturer is not required to supply iPads.

## 2.3 DIMMING CABINETS AND DIMMING PANELS

- A. Project Conditions:
1. Ambient temperature: 0 degrees to 40 degrees C (32 degrees to 104 degrees F).
  2. Relative humidity: Maximum 90 percent, non-condensing.
  3. Lighting control system must be protected from dust during installation.
  4. Ambient temperature for Q-Manager, system computer: 10 degrees C to 35 degrees C (50 degrees F – 90 degrees F)
- B. General:
1. Dimmers designed and tested to specifically control LED sources from specific manufacturers, inclusive of 0-10V dimming drivers, ELV drivers with requirements for Pulse-width modulation (PWM) modules, and MLV transformers operating LED sources. Dimmers to also be tested for standard, non-LED sources including incandescent/tungsten, magnetic low voltage, electronic low voltage, neon/cold cathode, fluorescent dimming ballasts, and non-dim loads.
  2. Utilize universal 16A continuous-use UL listed dimmer.
  3. Limit current rise time to minimum 350  $\mu$ sec as measured from 10-90 percent of load current waveform and minimum 525  $\mu$ sec as measured from 0-100 percent of load current waveform at 50 percent rated dimmer capacity at a 90 degree conduction angle. Current rise to be minimum 400  $\mu$ sec as measured from 10-90 percent of load current waveform and minimum 600  $\mu$ sec as measured from 0-100 percent of load current waveform at 100 percent rated dimmer capacity at a 90 degree conduction angle.
  1. Dimmers controlling public egress designated fixtures to have low end threshold factory set so as not to go below required code light levels.
- C. The dimmer cabinet shall be fabricated from 10 gauge formed steel. It shall have black epoxy painted finish. Contractor shall reinforce wall as required for wall-mounted panels.
- D. The cabinet door shall have a keyed lock. Manufacturer to furnish 2 spare keys.
- E. Dimming panel shall be completely pre-wired by the manufacturer. The contractor shall be required to provide input feed wiring and load wiring which terminates to a set of clearly marked terminals. No other wiring or assembly by the contractor shall be permitted. Contractor shall not remove jumpers or safety device load protection to dimmers until factory field commissioning has determined all loads are connected properly.

- F. Dimming cabinets shall be cooled via free-convection or integral fan. Panels shall allow full-rated dimmer capacity. Panels shall provide airflow across the heat sink areas and through the dimmer chassis. Contractor shall not install multiple cabinets directly above one another, or in any other means that restricts airflow and heat dissipation
- G. For a hybrid control system involving distributed load dimming packs, said devices shall be suitable for plenum conditions.

## 2.4 DIMMING MODULES

- A. General
  1. Dimmer modules shall be a self-contained assembly, factory wired and installed in a cabinet prior to shipment to the site.
  2. Quantities and sizes of each type of dimmer module shall be provided to control each type of load shown on the load schedule and/or drawings.
  3. All dimmers shall provide a smooth and continuous "square" law dimming curve throughout the range.
  4. A positive air gap relay shall be employed with each dimmer to ensure that the load circuits are open when the "off" function is selected.
  5. The maximum allowable asymmetry in the load wave form shall be  $\pm 1$  VDC.
  6. Electrolytic capacitors to operate at least 20 degrees C below the component manufacturer's maximum temperature rating when device is under fully-loaded conditions in 40 degrees C (104 degrees F) ambient temperature.
  7. Load Handling Thyristors (SCRs and triacs), Field Effect Transistors (FETs), and Isolated Gate Bipolar Transistors (IGBTs): The component's maximum current rating to be at least two times the dimmer's/relay's rated operating current.
  8. Capable of withstanding repetitive inrush current of 50 times operating current without impacting lifetime of dimmer/relay.
  9. Design and test dimmers/relays to withstand line-side surges without impairment to performance.
  10. Panels: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 3,000 amps per ANSI/IEEE C62.41 and per IEC 61000-4-5 surge requirements.
  11. When power is interrupted and subsequently returned, within 3 seconds lights will automatically return to same levels (dimmed setting, full on, or off) prior to power interruption
- B. Incandescent and Low Voltage Magnetic Transformer Dimmers
  1. Filtering shall be provided in each dimmer so that current rise time shall be at least 350 ma/microsecond at 50% rated dimmer capacity and at no point rise faster than 30ma/microsecond, measured from 10-90% of load-current waveform.
  2. Dimmers shall be capable of dimming lamps to 0% (Blackout)
  3. Each dimmer shall incorporate an electronic "soft-start" default at initial turn-on that smoothly ramps lights up to designated levels within 0.5 seconds.
  4. Provide real-time cycle-by-cycle compensation for incoming line voltage variations including changes in RMS voltage (plus or minus 2 percent change in RMS voltage/cycle), frequency shifts (plus or minus 2 Hz change in frequency/second), dynamic harmonics, and line noise.
  5. Contain circuitry designed to control and provide a symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472, Section 5.11.
- C. Low Voltage Electronic Transformer Dimmers
  1. Dimming shall not adversely affect sound rating of the electronic transformers. In addition dimmer shall not allow any "flicker" at any point within the dimming range.
  2. Each dimmer shall incorporate and electronic "soft-start" default.

3. Dimmer to operate electronic low voltage transformers via reverse phase control. All ELV based loads, whether LED or quartz-based shall be connected to a Pulse-width modulation (PWM) module internal or external to the dimming cabinet or proper dimming of ELV loads.
- D. 0-10V dimming modules
  1. Dimming shall operate as constant current for all conditions including dimming from 10% to 1% where indicated. PWM (pulse width modulation) dimming for 0-10V shall not be allowed.

## 2.5 LOW VOLTAGE WALL STATIONS

- A. Allows control of any devices or parts of the Lutron System.
- B. Wired devices designated as SW1 to be a Heritage series 1-button devices (color to be white as verified by architect or otherwise designated by architect/ interior designer) for those areas defined as "SW1" on documents. Button to be programmed so that during hours of operation button is disengaged. During after hours, button to turn all lights in restrooms to full output if vacancy sensor in restrooms turn off lights.
- C. Wired devices designated as SW2 to be a Heritage series 2-button devices (color to be white as verified by architect or otherwise designated by architect/ interior designer) for those areas defined as "SW2" on documents. 2-button station to represent scenes on and scene 13 of bars to allow (2) alternate scenes for operator. 2-button stations for other areas to represent on/off scenes if vacancy sensor turns off lights. Buttons to be programmed and a Sequence of Operation to be developed per each area during field commissioning.
- D. Wired devices designated as SW3 to be a Heritage series 3-button devices (color to be white as verified by architect or otherwise designated by architect/ interior designer) for individual suites or other areas defined as "SW3" on documents. 3-button station to represent scenes 1-3 with NO "off" scene available for suites or scenes 1 and 2 with "off" scene as defined per area. 3 scenes consistent for each space to be programmed and a Sequence of Operation to be developed per each area during field commissioning.
- E. Wired devices designated as SW5 to be a Heritage series 5-button device (color to be white as verified by architect or otherwise designated by architect/ interior designer) for those areas defined as "SW5" on documents. 5-button station to represent scenes 1-4 with "off" scene available or scenes 1-5 without "off" scene as defined per individual area. 4 or 5 scenes to be programmed and a Sequence of Operation to be developed per each area during field commissioning.
- F. Wired devices designated as SW6 to be a Heritage series 6-button device (color to be white as verified by architect or otherwise designated by architect/ interior designer) for those areas defined as "SW6" on documents. Station to include 4-buttons for lighting scenes and 2 buttons for "open/ close" of automated shade motor control. Scenes to be programmed and a Sequence of Operation to be developed per each area during field commissioning.
- G. Wired devices designated as SW7 to be 7-button device (color to be white as verified by architect or otherwise designated by architect/ interior designer) for those areas defined as "SW7" on documents. 7-button station to represent scenes 1-4 with "off" scene available with separate raise/lower function to control all zones with universal raise/lower function. Scenes to be programmed and a Sequence of Operation to be developed per each area during field commissioning.
- H. Wired device designated as MS to be a multi-page 14" wide AMX/ Crestron, or ETC touch-screen panel for master control of all dimming system public domain controlled areas. Master control station to be located in Security Office-room 01.23.06 with separate pages for: Event Level, Main concourse, and Suite Level. Master control station shall not be able to access locker rooms or individual suites, however, master control station can control suite lounges or loge clubs. 14" wide touch screen with programming of pages for each level and additional pages per level of individual

rooms and scene names and Sequence of Operations to be included in base bid. An interface device required by dimming system manufacturer to communicate and coordinate with switch MS to be included by dimming system manufacturer.

- I. Wired devices designated as MTS to be a Mosaic/ Pharos TPC wall recessed touch screen panel connected via Cat5/6 cable to a remote EXT series single- universe controller and to light fixture's DMX wiring and DMX control boxes. Refer to documents regarding location of devices to be coordinated and approved by architect and operator representative prior to final installation of devices. Each "MTS" designated Mosaic/ Pharos touch screen device to playback scenes or macros as developed during commissioning with programming through computer program and not through TPC device due to complexity of macros. Color to be white as verified by architect. Costs associated with actual DMX devices and control boxes to be provided by dimming system manufacturer as stated in Section 1.1.D. All ten (10) DMX touch screen devices and controllers to be indicated on one-line control diagrams for coordination and located per space.
- J. Confirm Sequence of Operation with owner during commissioning. Stated sequences and labeling is for reference only.
- K. Electronics
  1. Use RS485 wiring for low voltage communication.
- L. Functionality
  1. Upon button press, LEDs to immediately illuminate.
  2. LEDs to reflect the true system status. LEDs to remain illuminated if the button press was properly processed or the LEDs turn off if the button press was not processed.
  3. Engrave wall stations in English with appropriate button, zone, and scene engraving descriptions. Scene names and engraving to be determined by owner after project completion. Costs associated with engraving to be included in base bid.

## 2.6 WIRELESS WIRED CEILING SENSORS

- A. Wireless or wired occupancy sensor operating at 431 MHZ on ceilings of spaces as indicated and designated as per electrical documents. During "occupied" hours, as times so stated by the operator, occupancy sensor to act as means to turn lights to 100% upon detection with the capability of dimming to 50% after 30 minutes of inactivity. During "unoccupied" hours, as so determined by the operator, occupancy sensor to act as means to turn lights to 50% upon detection and turning off after 30 minutes of inactivity. Vacancy sensors to be indicated where noted and designated as per electrical documents. "Vacancy" sensor in rooms noted to turn lights off automatically after a period of non-activity, but with manual "on" requirement. Sensor to be disengaged by wallstations.
- B. Wireless daylight sensors designated with a "D" on ceilings as indicated on electrical documents. Wired daylight sensors to control only those zones as indicated on the control matrix. Light levels above 20fc measured by sensor to dim controlled zones.
- C. Power Savr wireless hub to connect wireless devices. Quantity of devices and distance from hub to devices not to exceed manufacturer's requirements. Wireless hub to be wired back to main hub as per one-line diagram.

## 2.7 INFRARED PARTITION CONTROLS

- A. For the Ballrooms with partition, system to include an infrared receiver/ transmitter pair located at the terminating point of the partition. Infrared receiver/ transmitter to automatically connect (or disconnect) individual rooms together without need for manual connection or other graphic interface. Device to include additional contact closure interface. Devices to be located 5 feet away from wall surface partitions run into to allow intended gap for passage between rooms with rooms acting independently. A/V system to access partition condition through network interface.

Dimming system manufacturer is not required to provide additional equipment for A/V interface specific to partition control.

## **2.8 A V INTERFACE AND CONTACT CLOSURE CONTROLS**

- A. As required, system to include A/V interface device and contact closure devices for “take command” operation of lighting scenes and “take command” of Mecho shades or other vendors through dimming system preset station. Specific A/V interface or shade system interface control, whether network or RS232 or contact closure to be coordinated with A/V system or automated shade system providers to ensure compatibility.

## **2.9 COMPUTER ACKS**

- A. Dimming system's main server and processor to be located in Fire Command Center-room 01.23.04 with computer jack to allow access to software and manual override of all loads associated with dimming system. Additional computer jacks that allow programming and download to the system's hub to be located in every electrical closet and with public concourses at each corner of concourse. Costs associated with data/ network wiring to these locations to be included in base bid and included in one-line diagram. Manufacturer to label computer jacks and cover plate as “dimming system”.

## **2.10 OVERCURRENT**

- A. Provide a UL 489 molded case main breaker.
- B. Primary circuit breakers in the dimmer module shall be rated at the same capacity as the dimmer. Both the Primary and the secondary breakers shall be thermal magnetic or magnetic for both overload and dead short protection, and shall have a minimum rating of 10,000 A.I.C. with a visual trip indicator. The breaker shall serve as disconnect for the dimmer.
- C. Each dimmer shall operate over an input range of 90 to 140 VAC, at 60Hz in an ambient air Temperature from 0° to 40° C. Each dimmer shall have a thermal sensor to shut down the dimmer's output when the heatsink temperature exceeds 185°F (85°C).
- D. Each dimmer shall be solid state with encapsulated silicon controlled rectifiers to provide symmetrical alternating current output to the load at any output level from OFF to FULL intensity.
- E. The solid state switch devices shall be mounted in a substrate material for heat dissipation. The substrate shall be encapsulated in an epoxy filled high impact plastic case with an optical isolator, a snubbing network and gating circuitry on the high voltage side of an integral opto-coupled control voltage isolator. Provide a minimum of 2500V RMS isolation between line and control in the switch device.

## **2.11 EMERGENCY SYSTEM**

- A. Contactor shall refer to one-line schematic documents and dimming panel schedule on electrical sheets for loads which shall be connected to normal/ emergency power or normal power. Normal/ emergency panels to be Feed-through type panels only.
- B. In event of power failure those loads designated as normal/emergency shall pass to designated transfer cabinet as supplied by dimming manufacturer transfer cabinet shall be listed as U.L. 1008 and U.L 924 standard. Transfer relay shall be connected in line as per manufacturer's one-line diagram so that during power failure all loads controlled in transfer cabinet default to full light levels; regardless if the load is ELV, MLV, or 0-10V. in the case of 0-10V loads, the emergency transfer shall not interrupt the control signal and a signal shall be sent across the control wires to ensure that fixture retains its full output status.



1. Transfer cabinet shall comprise voltage sensing circuitry to automatically transfer loads from normal to emergency feed when one or more of the phases in the normal feed drops to 55% (65 Volts) or below.
  2. Transfer cabinet shall contain an integral test switch to simulate normal power source failure for periodic verification of system operation. Access inside the transfer cabinet for test purposes shall not be necessary.
  3. Contractor shall connect normal/ emergency dimming panels to generator or redundant system able to provide full power through ETC device or other means of transfer to designated fixtures. ETC device to bring designated fixture to full power for emergency egress regardless of current dimmed setting during power failure.
- C. Emergency loads with self-contained batter back-up ballast connected to dimming system shall be contained within dedicated dimming panel as indicated on one-line diagram and as per load panel schedule per engineering documents. Contractor shall connect emergency ballast to "B" or constant hot of terminal block as per manufacturer's wiring diagram so as to provide constant power to emergency battery..

## 2.12 QUALITY CONTROL

- A. Components used in the lighting control system shall be inspected per the most current revision of Military Standard 105 or equivalent.
- B. Dimming module main power semiconductors shall be tested at a case temperature of 100 degrees C and with rated voltage applied for a minimum of 48 hours.
- C. Prior to shipment, the completely assembled dimming system shall be operated at full-rated load for a period of time long enough to identify and replace any components or subassemblies which would have failed within a short time of system star-up. All the dimmer and/or relays within a panel shall be full-load tested at the same time. Manufacturer shall prove that they have the capability of proving this full- load test as specified.
- D. Finished system shall also be fully tested for proper operation of all control functions per the approved submittal drawings.
- E. Each panel shall be certified by the technician who built the equipment or a quality assurance inspector of the successful completion of the tests described in 2.8, C and D above.

## 2.13 WARRANTY

- A. All bidding manufacturers to provide owner/ operator with full 100% coverage of parts and material for 8-years with pro-rating schedules. Custom, 8-year pro-rated warranties to be written for pro-rated coverage spanning 8 years starting with the date of system start-up completion. Costs associated with 8-year pro-rated warranty to be included in base bid associated with system and specifically noted. 8-year warranty to exclude labor costs.
- B. Paradigm processor is covered by a 1-year parts and labor warranty

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. The system shall be installed utilizing complete manufacturer's shop drawings and in accordance with these specifications.
- B. The electrical Contractor shall run separate neutrals for all branch load circuits.
- C. Provide dedicated network between server/ processors and dimming panels.

- D. Define each dimmer's/relay's load type, assign each load to a zone, and set control functions.
- E. Facility Representative to coordinate meeting between Facility Representative, Lighting Control System Manufacturer and other related equipment manufacturers to discuss equipment and integration procedures.

### 3.2 TRAINING AND SYSTEM COMMISSIONING

- A. At the end of Substantial Completion, the system shall be completely commissioned by a factory-trained engineer. During the design and construction process, dimming system factory agent shall conduct three (3) site visits. Visit 1 to be a pre-shop drawing submittal meeting between approved manufacturer, A/V system provider (as required), operator's IT director or other personnel, and a BAS/ BMS commissioning agent to review design and coordinate and ensure compatible components prior to official dimming system submittals. Required changes to the electrical one-line diagram to account for coordination equipment shall be provided to design team. Visit 2 shall be a "pre-wire" commissioning exercise by factory-trained personnel that shall include review of installed dimming system wiring to date as well as other non- dimming system specific wiring systems including BMS/ BAS wiring or coordination with fire-alarm system and coordination with sports lighting DMX control system interfacing and coordination verified during Visit 1. Second visit to include review of IP address interface and means for BAS/ BMS operator to seamlessly and effectively extract information programmed through the architectural dimming system to be accessed through the BAS without added programming time. "Pre-wire" commissioning to ensure compliance and coordination with the dimming system design intent and other systems so as to reduce future complications at substantial completion. Visit 3 to be a final commissioning exercise at substantial completion and to be performed upon notification by the electrical contractor that the system installation is complete and that all loads have been tested live for continuity and freedom from defects and that all control wiring has been connected and checked for proper continuity. The electrical contractor shall provide both the manufacturer and the Architect with ten working days' notice of the scheduled commissioning date. Pre-established factory start-up costs shall be included in the base bid for all three (3) visits and shall include adequate number of days on site by commissioning agent to perform all tasks, provide troubleshooting as required, train necessary facility personnel, and ensure system is completely operational and functioning to the owner representative's satisfaction. Base bid costs associated with the commissioning exercises shall be clearly defined with time on site as noted in Section 3.2.C.
- B. Startup and Programming
  - 1. Provide factory certified field service engineer to make site visits to ensure proper system installation and operation under following parameters
    - a. Qualifications for factory certified field service engineer:
      - 1) Minimum experience of 2 years training in the electrical/electronic field.
      - 2) Certified by the equipment manufacturer on the system installed.
    - b. Make visit prior to installation of wiring. Review:
      - 1) Low voltage wiring requirements.
      - 2) Separation of power and low voltage/data wiring.
      - 3) Wire labeling.
      - 4) Lighting Management Panel locations and installations.
      - 5) Control locations.
      - 6) Computer jack locations.
      - 7) Load circuit wiring.
      - 8) Network wiring requirements.
      - 9) Connections to other equipment and other Lutron equipment.
      - 10) Installer responsibilities.
      - 11) Power Panel locations.
      - 12) BACNet system and confirmation of dimming system compliance and interface ability without additional program time from BAS operator.
    - c. Make final visit upon completion of installation of Centralized Lighting Control System:

- 1) Verify connection of power wiring and load circuits.
  - 2) Verify connection and location of controls.
  - 3) Energize Lighting Management Panels and download system data program.
  - 4) Address devices.
  - 5) Verify proper connection of panel links (low voltage/data) and address panel.
  - 6) Download system panel data to dimming/switching panels
  - 7) Check dimming panel load types and currents and supervise removal of by-pass jumpers.
  - 8) Verify system operation control by control.
  - 9) Verify proper operation of manufacturers interfacing equipment.
  - 10) Verify proper operation of manufacturers supplied PC and installed programs.
  - 11) Coordinate with owner password protection to ensure specific computers with software can control only designated areas of the facility and not the entire facility.
  - 12) Configure initial groupings of ballast for wall controls, daylight sensors and occupant sensors.
  - 13) Initial calibration of sensors.
  - 14) Ensure interface coordination between architectural dimming system and sports lighting DMX control
  - 15) Obtain sign-off on system functions
  - 16) Create and install Sequence of Operation functions for wall stations, preset scenes, etc. as defined in this document or subsequent documents for review by owner or owner's representative as a starting point. Commissioning agent to coordinate with owner to modify Sequences of Operation to their satisfaction.
  - 17) Demonstrate and educate Owner's representative on system capabilities, operation and maintenance.
- C. Programming of the centralized dimming system and scope areas noted below shall be done under the direction of the Architect, owner's representative, and/or Lighting Designer and during the period of final focusing. The factory field commissioning agent shall perform the programming as per criteria established in the Sequence of Operations noted within this document or subsequent documents during construction for more detailed and accurate Sequence of Operations and modified and adjusted by client and owner during the commissioning phase. Transferring final, approved programmed scenes, fade rates, and zone intensity levels to the AMX/ Crestron A/V system , if required by owner, or to the master control panel per requirements stated in Section 2.5.F shall be performed by A/V provider or building's IT operator. Lighting designer shall only be responsible for input and direction and not for actual programming or commissioning. Upon notification by Contractor that all fixtures affected by dimming or other control devices are functioning and properly landed to appropriate circuits and zones, Lighting Designer shall coordinate with Contractor as to a mutually agreed upon time to coincide with focusing efforts. Programming time as aforementioned shall be included in dimming manufacturer's commissioning costs. Programming time for DMX equipment and Pharos/ Mosaic touch-screens and color scenes and programming macros by dimming system manufacturer or 3<sup>rd</sup> party theatrical programmer well-versed in the Pharos/Mosaic systems to be a separate line-item for time dedicated to those functions, especially the time required for the Tunnel Experience to meet client demands. Manufacturer to include costs associated with three (3) visits as such: Visit 1-meeting one full day, Visit 2-pre-installation visit accounting for 1 week, and Visit 3-final commissioning and training accounting for a minimum of 2-week period of time due to large number of control zones to be coordinated and verified. Actual time required for visits to be coordinated with contractor and manufacturer, however, said schedules and fees as stated to be provided as a base bid cost.

**PART 4 - SYSTEMS****4.1 OVERALL SYSTEM**

## A. General Description

1. Contractor shall install a centralized/ networked dimming system with one (1) central processor/ hub as per electrical documents and noted as "Hub" and coordinated with owner representative and dimming system manufacturer during shop drawing submittal. Designated space on plans include Server that contains software and access and master control of all lighting zones associated with system for security needs. Final locations and quantities to be determined and coordinated with architect. Hubs to contain Ethernet connection and dedicated IP address furnished by owner for internet diagnostics and connection to BAS system located in the area as per plans or otherwise designated by owner's representative. System to connect to building Wi-Fi system and to include networked dimming panels for normal and emergency loads as designated and with networked power supply units. All network equipment, including routers, network switches, and network cables to be included in base bid, whether supplied by manufacturer or by others that comply with ETC requirements. Wired ceiling mounted occupancy sensors, daylight sensors, and low-voltage wired wall-mount preset stations to be included. Separate wall-mounted AMX/ Crestron touch-screen panels furnished for the facility in quantities and locations indicated on A/V documents shall be furnished by A/V supplier/ consultant and to be coordinated with dimming system for "take-command" operation of architectural dimming programmed scenes, zone intensities, and fade rates as per Sequence of Operations. Ethernet/ network cable interface devices to communicate BAS system to be furnished by dimming system manufacturer. Central processor/ lighting management hub to be included with software package to allow diagnostics and alerts, energy management, and remote viewing and control of the entire facility with a CAD-based layout of the facility. Software to reside in the computer server located furnished by owner in the area stated by owner with password protected access. System to include iPhone App and programming software license to allow owner provided iPads as noted per Section 2.1.1 access to remote viewing and control of facility with iPads as part of owner stock (as noted by IT department). Manufacturer to coordinate with owner representative during commissioning to determine which areas can be controlled from specific iPads. Quantum Hub processors to allow scene and zone programming for downloading directly through hub. All preset control and master control stations to be engraved with room name.

B. Refer to Section 1.1.C regarding wired Mosaic/ Pharos Tessera/TPC wall recessed touch screen panels connected via Cat5/6 cable to a remote EXT series single universe or 4-universe controllers and to light fixture's DMX wiring and DMX control boxes. Dimming system manufacturer to be responsible for DMX interface equipment to allow color and scene "triggers" from Pharos DMX control devices furnished by light fixture manufacturer.

C. Within the Control booth/ video Production room-#03.21.02 at the Suite Level, both a DMX receptacle and Ethernet based receptacle at a designated wall to be provided by contractor for the use of a owner supplied theatrical control console with the capability of "take-command" functions. Only fixture types "LL2" at the main concourse with DMX control, type "SL2"-RGBW flood on existing poles along Civic Center Drive, type "SL7" RGBW flood at the new circular plaza, type "SL13" roof mounted RGBW lights and types "TL5" and "TL6" RGBW floods and spots at the player tunnel, types "TL12" and "TL13" mounted to the catwalk to illuminate underside of arena roof, type "WL4" at the south end of the Main Concourse, and type "WL7" along the main concourse to be controlled by this 3<sup>rd</sup> party theatrical control console in the Control booth. The DMX/ Ethernet receptacle to be connected to the ETC or approved centralized architectural dimming system for control of DMX based architectural light fixtures. Only the specific fixtures noted in the schedule and per this section to be controlled at this position. The "take-command" function of the theatrical console to allow network or owner personnel the opportunity for black-out conditions or for the opportunity to control architectural light fixtures for pre-game activities

- C. Within the overall controlled system there will be connected areas that operate from exclusive timeclock/ astronomic timeclock control or in addition to the DMX control console noted in Section C above. These spaces to not have local preset stations as defined for specific spaces in Section 4.2. These spaces to also be accessed through iPad control as defined by owner representative
1. Event Level concourse within public access areas not controlled by Home Team Locker Room
  2. All concourse level markets
  3. Main and Suite level concourses.
  4. All concourse levels Hot and Cold Market interiors (not Back of House pantries or kitchens)
  5. All concourse level restrooms with override station SW1 for toggled on/off operation after hours and occupancy sensors to turn lights on automatically at all times of day.
  6. Exterior lighting for egress
- D. Equipment
1. To reduce and ensure network lengths are not overextend, system to include the number of Paradigm processors as directed by dimming system manufacturer. Components to include power panel links and all dimming panels
  2. Manufacturer shall provide common loaded dimming cabinets for 277V or 120V normal or emergency loads with required ETC device for UL-924 requirements. Common load main lug cabinets to maximize capacity and reduce locations of panels with specific panels indicated on electrical documents. Dimming cabinets to be, capable of accepting load inputs as per load/power panel schedule in engineering documents. Dimmers shall accept loads indicated on electrical documents.. Refer to manufacturer's equipment list for component parts.

#### 4.2 EVENT LEVEL-GRAND HALL

- A. General Description
1. Contractor shall install wireless daylight sensors along western window wall and within vestibules as indicated to control Zones within vestibules and types DL17, FL2A,PL7 and WL1 fixtures within daylight zone.
  2. Contractor shall install wired preset station within secured storage area under stairs and adjacent to "MTS" designated touch screen for DMX lighting equipment, to control Zones within those areas. Preset station to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"-master control station in office reception- room 01.04.04.
  3. Contractor to install "MTS" Pharos single-universe DMX controller and Mosaci/Pharos Tessera/TPC touch screen within storage area under for control of specific color-changing equipment within this area. Color scenes and macros programmed into the Mosaic/ Pharos touch screen to be transferred to iPad with password protection for Grand Hall/ Ballroom.
  4. Contractor to install DMX interface in storage area connected to DMX-based architectural lighting within Grand Hall for connection to DMX controller and touch screen as noted above.
  5. Owner provided iPad for this area to import type TR1/ TL1/ TL2 manufacturer's mesh network app so that iPad control can pan/ tilt all fixtures indicated on plan separately for remote control of aiming from the ground. Manufacturer of types TR1/ TL1/ TL2 to coordinate with dimming system manufacturer and owner representative so that mesh network and app can be accessed from owner provided Ipads and not from a phone app.
  6. Contractor shall install A/V interface device within same storage area under stairs to allow A/V touch screen to "take command" of architectural light fixtures. Theatrical color changing fixtures and DMX distribution system, type "RL1/RL1A" to only be controlled through the Pharos DMX touch screen. Provide additional interface for on/off control of TVs in this area in lieu of remote control. Content of TV to be accessed through separate A/V touch screen or iPad.
  7. Market area within Grand Hall area to be controlled with all other markets through the "MS" station in the Security Office.

8. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for review by owner representative and commentary throughout the commissioning process.

#### 4.3 EVENT LEVEL-WEST AND NORTH BALLROOMS

##### A. General Description

1. Contractor shall install vacancy sensors to be located within specific ballrooms on the west side as designated. During occupied hours and after 30 minutes of no activity, vacancy sensor to control type WL12 associated with each ballroom, typical of one (1), and turn fixture off. During occupied hours whenever any scene is pressed on the SW7 preset station, type WL12 associated with each of three (3) ballrooms shall turn to 100% to indicate to those in the Grand Hall or VIP bar area that the room is occupied and activities occurring.
2. Contractor shall install wired preset station SW7-for (4) scenes with "off" scene and raise/lower buttons as indicated on plans for west ballrooms and adjacent to "MTS" designated touch screen for DMX lighting equipment, to control Zones within those areas. An additional preset SW2- 2 button at certain entry doors to control scenes 1 and security scene 13. Preset station to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"-master control station office reception- room 01.04.04.
3. Contractor shall install wired preset station SW6-for (4) scenes with no "off" scene and open/ close preset buttons for automated mechoshades or other shade control device as indicated on plans for the north ballrooms and adjacent to "MTS" designated touch screen for DMX lighting equipment, to control Zones within those areas. An additional preset SW2- 2 button at the entry from the service corridor-room 01.13.06 to control all type pl3e fixtures in the entire area for security. Preset station to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"-master control station office reception- room 01.04.04.
4. Contractor to install "MTS" Pharos single-universe DMX controller and Mosaci/Pharos Tessera/TPC touch screen as indicated per plans for control of specific color-changing equipment within this area. Color scenes and macros programmed into the Mosaic/ Pharos touch screen to be transferred to iPad with password protection for Grand Hall/ Ballroom.
5. Contractor to install DMX interface above accessible ceiling or Back-of-House corridor ceiling and connected to DMX-based architectural lighting within ballrooms for connection to DMX controller and touch screen as noted above.
6. Owner provided iPad for this area to import type TR1/ TL3/ TL4 manufacturer's mesh network app so that iPad control can pan/ tilt all fixtures and select color temperature indicated on plan separately for remote control of aiming from the ground. Manufacturer of types TR1/ TL3/ TL4 to coordinate with dimming system manufacturer and owner representative so that mesh network and app can be accessed from owner provided Ipad and not from a phone app.
7. Contractor shall install A/V interface device within accessible area in corridor to allow A/V touch screen to "take command" of architectural light fixtures. Theatrical color changing fixtures and DMX distribution system, type "RL2/RL1A" to only be controlled through the Pharos DMX touch screen.
8. Contractor to install wireless, Infra-red receiver/ transmitter for automatic partition control of space. Receiver/ transmitter on opposite sides of the partition as indicated on architectural plans to be located 5 feet from the partition's end connection to the wall to prevent mistaken use of partition. With partition open, either station SW5 within the back hall entrance to ballrooms control to engage all fixtures within open ballrooms.
9. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for review by owner representative and commentary throughout the commissioning process.

**4.4 EVENT LEVEL-BUNKER CLUB**

1. No daylight or vacancy sensors to be located within Bunker Club. Contractor to provide occupancy sensors within the restroom hallway only as indicated on plans.
2. Contractor shall install wired preset station SW7 for (4) scenes with "off" scene and raise/lower as indicated on plans at bar area and SW2 station for scene 13 and 14 at entry to club from player corridor to control zones within this area and corridor to player tunnel, but not individual restrooms. Station SW1 at the entry from the player tunnel to be included and shall control of only type DL3 in the corridor and type DL10 at the bar. Preset stations to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"-master control station.
3. All TVs to be controlled by remote control at bar. No AV interface needed for power control of TVs.
4. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for review by owner representative and commentary throughout the commissioning process.

**4.5 EVENT LEVEL LOCKER ROOM COMPLEX****A. General Description**

1. Contractor shall install wireless occupancy sensors within corridor areas, wet areas of the locker room, treatment room, hydrotherapy room, and individual offices and coaches locker rooms. A vacancy sensor to be located for the home team locker room itself. Fixture types "LL10", "LL11" and "DL6" in the wet area to be on emergency circuit and 24-hours for security. Occupancy sensor in corridor surrounding locker room grooming area- room 01.13.01 to be engaged during occupied and non-occupied hours. During occupied hours, occupancy sensor to turn all zones of control to full output. During non-occupied hours, occupancy sensor to turn all zones to 50% output. Stations SW2 at corridor entries or stations within locker room to override 50% output as needed.
2. Contractor shall install wired preset station SW7 for 5 scenes with no "off" and raise/lower at locker room entry and adjacent to "MTS" designated touch screen for DMX lighting equipment, to control Zones within those areas. An additional station SW2 at the other entry off the wet area plus station SW2 to control the hallway. An additional station SW1 to be located at the exit from the locker room to the player tunnel to control non-DMX based light fixtures, types "DL4" and "FL14" for a "Go-Time" scene in conjunction with the DMX light fixtures controlled by the "MTS" DMX touch screen in the locker room. Treatment area, hydrotherapy, Street Locker and coach's locker-room 01.12.03 to be equipped with SW3 preset stations at room entries for control of scenes 1 and 2 plus "off" scene. Preset station to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area will not be controlled through "MS"-master control station in Security Office.
3. Contractor to install "MTS" Pharos single-universe DMX controller and Mosaci/Pharos Tessera/TPC touch screen as indicated per plans for control of specific color-changing equipment within this area. Color scenes and macros programmed into the Mosaic/ Pharos touch screen to be transferred to iPad with password protection for locker room and player tunnel. Said touch screen to be programmed with separate pages for "locker room" and "player tunnel" to control fixture types "TL5" and "TL6". Within the "locker room" page buttons to be programmed to allow control of types "FL10" and "FL11" separately.
4. Contractor to install DMX interface above accessible ceiling or corridor ceiling and connected to DMX-based architectural lighting within locker room and player tunnel and player corridor for connection to DMX controller and touch screen as noted above.
5. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for review by owner representative and commentary throughout the commissioning process.

**4.6 EVENT LEVEL AUXILIARY LOCKER ROOMS**

## A. General Description

1. Contractor shall install wireless occupancy sensors within entry vestibules to auxiliary locker rooms as indicated on plans as well as wet areas of the locker room and treatment rooms. A vacancy sensor to be located for the locker room itself.
2. Contractor shall install wired preset station SW3 at room entries for control of scenes 1 and 2 plus "off" scene as indicated on plans. Stations SW3 to also be located at treatment rooms and individual restrooms as indicated. Preset station to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area will not be controlled through "MS"-master control station in Security Office.
3. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for review by owner representative and commentary throughout the commissioning process.

**4.7 EVENT LEVEL-GREEN ROOM**

1. No daylight, occupancy, or vacancy sensors to be located within Green Room Lounge or dressing rooms. Occupancy sensors to be located in Officials locker rooms and meeting room
2. Contractor shall install wired preset station SW5 for (4) scenes plus "off" scene as indicated on plans at all entry points to green room lounge. Individual dressing rooms and Star/Officials toilet to be equipped with station SW3 for scene 1, and raise/lower function. The mirror lights within rooms to be locally dimmed. Restrooms or locker rooms to be equipped with station SW1 for "on" scene with control of all light fixtures. Preset station SW5 to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"-master control station in Security Office.
3. All TVs to be controlled by remote control within individual spaces. No AV interface needed for power control of TVs.
4. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for review by owner representative and commentary throughout the commissioning process.

**4.8 EVENT LEVEL SUPER VOMS-CORRIDORS-PLAYER CORRIDOR**

## A. General Description

1. Contractor shall install wireless occupancy sensors suspended from structural ceiling to be located 6" above bottom of open grid black ceiling where applicable or attached to ACT ceiling in other locations. For open grid conditions, occupancy sensor to be black finish and white everywhere else.
2. No preset stations to be provided for the concourse. Only the "MS" mater control station in the officereception-room 01.04.04 or iPad control to have access to the zones associated with the concourse or the individual markets. Refer to the section associated with public restrooms for control requirements.
3. DMX touch screen station designated as "MTS" Pharos single-universe DMX controller and Mosaci/Pharos Tessera/TPC touch screen within the locker room as noted in Section 4.5 to also control types "TL5" and "TL6" within the player tunnel as well as within the player corridor. No additional DMX touch screens required for the player corridor.
4. Contractor shall install A/V interface device at exposed ceiling on underside of slab for on/off control of TVs in this main concourse in lieu of remote control. Content of TV to be accessed through separate A/V touch screen or iPad.
5. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during



commissioning for university review and commentary throughout the commissioning process.

#### 4.9 MAIN CONCOURSE-SIDELINE CLUB

- A. General Description
1. No daylight, occupancy, or vacancy sensors to be located within public area of club itself. Occupancy sensor to be located within restrooms as typical for all public restrooms.
  2. Contractor shall install wired preset station SW5 for (5) with no "off" scene as indicated on plans at central bar to control all lights within this area only and not the other individual bars on this concourse. An additional preset station SW2 for on/off function to be located at the display kitchen. As per all public restrooms preset station SW1 to be provided at restroom entries with operating function as defined in section associated with public restrooms.
  3. All TVs to be controlled by remote control at bar. No AV interface needed for power control of TVs.
  4. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for university review and commentary throughout the commissioning process.

#### 4.10 MAIN CONCOURSE LEVEL BARS-ALL AREAS

- A. General Description
1. No daylight, occupancy, or vacancy sensors to be located within the confines of the bar itself. Occupancy sensors to be located for the concourse, not the bar.
  2. At each individual bar, typical of four (4) bars, contractor shall install wired preset stations designated as station SW3 at back bar area in location that does not interfere with architectural details. Stations SW3 to control only those zones associated with the bar for temporary override and preference of light levels and connects to scenes 1-3 with no "off" scene. Master control station at the Security office to have access to "off" scene only. Preset station to be programmed to be engaged during operating hours as stated by owner representative.
  3. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for university review and commentary throughout the commissioning process.

#### 4.11 MAIN CONCOURSE PUBLIC AREAS

- A. General Description
1. No preset stations to be provided for the concourse. Only the "MS" master control station in the officereception-room 01.04.04 or iPad control to have access to the zones associated with the concourse or the individual markets. Refer to the section associated with public restrooms for control requirements.
  2. Contractor shall install wireless daylight sensors at each vestibule as indicated on plans to control only type "DL6" fixtures within vestibules. Additional daylight sensors to be located within markets with access to windows only.
  3. Contractor shall install A/V interface device at exposed ceiling on underside of slab for on/off control of TVs in this main concourse in lieu of remote control. Content of TV to be accessed through separate A/V touch screen or iPad.
  4. Contractor to install DMX interface at exposed ceiling to control DMX-based light fixtures, types "LL2", "WL4", and "WL7" and connected to DMX-touch screen within Video Production room-03.21.02 for control during blackout conditions. No DMX touch screen to be located in concourse; only in Video Production room.

4. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for university review and commentary throughout the commissioning process.

#### 4.12 SUITE LEVEL INDIVIDUAL SUITES

- A. General Description
  1. No daylight, occupancy, or vacancy sensors to be located within suites.
  2. Contractor shall install wired preset station SW3 within each suite to control zones within those individual suites based on quantities of suites indicated. Preset stations to be programmed to be engaged during operating hours as stated by owner representative.
  3. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for university review and commentary throughout the commissioning process.
  4. All zones within suite except the zones dedicated for the food service/ entry steplights, type "WL18" to be accessed through an override within the Video Production room- 03.21.02 master control of the arena for blackout conditions. The steplights to remain on during blackout requirements

#### 4.13 SUITE LEVEL LOUNGES

- A. General Description
  1. No daylight, occupancy, or vacancy sensors to be located within suites.
  2. Contractor shall install wired preset station SW5 for (5) scenes with no "off" scene as indicated on plans at bar area. Preset stations to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"-master control station in Security Office. Only the master control station of iPad control to have access to an "off" scene.
  3. All TVs to be controlled by remote control at bar. No AV interface needed for power control of TVs.
  5. All zones within suite except the zones dedicated for the food service/ entry steplights, type "WL18" to be additionally accessed through an override within the Video Production room- 03.21.02 master control of the arena for blackout conditions. The steplights to remain on during blackout requirements
  6. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for university review and commentary throughout the commissioning process.

#### 4.14 SUITE LEVEL BARS

- A. General Description
  1. No daylight, occupancy, or vacancy sensors to be located within bars.
  2. Contractor shall install wired preset station SW5 for (5) scenes with no "off" scene as indicated on plans at bar area. Preset stations to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"-master control station in Security Office. Only the master control station of iPad control to have access to an "off" scene.
  3. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for university review and commentary throughout the commissioning process.

**4.15 SUITE LEVEL LOGE CLUB AND PUBLIC AREAS**

## A. General Description

1. No daylight, vacancy or occupancy sensors provided. Due to drapery along window wall daylight sensors to be rendered ineffective.
2. Contractor shall install wired preset station SW5 for (5) scenes with no "off" scene as indicated on plans at northwest buffet area-room 03.07.04 on west side of column for control of loge club-room 03.03.02 in areas A and B of plans. Buffet areas themselves to be controlled only through master control station-"MS" along with markets in the main concourse. Preset stations to be programmed to be engaged during operating hours as stated by owner representative. Lighting in this area to also be controlled through "MS"-master control station in Security Office. Only the master control station of iPad control to have access to an "off" scene.
3. Contractor shall install A/V interface device at exposed ceiling on underside of slab for on/off control of TVs in this suite level loge club in lieu of remote control. Content of TV to be accessed through separate A/V touch screen or iPad.
4. Control of type "DL5A" fixtures to also be accessed from Video Production Room as referenced in Section 1.1.F
5. Preliminary Sequence of Operation accessed through preset stations referenced above to be indicated in shop drawings so that scene light levels per zone can be downloaded during commissioning for university review and commentary throughout the commissioning process.

**4.16 CATWALK LEVEL**

## A. General Description

1. Contractor to install DMX interface at exposed ceiling to control DMX-based light fixtures, types "TL12" and "TL13" and to DMX-touch screen within Video Production room-03.21.02 for control during blackout conditions. No DMX touch screen to be located in concourse; only in Video Production room.

**4.17 ALL LEVEL PUBLIC RESTROOMS**

## A. General Description

1. Contractor shall install wireless occupancy sensors as indicated to control zones within these areas. Occupancy sensors to be engaged during operating hours.
2. Contractor shall install wired preset station noted as "SW1" single button station for use during off hours for cleanup requirements if occupancy sensor turnslights off. Preset stations to be located for each multi-occupant restroom indicated on every level except those restroom associated with player locker rooms. Preset station programmed to be engaged only during non-operating hours and dis-engaged during normal hours as stated by owner representative.

**4.18 FAÇADE AND SITE LIGHTING**

## A. General Description

1. At the northwest and southwest corners of the catwalk/roof level, contractor to install a wireless DMX antenna connected to Acclaim's Aria wireless DMX transmitter/receiver on the roof and then connected via wired DMX within the building to the Pharos/ Mosaic single universe DMX touch screen designated as station "MTS" in the Event Level administration office. From all corners of the building at the roof, an Acclaim Aria series antenna to be connected to wireless DMX transmitter/ receivers at each indicated site pole, types "SLP1", "SLP2", and "SLP5/A/B" series. The northwest Acclaim's Aria transmitter/ receiver and antenna to be within field of view of fixture types "SL1" and "SL2" along Civic Center

Drive. The six (6) existing poles along Civic Center Drive to support the Acclaim Aria wireless transmitter/ receiver as per manufacturer's requirements so that existing power wiring to these poles can be re-used without additional expense of providing DMX control wiring. The southwest Aria transmitter/receiver and antenna to be within field of view of fixture types "SL6", "SL7", "SL8", "SL10" at the circular plaza, and "SL13" at the roof. A transmitter/receiver to be mounted to each of the "smart" site lighting poles, types "SLP1", "SLP2", and "SLP5" series which connects to specific fixtures on said poles through wired DMX. The wireless DMX system for Civic Center Drive and within the new southwest plaza and connecting paths allows DMX control without the need to run DMX or Ethernet cable underground.

2. Zones within these areas to be operated by iPad control with password protection and automatic astronomic timeclock function with preliminary Sequence of Operations.
3. No preset stations to be provided for the concourse. Only the "MS" mater control station in the officereception-room 01.04.04 or iPad control to have access to the zones associated with the concourse or the individual markets. Refer to the section associated with public restrooms for control requirements.

END OF SECTION

**SECTION 26 09 23 - LIGHTING CONTROL DEVICES****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. This Section includes the following lighting control devices:
  - 1. Line-voltage dimming wall switches.
  - 2. Line-voltage wall switch occupancy sensors.
  - 3. Line-voltage dimming wall switch occupancy sensors.
  - 4. Stand-Alone Low-voltage occupancy sensors.
  - 5. Stand-Alone Low-voltage photoelectric switches.
  - 6. Stand-Alone Low-voltage power packs.
  - 7. Stand-Alone Low-voltage switches.
  - 8. Automatic load control relays.
  - 9. Branch circuit transfer switches.
  - 10. Conductors and Cables for Lighting Control Devices.

**1.2 DEFINITIONS**

- A. Acoustic Type: Occupancy sensor detection type that detects occupancy by listening for acoustic noises.
- B. Closed loop: Photosensor control algorithm designed for influence by both daylight and electric light in a space or area.
- C. DPDT: Double pole, double throw.
- D. DPST: Double pole, single throw.
- E. Dual-Technology Type: Occupancy sensor detection type that detects occupancy by using a combination of PIR and ultrasonic or acoustic detection technologies.
- F. LED: Light-emitting diode.
- G. Open loop: Photosensor control algorithm designed for influence by daylight entering in a space or area.
- H. PIR Type: Passive infrared. Occupancy sensor detection type that detects occupancy by sensing a combination of infrared heat and movement.
- I. SPST: Single pole, single throw.
- J. Ultrasonic Type: Occupancy sensor detection type that detects occupancy by sensing a change in pattern of reflected ultrasonic energy.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

**1.4 SUBMITTALS**

- A. Product data for the following products:
  - 1. Catalog cut sheets, including major and minor motion coverage patterns sensors, time delay and sensitivity adjustability settings, load restrictions, and performance specification items indicating compliance with this specification for all lighting control devices.

- B. Shop Drawings:
  - 1. Occupancy sensors and photoelectric switches
    - a. Show installation details.
    - b. Lighting plan showing location, mounting height, orientation and coverage area of each sensor and coordination with other trades.
    - c. Interconnection diagrams showing field-installed wiring.
    - d. Include diagrams for power, signal, and control wiring.
    - e. For any manufacturer submitted other than that listed as the Basis of Design, provide the following information for Engineer review:
      - 1) Factory-generated occupancy sensor and photoelectric switch layouts on project lighting plans with sensor location, orientation and product type clearly marked on plans. Sensor placement shall be coordinated with project reflected ceiling plan layout, ceiling heights, lights, diffusers, and any other ceiling devices and equipment.
      - 2) List of any deviations to this specification or Basis of Design products.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
  - 1. Occupancy sensors and photoelectric switches:
    - a. Manufacturer's installation instructions, including instructions for storage, handling, protection, examination, preparation, start-up calibration and installation.
    - b. Product data clearly showing sensor field adjustments, including dip switch setting definitions and location of settings within sensors.
    - c. Manufacturer's maintenance, including operating and adjustment instructions.
  - 2. Timeclocks
    - a. Description of programmed timeclock settings at time of substantial completion.
  - 3. Line-voltage wall box dimming switches
    - a. Provide operating instructions for each type of dimmer.

## 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Occupancy sensors and photoelectric switches
  - 1. Products supplied shall be from a single manufacturer that has been continuously involved in the manufacturing of occupancy sensors for a minimum of 5 years.
  - 2. Products shall be manufactured by an ISO 9001 certified manufacturing facility.
  - 3. Manufacturer shall test all equipment prior to shipment.

## 1.6 WARRANTY

- A. Manufacturers shall provide a five (5) year warranty for sensors and accessories from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GENERAL INFORMATION

- A. PIR type requirements:
  - 1. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.

2. Sensor shall utilize pulse count processing and digital signature analysis to respond only to those signals caused by human motion.
  3. Sensor shall provide high immunity to false triggering from RFI and EMI.
  4. Sensor shall have a multiple-segmented fresnel lens in a multiple-tier configuration, with grooves to eliminate dust and residue buildup. Sensor shall be capable of accepting mask inserts to mask specific portions of the lens to prevent false triggering.
- B. Ultrasonic type requirements:
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  2. Detection Frequency (Small Area – 500 sq ft and less): Ultrasonic operating frequency shall be crystal controlled at 40 kHz within  $\pm 0.005\%$  tolerance to assure reliable performance and eliminate sensor cross-talk.
  3. Detection Frequency (Medium and Large Areas – greater than 500 sq ft): Ultrasonic operating frequency shall be crystal controlled at 32 kHz within  $\pm 0.005\%$  tolerance, to assure reliable performance and eliminate sensor cross-talk.
  4. Sensors shall be capable of automatically adapting to airflow conditions or filtering frequency spectrum related to air movement.
- C. Acoustic type requirements:
1. Detector Sensitivity: Acoustic type technology shall only be used as secondary to PIR in a Dual-Technology Type sensor. Specific sensitivity is based on PIR technology.
  2. Sensors shall distinguish noises made by human activity (typing, talking, eating, etc.) and filter out noises made by the environment or building (HVAC, equipment, cars, etc.).
  3. Acoustic technology shall enhance reliability and accuracy of PIR sensor.
- D. Dual-Technology type requirements:
1. Dual-Technology sensors using ultrasonic technology shall have field-selectable controls on unit to determine if a particular technology or combination of technologies controls the on-off function.
  2. Dual-Technology sensors using acoustic technology shall have the PIR technology initially detect motion and a combination of PIR and acoustic technologies shall keep the load on.
  3. Sensitivity Adjustment: Separate for each sensing technology.
  4. Different LED indicator colors for each sensing technology
  5. PIR sensor component shall comply with all requirements listed under PIR type requirements.
  6. Ultrasonic sensor component shall comply with all requirements listed under Ultrasonic Type requirements.
  7. Acoustic sensor component shall comply with all requirements listed under Acoustic Type requirements.

## 2.2 LINE-VOLTAGE DIMMING WALL SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. Dimmer shall be suitable for dimmed load type of connected light fixture. Load types shall be as indicated on Drawings and confirmed per load type for connected luminaire as indicated in Light Fixture Schedule and approved light fixture and dimmer shop drawings.

## 2.3 LINE VOLTAGE WALL SWITCH OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for Sensors:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C), unless indicated elsewhere for specific model and application.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
4. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply.
  - a. Occupancy Sensor (auto-on): Upon occupancy of space, loads shall be energized. If occupancy is not detected within the time delay period, loads shall be de-energized.
  - b. Vacancy Sensor (manual-on): Upon occupancy of space, loads are enabled such that manual operation of the switch shall energize loads. If occupancy is not detected within the time delay period, loads shall be de-energized.
5. Operation adjustment: Concealed, field-adjustable for auto-on or manual-on operation.
6. Time Delay adjustment:
  - a. Concealed, field-adjustable.
  - b. Time delay for de-energizing loads shall be adjustable with multiple increments from 30 seconds up to 30 minutes.
7. Adaptive technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
8. Mounting: Single-gang wall box switch
9. Finish: Sensor finish shall be as directed by the Architect.
10. Sensor:
  - a. Vandal-resistant lens
  - b. Integral sliding blinders or pre-cut tape strips to block sensor views
  - c. Protrudes no greater than 0.50 inches from wall.
  - d. 180-degree field of view
  - e. Major and minor motion coverage patterns confirmed per Nema WD7 guidelines.
  - f. Detection types: Provide type or types indicated in Lighting Control Device Schedule. Refer to Section 2.1 General Information above for more information.
11. Indicators:
  - a. LED indicator for visual detection of motion
  - b. audible and/or visual alerts for pending shut-off
12. Suitable for switching load types used, including LED, fluorescent, incandescent, magnetic and electronic low voltage and motor load types. UL listed and labeled, zero-cross relay, no minimum load requirement, ground wire.
13. Wall switch shall have no leakage of current to load and integral service switch to permit a maintained off for servicing of lamps for safety purposes
14. Buttons/Relays: Provide control relay and push button quantities as indicated by model listed in Lighting Control Device Schedule.
15. Restriction on leakage to grounding conductor.
  - a. For new construction: Dual-technology wall switch sensor shall have not more than 0.5ma leakage of current to ground per UL requirements. Provide and connect a neutral conductor to these devices.

## 2.4 LINE-VOLTAGE DIMMING WALL SWITCH OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for Sensors:
  1. Comply with all requirements listed under Line-Voltage Dimming Wall Switches in this specification and,



2. Comply with all requirements listed under Line-Voltage Wall Switch Occupancy Sensors in this specification.

## 2.5 LINE-VOLTAGE OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors. Integral relay unit for line voltage sensors.
  1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. UL Listed for dry locations and complies with local codes.
  3. Operation: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply. Upon occupancy of space, loads shall turn on. If occupancy is not detected within the time delay period, loads shall de-energize. Time delay for de-energizing loads shall be adjustable over a minimum range of 1 to 15 minutes with a maximum of 30 minutes.
  4. Switch Rating: As indicated in Lighting Control Device Schedule.
  5. Detection Coverage: As indicated in Lighting Control Device Schedule on Drawings.
  6. Mounting: Suitable for mounting in any position on a standard outlet box.
  7. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  8. Indicator: LED, to show when motion is detected during testing and normal operation of the sensor.
  9. Bypass Switch: Override the "on" function in case of sensor failure, concealed on unit to prevent tampering.
  10. Finish: Sensor finish shall be as directed by the Architect.
  11. Operating temperatures: Unless indicated otherwise for specific models, 32 degree F through 104 degree F, and relative humidity of 0%-95%.
  12. Field selectable time delay and sensitivity settings or the capability for self-adjusting technologies to optimize time delay and sensitivity settings to respond to occupancy usage patterns. Occupancy usage patterns shall be saved in a non-volatile memory that retains settings in the event of a power outage.
  13. Device shall include isolated relay with NO and NC contacts to interface with BMS, HVAC and or other building monitoring systems as indicated on the Drawings
  14. Device and related relays shall be compatible with the specific load types controlled.
  15. Sensor:
    - a. Coverage pattern: As indicated in Lighting Control Device Schedule, and shall have been confirmed with NEMA WD7 Guide and Robotic test method.
    - b. Detection types: Provide type or types indicated in Lighting Control Device Schedule. Refer to Section 2.1 General Information above for more information.
- C. High-Bay Model:
  1. Detection type: PIR type. Refer to Section 2.1 General Information above for more information.
  2. Detection Coverage: Selectable by interchangeable PIR lenses, suitable for mounting heights from 12 to 50 feet.
- D. Extreme Temperature Model:
  1. Detection type: PIR type. Refer to Section 2.1 General Information above for more information.
  2. Operating Ambient Conditions: Temperatures from minus 40 to plus 125 degree F.

**2.6 STAND-ALONE LOW-VOLTAGE OCCUPANCY VACANCY SENSORS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensor unit, for use with a separate stand-alone low-voltage power pack containing a line-voltage relay.
1. Occupancy sensors and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
  2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  3. UL Listed for dry locations and complies with local codes.
  4. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply.
    - a. Occupancy Sensor (auto-on): Upon occupancy of space, loads shall be energized. If occupancy is not detected within the time delay period, loads shall be de-energized.
    - b. Vacancy Sensor (manual-on): Upon occupancy of space, loads are enabled such that manual operation of a separate, associated switch shall energize loads. If occupancy is not detected within the time delay period, loads shall be de-energized.
  5. Switch Rating: As indicated in Lighting Control Device Schedule.
  6. Detection Coverage: As indicated in Lighting Control Device Schedule on Drawings.
  7. Mounting: Suitable for mounting in any position on a standard outlet box.
  8. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  9. Indicator: LED, to show when motion is detected during testing and normal operation of the sensor.
  10. Bypass Switch: Override the "on" function in case of sensor failure, concealed on unit to prevent tampering.
  11. Finish: Sensor finish shall be as directed by the Architect.
  12. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.
  13. Field selectable time delay and sensitivity settings or the capability for self-adjusting technologies to optimize time delay and sensitivity settings to respond to occupancy usage patterns. Occupancy usage patterns shall be saved in a non-volatile memory that retains settings in the event of a power outage.
  14. Sensors:
    - a. Sensor shall be compatible with lighting control system.
    - b. Sensors shall be capable of being combined with additional sensors to achieve adequate coverage.
    - c. Sensor coverage pattern: AS indicated on Lighting Control Device Schedule, and shall have been confirmed with Nema WD7 Guide and Robotic test method.
    - d. Detection types: Provide type or types indicated in Lighting Control Device Schedule. Refer to Section 2.1 General Information above for more information.
- C. High-Bay Model:
1. Detection type: PIR type. Refer to Section 2.1 General Information above for more information.
- D. Extreme Temperature Model:
1. Detection type: PIR type. Refer to Section 2.1 General Information above for more information.
  2. Operating Ambient Conditions: Temperatures from minus 40 to plus 125 degree F.

**2.7 STAND-ALONE LOW-VOLTAGE PHOTOELECTRIC SWITCHES**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for switches: Ceiling-mounted, solid-state indoor photoelectric switch, for use with a separate stand-alone low-voltage power pack, containing a line-voltage relay.
  - 1. Switches and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
  - 2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 3. UL Listed for dry locations and complies with local codes.
  - 4. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply. Upon ambient light level measurement reading below setpoint, loads shall be de-energized. Upon ambient light level measurement reading above setpoint, loads shall be energized.
  - 5. Finish: Sensor finish shall be as directed by the Architect.
- C. Indoor:
  - 1. Photoelectric switches shall be Open Loop or Closed Loop as indicated on the Lighting Control Device Schedule on the Drawings.
  - 2. Description: Solid state, low voltage with contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the lighting control system or as indicated on the Drawings.
    - a. Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lx), with an adjustment for turn-on and turn-off levels within that range.
    - b. Time Delay: 30-second minimum, to prevent false operation.
    - c. Mounting: Twist lock complying with IEEE C136.10, with base.

**2.8 STAND-ALONE LOW-VOLTAGE POWER PACKS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for power packs: Box mounted, solid-state indoor power pack/relay unit, for use with a separate stand-alone low-voltage sensor and switches.
  - 1. Power packs and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
  - 2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 3. UL Listed for dry locations and complies with local codes.
  - 4. Unit shall include isolated relay with NO and NC contacts to interface with BMS, HVAC and or other building monitoring systems as indicated on the Drawings
  - 5. Relay shall be compatible with the specific lighting types controlled.
  - 6. Operations: Refer to drawings for Sequence of Operations or other operational instructions. Unit operates in conjunction with other system components. Refer to operations requirements of associated devices.
  - 7. Switch Rating: As indicated in Lighting Control Device Schedule.  
Mounting: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
  - 8. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.

**2.9 STAND-ALONE LOW-VOLTAGE SWITCHES**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for switches: Wall-mounted, solid-state indoor manual switch, for use with a separate stand-alone low-voltage power pack, containing a line-voltage relay.
  - 1. Switches and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
  - 2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 3. UL Listed for dry locations and complies with local codes.
  - 4. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply. Manual push of any button shall energize or de-energize loads.
  - 5. Mounting: Suitable for mounting in any position on a standard outlet box.
  - 6. Indicator: LED, for each button to indicate when loads are energized and de-energized.
  - 7. Finish: Sensor finish shall be as directed by the Architect.
  - 8. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.

**2.10 AUTOMATIC LOAD CONTROL RELAYS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings.
- B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
  - 1. For control of emergency lighting circuits: Loss of normal power shall cause relay to automatically shunt emergency power to lighting circuit regardless of manual or automatic switch position. Emergency lighting circuit shall continue to operate at full power until normal power has been restored.
  - 2. Coil Rating: 120 or 277 V, as indicated on Drawings.
  - 3. Mounting: a 2-gang outlet box with separation barrier and plaster ring. Mount per manufacturer's instructions.

**2.11 BRANCH CIRCUIT TRANSFER SWITCHES**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings.
- B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 1008.
  - 1. For control of emergency lighting circuits: Loss of normal power shall cause relay to automatically shunt emergency power to lighting circuit regardless of manual or automatic switch position. Emergency lighting circuit shall continue to operate at full power until normal power has been restored.
  - 2. Coil Rating: 120 or 277 V as indicated on Drawings.

**2.12 CONDUCTORS AND CABLES FOR LIGHTING CONTROL DEVICES**

- A. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

- B. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG.
- C. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG.
- D. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG.
- E. Provide all necessary conductor and cabling required for operation of the controls and control systems specified. This includes power and control wiring required for the controls to operate as described.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. GENERAL
  - 1. Install devices and associated power packs and wiring in accordance with manufacturer's instructions and applicable codes.
- B. LINE VOLTAGE WALL SWITCHES
  - 1. Install dimming wall switches to achieve full rating specified on Lighting Control Device Schedule taking into account de-rating for ganging as instructed by the manufacturer.
  - 2. Provide a separate grounded (neutral) conductor for each circuit controlled by a line voltage switch.
    - a. Do not share neutral conductor on load side of dimmers.
    - b. If neutral termination is not required for the device, cap conductor and tag as "Neutral for future use".
- C. OCCUPANCY/VACANCY SENSORS AND PHOTOELECTRIC SWITCHES
  - 1. Arrange a pre-installation meeting with manufacturer's factory authorized field representative, at Owner's facility, to verify placement of sensors and installation criteria.
  - 2. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage areas specified in manufacturer's literature. The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms or areas that are to be provided with sensors. Provide additional sensors as required to properly and completely cover the respective areas.
  - 3. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems and partition assemblies.
  - 4. Occupancy sensors with ultrasonic or dual-technology sensing technologies shall be located not closer than 4 feet from the nearest edge of air supply devices or similar obstructions that would adversely affect the sensor performance.
  - 5. Adjust time delay setting of occupancy sensors to de-energize loads after space has been unoccupied for period of time indicated on the Drawings.
  - 6. Install outdoor photoelectric switches with clear view of the northern sky unless noted otherwise on the Drawings.
  - 7. Adjust settings of photoelectric switches to turn on lighting at illumination level indicated on the Drawings.
  - 8. Install devices and auxiliary equipment in compliance with manufacturer's instructions and recommendations.
  - 9. Install relay units where concealed from view and where accessible.
  - 10. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
  - 11. Install switchbox mounted occupancy sensors at same elevation as other lighting control switches.

**D. AUTOMATIC LOAD CONTROL RELAYS**

1. When used with manual controls, install emergency shunt relay in accessible ceiling near the control device or wall mounted within electrical room. Label within enclosure the connected normal and emergency circuits.
2. When used with automatic controls, install where concealed from view in accessible ceiling near the automatic control device or wall mounted within electrical room. Label outlet box cover with connected normal and emergency circuits.

**E. BRANCH CIRCUIT TRANSFER SWITCHES**

1. Install branch circuit transfer switches where concealed from view in accessible ceiling near the automatic control device or wall mounted within electrical room. Label outlet box cover with connected normal and emergency circuits.

**F. WIRING**

1. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm) insert size .
2. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
3. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
4. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

**3.2 IDENTIFICATION**

- A. General: Provide identification complying with requirements specified in Division 26 Section "Identification for Electrical Systems."
- B. Power and control wiring: Identify using marker tapes.
  1. Identify controlled circuits in lighting contactors.
  2. Identify circuits or luminaires controlled by photoelectric switches and occupancy sensors at each sensor.
- C. Components: Label each component with self-laminating computer printed labels, using a unique designation matching control drawing.
- D. Cover plates: Refer to drawings for labeling requirements of certain cover plates for manual switches, or similar devices, requiring labeling for user information.
- E. Buttons/switches:
  1. Engraved from manufacturer. Refer to drawings for detailed requirements and text for labeling.

**3.3 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
  2. Operational Test: Test all occupancy sensors in test mode to confirm sensor coverage and sensitivity of sensor per manufacturer's instructions. Upon completion of tests, set sensor time delay as indicated on Lighting Control Device Schedule. Follow testing and adjustment procedures as written in the manufacturer's installation instructions for each sensor model.
- B. Lighting control devices that fail tests and inspections are defective work. Remove, replace, and retest devices that fail tests.

**3.4 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
- B. Photoelectric switch Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project for this purpose.

**3.5 DEMONSTRATION**

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Lighting Control Systems."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training" for additional information

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1500 kVA:
  - 1. Distribution transformers.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

**1.3 SUBMITTALS**

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, technical certification sheets and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
  - 2. Transformer ratings including:
    - a. kVA
    - b. Primary and secondary voltage
    - c. Taps
    - d. Basic impulse level (BIL) for equipment over 600 volts
    - e. Design impedance
    - f. Insulation class and temperature rise
    - g. Sound level.
- C. Source quality-control test reports.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

**1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."
- D. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".

- E. All transformers shall be UL listed and bear the UL label.

## 1.5 DELIVERY STORAGE AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

## PART 2 - PRODUCTS

### 2.1 GENERAL TRANSFORMER REQUIREMENTS

- A. Manufacturers:
  - 1. ACME Electric Corporation; Power Distribution Products Division
  - 2. Eaton Electrical Inc.; Cutler-Hammer Products.
  - 3. General Electric Company.
  - 4. Hammond Company
  - 5. Siemens Energy & Automation, Inc.
  - 6. Sola/Hevi-Duty
  - 7. Square D; Schneider Electric.
- B. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- C. Cores: One leg per phase. Cores shall be constructed of high grade, non-aging silicon steel. The core and coil assembly shall be impregnated with non-hydroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture. The completed core and coil shall be bolted to the base of the enclosure but isolated by means of rubber, vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor or strap sized in accordance with UL and NEC requirements. The neutral shall be brought to a stud to facilitate the required external grounding of the secondary
- D. Coils: Continuous windings without splices except for taps.
  - 1. Internal Coil Connections: Brazed or pressure type.
  - 2. Coil Material: Aluminum.
- E. Connections to transformers shall be by flexible metal conduit and using flexible couplings.
- F. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.
- G. Wiring/Terminations:
  - 1. Recommended external cable shall be rated 90 degrees C (sized at 75 degrees C ampacity) for encapsulated and 75 degrees C for ventilated designs.
  - 2. Connectors should be selected on the basis of the type and cable size used to wire the specific transformer.
  - 3. Lug kits shall be provided by the Manufacturer of the transformer.

### 2.2 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Enclosures: Unless otherwise specified, transformer enclosures shall be ventilated and be fabricated of heavy gauge, sheet steel construction. Enclosures shall have a baked polyester powder coat finish-gray in color and suitable for interior or exterior applications. Enclosures shall be constructed so that there are no exposed live parts. Enclosures shall have a removable front cover to allow access to internal parts and wiring terminations

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
  2. Transformer locations:
    - a. Dry locations:
      - 1) Ventilated
      - 2) NEMA 250, Type 2.
    - b. Damp or wet:
      - 1) Ventilated. Provide weather shields over ventilation openings.
      - 2) NEMA 250, Type 3R.
    - c. Corrosive locations:
      - 1) Totally enclosed, non-ventilated
      - 2) NEMA 250, Type 4X, stainless steel
  3. The maximum temperature of the enclosure shall not exceed 90 degrees C.
  4. The maximum temperature of the top of the enclosure shall not exceed 50°C rise above a 40°C ambient.
- C. Transformer Enclosure Finish: Comply with NEMA 250.
1. Finish Color: ANSI 61 gray.
- D. Taps
1. Three-phase Transformers smaller than 24 kVA and all single phase transformers:
    - a. One 5 percent tap above and one 5 percent tap below normal full capacity
  2. Transformers 25 kVA through 500 kVA:
    - a. Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
  3. Transformers 501 kVA and Larger:
    - a. Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity manufacturer's standard tap configuration.
- E. Insulation Class for transformers less than 15 kVA: 185 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- F. Insulation Class for transformers 15 kVA and larger: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature
- G. Energy Efficiency for Transformers Rated 15 kVA and Larger:
1. Complying with the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment" efficiency levels.
  2. Tested in accordance with federal law 10 CFR Part 431.
- H. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
  2. Indicate value of K-factor on transformer nameplate.
  3. K-Factor rated transformers shall have an impedance range of 3% to 5%, and shall have a minimum reactance of 2% in order to prevent excessive neutral current when supplying loads with large amounts of third harmonic.
  4. 115 degree C temperature rise.
  5. All cores to be constructed with low hysteresis and eddy current losses. The core flux density shall be well below the saturation point to prevent core overheating and excessive sound level caused by harmonic voltage distortion.
  6. Transformers shall be common core construction. Transformers utilizing more than one core, or Scott-T connections, shall not be acceptable.
  7. Three-phase transformer secondary neutral terminals shall be sized for 200% of the secondary phase current.
  8. The transformer shall be mounted on vibration absorbing pads.

- I. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize inter-winding capacitance.
  1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
  2. Include special terminal for grounding the shield.
  3. Shield Effectiveness:
    - a. Capacitance between Primary and Secondary Windings: Not to exceed 33 Pico farads over a frequency range of 20 Hz to 1 MHz.
    - b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz; minimum of minus 40 dBA at 100 kHz to 1MHz.
    - c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz; minimum of minus 30 dBA at 10 kHz to 1MHz.
- J. Motor Drive Isolation
  1. Where shown on the drawings, provide motor drive isolation transformers
  2. Motor drive isolation transformers shall be designed for use with three-phase ac adjustable frequency drives 600 volts and below to provide isolation between the incoming line and drive circuitry. These drives minimize the line disturbances caused by SCR firing within the drive unit. Thermoguards shall be included in all motor drive isolation transformers to provide additional protection for the transformer from increased heating due to the non-sinusoidal characteristics of drive currents. The transformer shall provide reduced short-circuit currents and voltage line transients. The transformer shall be specifically sized to the drive kVA requirements dictated by the horsepower of the motor and, as such, will be mechanically braced to withstand the stress of current reversals and short-circuit currents associated with the specific drive kVA rating. Transformers shall be low loss type with minimum efficiencies per NEMA TP-1 when operated at 35% of full load capacity
- K. Mounting Methods.
  1. Transformers 75 KVA and larger shall be floor mounted unless indicated otherwise. Transformers 45 KVA and smaller may be wall mounted where wall construction is suitable for the load. Floor mounted transformers shall be securely bolted to a 4 inch, concrete housekeeping pad with vibration isolation pads. Wall mounted or suspended transformers shall have a means of isolating vibration from the support.
  2. Transformers up through 1000 KVA shall be mounted on elastomeric vibration isolation pads. Pad shall be constructed of neoprene, rubber, glass fiber, or a combination thereof. Pads shall be "ribbed" or "waffled" in texture. Pads shall be selected for smallest durometer (hardness), preferably less than 50. Deflection of pad shall be .25" static minimum. Stack pads until the desired deflection is achieved.
  3. Wall Mounting: Manufacturer's standard brackets.
  4. Suspended Mounting: See transformer mounting detail on plans.
- L. Fungus Proofing: Permanent fungicidal treatment for coil and core.
- M. Low-Sound-Level Requirements: Maximum sound levels (NEMA ST 20), when factory tested according to IEEE C57.12.91, as follows:
  1. 29 kVA and Less: 40 dBA
  2. 10 to 50 kVA: 45 dBA
  3. 51 to 150 kVA: 50 dBA
  4. 151 to 300 kVA: 55 dBA
  5. 301 to 500 kVA: 60 dBA
  6. 501 to 700 kVA: 62 dBA
  7. 701 to 1000 kVA: 64 dBA
  8. 1001 to 1500 kVA: 65 dBA

## 2.3 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to ANSI C57.12.01 and IEEE C57.12.91.

## 2.4 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
  - 1. Ratio tests at the rated voltage connection and at all tap connections
  - 2. Polarity and phase relation tests on the rated voltage connection
  - 3. Applied potential tests
  - 4. Induced potential test
  - 5. No-load and excitation current at rated voltage on the rated voltage connection

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Floor mounted transformers shall be mounted on a 4 inch concrete housekeeping pad 2 inches larger all around transformer.
- C. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
- D. Use flexible conduit under the provisions of Division 26 Section "Raceways and Boxes for Electrical Systems" for connections to transformer case. Minimum flexible conduit length shall be two (2) feet.
- E. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- F. CONNECTIONS
  - 1. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
  - 2. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 IDENTIFICATION

- A. Nameplates: Label each transformer with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems." Nameplates shall be engraved with the following information
  - 1. Transformer name

2. Fed from (primary source)
  3. Secondary voltage, phase, wires
- B. Warning Labels: Label each panelboard with a warning label indicating NFPA 70 workspace clearance requirements, complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Remove and replace units that do not pass tests or inspections and retest as specified above.
- C. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
  2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
  3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### 3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

### 3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

**SECTION 26 24 13 - SWITCHBOARDS****PART 1 - GENERAL****1.1 SUMMARY**

- A. This section includes switchboards rated 600 V and less, including the following:
  - 1. Service and distribution switchboards.
  - 2. Surge Protection Devices.
  - 3. Disconnecting and overcurrent protective devices.
  - 4. Instrumentation.
  - 5. Control power.
  - 6. Accessory components and features.

**1.2 DEFINITIONS**

- A. GFCI: Ground-fault circuit interrupter.
- B. NETA ATS: InterNational Electrical Testing Association Acceptance Testing Specification.
- C. SPD: Surge Protection Device

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Fault-Current Study, Coordination Study, and Overcurrent Protective Device Settings report must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. If studies have not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the contractor at no additional cost to the project. Refer to specification section "Power System Studies."

**1.4 SUBMITTALS**

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements".
- B. Product Data: For each type of switchboard, switching and overcurrent protective device, instrumentation, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, weights, and finishes.
- C. Shop Drawings: For each switchboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details, including required clearances, service space around equipment, and attachments to other work. Show tabulations of installed devices, equipment features, and ratings.
    - a. Tabulate features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.

3. Include outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
  4. Detail bus configuration, current, and voltage ratings, including size and number of bus bars and current rating for each bus. Indicate mains and branches of phase, neutral, and ground buses.
  5. Detail short-circuit current rating of switchboard assembly and overcurrent protective devices.
  6. Include descriptive documentation of barriers specified for electrical insulation and isolation.
  7. Detail utility company's metering provisions with indication of approval by utility company.
  8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  9. Include schematic and wiring diagrams for power, signal, and control wiring.
  10. Include nameplate legends.
  11. Include list of materials.
- D. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchboard where pipe and ducts are prohibited. Show switchboard layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
1. For each equipment room, provide dimensioned layout of the electrical equipment within the space, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved.
  2. Dimensioned concrete base, outline of switchboard, conduit entries, and ground rod locations; including equipment working clearances and manufacturer required access space.
  3. Indicate structural members, light fixtures, sprinkler piping and heads, HVAC equipment, ducts and diffusers, plumbing piping and access fittings. Include maintenance access clearances.
  4. Location of structural supports for structure-supported raceways.
  5. Location and clearance of electrical equipment and raceways impacting equipment installation.
- E. Sustainable Design Documentation: Submit manufacturer's product data on materials and assemblies showing compliance with building rating standard(s) requirements.
- F. Qualification Data: For qualified Installer.
- G. Field Quality-Control Reports:
1. Test procedures used.
  2. Test results that comply with requirements.
  3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- H. Sample Warranty: For warranty.
- I. Project Record Documents: Record actual installed equipment and circuiting arrangements. Record actual routing for underground circuits. Record actual installed location of ground rods.
- J. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for switchboards and all installed components.
  2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  3. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.
  4. Features and operating sequences, both automatic and manual.
  5. Video recording of operation training and demonstration.



- K. Follow-up service reports.

### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E; Employs installers and supervisors who are trained and approved by manufacturer.
- B. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."
- C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 2.
- F. Comply with NFPA 70.
- G. Comply with UL 891.

### 1.6 PROJECT CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
- B. Environmental Limitations:
  - 1. Do not install switchboards until spaces are enclosed and weathertight. Equipment shall be protected from any remaining wet work in the space and work above secondary unit substation. Provide temporary HVAC system for maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
    - b. Altitude: Not exceeding 6600 feet (2000 m).

### 1.7 DELIVERY STORAGE AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Coordinate delivery of equipment to allow movement into designated space.
- C. Store in a clean, dry space, protected from weather and so condensation will not form on or in units. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic. Handle carefully in accordance with manufacturer's instructions to avoid damage to equipment components, enclosure, and finish. Provide temporary heating according to manufacturer's written instructions.
- D. Handle and prepare switchboard components according to NEMA PB 2.1 and manufacturer's written instructions. Use factory-installed lifting provisions.

### 1.8 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components and/or products of the switchboards that fail in materials or workmanship within the specified warranty period.
- B. Warranty Period: Three years from date of Substantial Completion.

**1.9 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Refer to Division 26 section "Fuses" for spare fuse requirements. At a minimum, include spares for the following:
    - a. Fuses for fusible devices.
    - b. Potential transformer fuses.
    - c. Control power fuses.
  - 2. Indicating Lights: Four of each type installed.
  - 3. Primary Switch Contact Lubricant: One container.
  - 4. Touchup Paint: Two containers of paint matching enclosure finish, each 0.5 pint (250 mL).
  - 5. Enclosure Keys: Two for each enclosure type. All distribution equipment keyed alike.

**PART 2 - PRODUCTS****2.1 GENERAL**

- A. Manufacturers:
  - 1. ABB Inc.
  - 2. Eaton.
  - 3. Schneider Electric.
  - 4. Siemens Energy & Automation, Inc.
- B. Front-Connected, Front-Accessible Switchboards:
  - 1. Main Devices: Fixed, individually mounted.
  - 2. Branch Devices: Panel mounted.
  - 3. Sections front and rear aligned.

**2.2 RATINGS**

- A. Nominal System Voltage: As indicated on the Drawings.
- B. Main-Bus Continuous: Ampacity as indicated on the Drawings.
- C. Short-Circuit Current Rating (SCCR):
  - 1. Refer to fault-current and coordination study submittal requirements listed in other parts of this section, in addition to specification section "Power System Studies".
  - 2. Rating value: Rated to interrupt symmetrical short-circuit current available at terminals. Switchboard shall be fully-rated, unless series-rated is indicated on the drawings. SCCR shall not be less than the highest AIC rating of any circuit breaker in switchboard.

**2.3 FABRICATION**

- A. Indoor Enclosures: Steel, NEMA 250, Type 1.
  - 1. Finish: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- B. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.
- C. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- D. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

- E. Buses and Connections: Three phase, four wire unless otherwise indicated.
1. Bus bars shall connect between vertical sections and between compartments. Cable connections are not permitted.
  2. Phase- and Neutral-Bus Material: Silver- or tin-plated, high-strength, electrical-grade aluminum alloy, with copper or tin-plated aluminum circuit-breaker line connections.
  3. Main-Phase Bus Size: Ampacity as indicated on drawings, with uniform capacity for entire length of switchboard's main and distribution sections
  4. Neutral Bus: 100 percent of phase-bus ampacity, except as indicated. Equip bus with pressure-connector terminations for outgoing circuit neutral conductors.
  5. Vertical Section Bus Size: Ampacity equivalent to horizontal bus, with uniform capacity for entire length of vertical section bus.
  6. Ground Bus: Hard-drawn copper of 98 percent minimum conductivity, with pressure connector for feeder and branch-circuit ground conductors, minimum size required by UL 891.
  7. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
  8. Provide for future extensions from either end of main phase, neutral, and ground bus by means of predrilled bolt-holes and connecting links.
  9. Equip distribution sections with full height vertical bussing to accommodate maximum utilization of space for devices.
  10. Line-Side Conductor and Feeder Circuit-Breaker Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors unless otherwise indicated on Drawings, suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 section "Low-Voltage Electrical Power Conductors and Cables". Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
- F. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- G. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.
- H. Service Entrance Equipment:
1. Label: Where used as service entrance equipment, provide NRTL label for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.
  2. Infrared Windows: Provide with infrared windows in quantities and locations to provide line-of-sight viewing of all cable terminations on the line side of the main overcurrent protective device.

## 2.4 SURGE PROTECTION DEVICES

- A. Provide surge protective devices as required by Division 26 Section "Surge Protective Devices".

## 2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Ratings:
1. Continuous ampere rating: as indicated on drawings.
  2. Voltage and frequency rating: same as switchboard.
  3. Short-circuit current rating (SCCR): Same as requirements for switchboard.
  4. Ampere Interrupting Current (AIC) rating: Rated to interrupt symmetrical short-circuit current available at terminals. Switchboards shall be fully-rated, unless series-rated is indicated on the drawings.

- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long- and short-time time adjustments.
    - d. Ground-fault pickup level, time delay, and  $I^2t$  response.
  4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
  6. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
  8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Mechanical or compression style as indicated, suitable for number, size, trip ratings, and conductor material.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
    - f. Under voltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
    - g. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
    - h. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- C. Insulated-Case Circuit Breaker (ICCB): 80 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
1. Fixed circuit-breaker mounting.
  2. Two-step, stored-energy closing.
  3. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time time adjustments.
    - c. Ground-fault pickup level, time delay, and  $I^2t$  response.
  4. Remote trip indication and control.
  5. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
  6. Control Voltage: as indicated, or as required by control devices per power supply.
- D. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Boltswitch, Inc.
    - b. Eaton Corporation.
    - c. Schneider Electric.
    - d. Siemens Energy & Automation, Inc.
  2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
  3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.
    - a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
    - b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
  4. Auxiliary Switches: Factory installed, single pole, double throw, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
  5. Service-Rated Switches: Labeled for use as service equipment.
  6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
    - a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
    - c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
    - d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
  7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.
- E. High-Pressure, Butt-Type Contact Switch: Operating mechanism uses butt-type contacts and a spring-charged mechanism to produce and maintain high-pressure contact when switch is closed.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
  3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.
    - a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
    - b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
  4. Auxiliary Switches: Factory installed, single pole, double throw, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
  5. Service-Rated Switches: Labeled for use as service equipment.
  6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
    - a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
    - c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
    - d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
  7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.
- F. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

- G. Fuses are specified in Division 26 Section "Fuses."
- H. Arc Flash Mitigation
  - 1. Circuit breakers, 1200 A and larger, shall be provided with an energy-reducing active arc flash mitigation capability. The energy-reducing active arc flash mitigation system shall allow the operator to enable a maintenance mode using a switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. An LED on the trip unit shall indicate the trip unit is in the maintenance mode.
  - 2. Fuses, 1200 A and larger, shall have a clearing time of 0.07 seconds or less at the available arcing current, or shall be provided with an energy-reducing active arc flash mitigation capability. The energy-reducing active arc flash mitigation system shall allow the operator to enable a maintenance mode using a switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. An LED on the trip unit shall indicate the trip unit is in the maintenance mode.
  - 3. Documentation shall be provided in accordance with the NEC for location of overcurrent device and method of clearing time reduction.

## 2.6 INSTRUMENTATION

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
  - 1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
  - 2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; wound type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
  - 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
  - 4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
  - 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
    - a. Phase Currents, Each Phase: Plus or minus 1 percent.
    - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
    - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
    - d. Megawatts: Plus or minus 2 percent.
    - e. Megavars: Plus or minus 2 percent.
    - f. Power Factor: Plus or minus 2 percent.
    - g. Frequency: Plus or minus 0.5 percent.
    - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
    - i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
    - j. Contact devices to operate remote impulse-totalizing demand meter.
  - 2. Mounting: Display and control unit flush or semi flush mounted in instrument compartment door.

## 2.7 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

- B. Control Circuits: 120-V ac, supplied from remote branch circuit.
- C. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- D. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

## 2.8 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
- C. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

## 2.9 IDENTIFICATION

- A. Nameplates: Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine switchboards before installation. Reject equipment that is damaged, or rusted, or have been subjected to water saturation.
- B. Examine areas, surfaces, substrates, and elements to receive switchboards with Installer present, for compliance with requirements for installation tolerances, structural support, ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  - 1. Verify that field measurements are as indicated.
  - 2. Verify that manufacturer's written instructions for environmental conditions have been established in spaces where equipment will be installed, before installation begins.
- C. Examine roughing-in of conduits and grounding systems to verify the following:
  - 1. Wiring entries comply with layout requirements.
  - 2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1 and manufacturer's instructions.
- B. Coordinate layout and installation of equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Seismic Controls for Electrical Systems."
- D. Equipment Mounting: Install switchboards on concrete bases.

1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 3 inches (75 mm) in all directions beyond the maximum dimensions of switchboard unless otherwise indicated or unless required for seismic anchor support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
  2. Anchor switchboards to concrete bases according to manufacturer's written instructions, and requirements in Division 26 Sections "Hangers and Supports for Electrical Systems".
  3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  4. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  6. Install anchor bolts to elevations required for proper attachment to switchboards.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- F. Mount equipment plumb and rigid without distortion of enclosure.
- G. Install overcurrent protective devices, surge suppression devices and instrumentation.
- H. Install filler plates in unused spaces of panel-mounted sections.
- I. Arrange conductors in auxiliary compartments and gutters into groups and bundle and wrap with wire ties.
- J. Comply with NECA 1.

### 3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools for control wiring.

### 3.4 IDENTIFICATION

- A. Equipment Nameplates: Label each contiguous main, or entrance, section with equipment nameplate.
- B. Device Nameplates: Label each main, feeder and branch circuit device with a nameplate.
- C. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- D. Diagram and Instructions:
1. Engraved, Laminated Acrylic or Melamine Label. Mount on front of switchboard.
    - a. Operating Instructions: Printed operating instructions for switchboard, including key interlocking, control sequences, elementary single-line diagram, and emergency procedures.
    - b. System Power One-Line Diagrams: Provide color-coded, large-format one-line diagram showing the new work is to be provided and installed in the associated electrical room. Depict power sources, feeders, distribution components, and major loads.



2. Storage for Maintenance Instructions: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.
- E. Warning Labels: Label each switchboard with a warning label in accordance with NFPA 70 and NFPA 70E.
1. Provide Arc Flash and available fault current warning labels.

### 3.5 CLEANING

- A. After completing equipment installation and before energizing, inspect unit components. Vacuum dirt and debris from interior of equipment; do not use compressed air to assist in cleaning. Remove paint splatters and other spots. Repair exposed surfaces to match original finish.

### 3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions throughout periods when equipment environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.

### 3.7 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges and protective relay trip characteristics as specified in Division 26 Section "Power System Studies."

### 3.8 FIELD QUALITY CONTROL

- A. Testing: Perform the field quality-control tests and inspections listed below:
- B. Acceptance Testing Preparation:
1. After installing equipment but before equipment is energized, test for compliance with requirements.
  2. Verify that grounding system at the equipment tested at the specified value or less.
  3. Test insulation resistance for each bus, component, connecting supply, feeder, and control circuit.
  4. Test continuity of each circuit.
- C. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. After electrical circuitry has been energized, test for compliance with requirements.
  2. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 26 Sections.
  3. Complete installation and startup checks according to manufacturer's written instructions.
  4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
  5. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  6. Report results of tests and inspections in writing. Record adjustable settings and measured insulation resistances. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- D. Infrared Scanning: Perform the following infrared scan tests and inspections and prepare reports:

1. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove necessary panels so joints and connections are accessible to portable scanner.
  2. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
  3. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Voltage Monitoring and Adjusting: After Substantial Completion, if requested by Owner, but not more than six months after Final Acceptance, perform the following voltage monitoring:
1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at the main incoming section of each service entrance switchboards. Use voltmeters with calibration traceable to the National Institute of Science and Technology standards. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from the nominal value by more than plus or minus 5 percent during the test period, is unacceptable.
  2. Corrective Action: If test results are unacceptable, perform the following corrective action, as appropriate:
    - a. Rebalance loads.
    - b. Prepare written request for voltage adjustment by electric utility in accordance with Division 26 section "Provisions for Electric Utility Service".
  3. Retests: Repeat monitoring, after corrective action has been performed, until satisfactory results are obtained.
- F. Switchboard will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.9 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment, overcurrent protective devices, instrumentation, and accessories.
- B. Video record demonstrations presentation for Owner's records.

END OF SECTION

**SECTION 26 24 16 - PANELBOARDS****PART 1 - GENERAL****1.1 SUMMARY**

- A. This section includes panelboards rated 600 V and less, including the following:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.
  - 3. Disconnecting and Overcurrent Protective Devices.
  - 4. Fused Lighting and Appliance Branch-Circuit Panelboards.
  - 5. Surge Protection Devices.
  - 6. Accessory Components and Features.

**1.2 DEFINITIONS**

- A. NETA ATS: InterNational Electrical Testing Association Acceptance Testing Specification.
- B. SVR: Suppressed voltage rating.
- C. SPD: Surge Protection Device

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Fault-Current Study, Coordination Study, and Overcurrent Protective Device Settings report must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. If studies have not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the contractor at no additional cost to the project. Refer to specification section "Power System Studies."

**1.4 SUBMITTALS**

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements".
- B. Product Data: For each type of panelboard, switching and overcurrent protective device, furnished accessories and components. Include dimensions and Manufacturer's technical data on features, performance, electrical characteristics, ratings, weights, furnished options, specialties, accessories, and finishes.
- C. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details, including required clearances, service space around equipment, and attachments to other work. Show tabulations of installed devices, equipment features, and ratings.
    - a. Tabulate features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 2. Detail enclosure types and details for other than NEMA 250, Type 1.

3. Include general arrangement drawing showing dimensions and weights of each assembled section.
  4. Detail bus configuration, current, and voltage ratings, including size and number of bus bars and current rating for each bus. Indicate mains and branches of phase, neutral, and ground buses.
  5. Detail short-circuit current rating of panelboard assembly and overcurrent protective devices.
  6. Include descriptive documentation of barriers specified for electrical insulation and isolation.
  7. Detail utility company's metering provisions with indication of approval by utility company.
  8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  9. Include schematic and wiring diagrams for power, signal, and control wiring.
  10. Include nameplate legends.
  11. Include list of materials.
- D. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around panelboards where pipe and ducts are prohibited. Show panelboard layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
1. For each equipment room, provide dimensioned layout of the electrical equipment within the space, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved.
  2. Dimensioned concrete base, outline of panelboard sections, conduit entries, and ground rod locations; including equipment working clearances and manufacturer required access space.
  3. Indicate structural members, light fixtures, sprinkler piping and heads, HVAC equipment, ducts and diffusers, plumbing piping and access fittings. Include maintenance access clearances.
  4. Location of structural supports for structure-supported raceways.
  5. Location and clearance of electrical equipment and raceways impacting equipment installation.
- E. Sustainable Design Documentation: Submit manufacturer's product data on materials and assemblies showing compliance with building rating standard(s) requirements.
- F. Field Quality-Control Reports:
1. Test procedures used.
  2. Test results that comply with requirements.
  3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- G. Sample Warranty: For warranty.
- H. Project Record Documents: Record actual installed equipment and circuiting arrangements. Record actual routing for underground circuits. Record actual installed location of ground rods.
- I. Panelboard Schedules: Submit final panelboard directories.
- J. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for panelboards and all installed components.
  2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  3. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.
  4. Features and operating sequences, both automatic and manual.
  5. Video recording of operation training and demonstration.

- K. Follow-up service reports.

### **1.5 QUALITY ASSURANCE**

- A. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

### **1.6 PROJECT CONDITIONS**

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
- B. Environmental Limitations:
  - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above equipment is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
    - b. Altitude: Not exceeding 6600 feet (2000 m).

### **1.7 DELIVERY STORAGE AND HANDLING**

- A. Coordinate delivery of equipment to allow movement into designated space.
- B. Store in a clean, dry space, protected from weather and so condensation will not form on or in units. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic. Handle carefully in accordance with manufacturer's instructions to avoid damage to equipment components, enclosure, and finish. Provide temporary heating according to manufacturer's written instructions.
- C. Handle and prepare panelboards for installation according to NEMA PB 1 and manufacturer's written instructions. Use factory-installed lifting provisions.

### **1.8 WARRANTY**

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components and/or products of the panelboards that fail in materials or workmanship within the specified warranty period.
- B. Warranty Period: Three years from date of Substantial Completion.

### **1.9 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Refer to Division 26 section "Fuses" for spare fuse requirements. At a minimum, include spares for the following:
  - a. Fuses for fusible devices.
  - b. Potential transformer fuses.
  - c. Control power fuses.
2. Indicating Lights: Four of each type installed.
3. Primary Switch Contact Lubricant: One container.
4. Touchup Paint: Two containers of paint matching enclosure finish, each 0.5 pint (250 mL).
5. Enclosure Keys: Two for each enclosure type. All distribution equipment keyed alike.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Manufacturers:
  1. ABB Inc.
  2. Eaton.
  3. Schneider Electric.
  4. Siemens Energy & Automation, Inc.
- B. Enclosures: Flush- or surface-mounted cabinets as noted.
  1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
    - c. Kitchen and/or Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
    - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.
  2. Hinged Front Cover: Entire front trim hinged to box.
  3. Door: Standard door with concealed hinges, within hinged trim cover. Secured with vault-type latch with tumbler lock; keyed alike.
  4. Finishes:
    - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.
    - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
  5. Directory Card: Inside panelboard door, mounted in transparent card holder.
- C. Incoming Mains Location: Top and/or bottom as required.
- D. Buses: Three phase, four wire unless otherwise indicated.
  1. Phase, and Neutral Buses:
    - a. Material:
      - 1) Tin-plated aluminum.
        - a) Hard-drawn copper, 98 percent conductivity, may be substituted if provided at no additional cost.
      - 2) Hard-drawn copper, 98 percent conductivity.
      - 3) Hard-drawn copper, 98 percent conductivity, silver-plated
    - b. Size: Ampacity as indicated on drawings, with uniform capacity for entire length of panelboard's sections.
      - 1) Neutral bus: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus

2. Ground Bus: Equipped with connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
    - a. Material: Hard-drawn copper, 98 percent conductivity
    - b. Size: Minimum-size required by UL 67
  3. Provide any available breaker mounting space with bussing.
- E. Line-Side Conductor Connectors (Lugs):
1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
  2. Material: Same as bus material.
  3. Capacity rating: Same as associated bus.
  4. Type: Provide mechanical type unless otherwise indicated on Drawings, refer to schedules and one-line diagram.
  5. Provide properly sized lugs for all equipment, circuit breakers and other electrical devices to accommodate installed conductors. A larger frame, oversized lugs or non-standard product may be required in some instances.
    - a. Pin adapters may be utilized only as allowed by manufacturer and the authority having jurisdiction.
- F. Feed-Through Lugs:
1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
  2. Location: Locate at opposite end of bus from line side lugs or main device.
  3. Material: Same as line side conductor connectors.
  4. Capacity rating: Same as associated bus.
  5. Type: Same as line side conductor connectors.
- G. Subfeed lugs (Double Lugs):
1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
  2. Location: Locate at same end of bus as incoming lugs or main device.
  3. Material: Same as line side conductor connectors.
  4. Capacity rating: Same as associated bus.
  5. Type: Same as line side conductor connectors.
- H. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- I. Short-Circuit Current Rating (SCCR):
1. Refer to fault-current and coordination study submittal requirements listed in other parts of this section, in addition to specification section "Power System Studies".
  2. Rating value: Rated to withstand symmetrical short-circuit current available at terminals. Panelboards shall be fully-rated, unless series-rated is indicated on the drawings. SCCR shall not be less than the highest AIC rating of any circuit breaker in panelboard.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Panelboards: NEMA PB 1, power and feeder distribution type.
- B. Doors: For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- C. Mains: As indicated on drawings.
- D. Branch Overcurrent Protective Devices:
  1. Connection to bus:

- a. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
  - b. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
2. Type: Provide types as indicated on drawings and as defined below.
- E. Device Ratings:
1. Continuous ampere rating: as indicated on drawings.
  2. Voltage and frequency rating: same as panelboard.
  3. Short-circuit current rating (SCCR): Same as requirements for panelboard.
  4. Ampere Interrupting Current (AIC) rating: Rated to interrupt symmetrical short-circuit current available at terminals. Panelboards shall be fully-rated, unless series-rated is indicated on the drawings.

### 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: Circuit breaker type: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: As indicated on drawings.
- C. Branch Overcurrent Protective Devices:
  1. Connection to bus: Plug-in circuit breakers, replaceable without disturbing adjacent units.
  2. Type: Provide types as indicated on drawings and as defined below.
- D. Device Ratings:
  1. Continuous ampere rating: as indicated on drawings.
  2. Voltage and frequency rating: same as panelboard.
  3. Short-circuit current rating (SCCR): Same as requirements for panelboard.
  4. Ampere Interrupting Current (AIC) rating: Rated to interrupt symmetrical short-circuit current available at terminals. Panelboards shall be fully-rated, unless series-rated is indicated on the drawings.

### 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
  1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long- and short-time time adjustments.
    - d. Ground-fault pickup level, time delay, and  $I^2t$  response.
  4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
  7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.



- b. Lugs: Mechanical type unless otherwise indicated on Drawings, suitable for number, size, trip ratings, and conductor materials.
  - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
  - d. Ground-Fault Protection: Relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - 1) Mounting: Integral
  - e. Shunt Trip: 24-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
  - f. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
  - g. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
  - h. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
  - i. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
  - j. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
  - k. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- 1. Fuses are specified in Division 26 Section "Fuses."
- C. Arc Flash Mitigation
- 1. Circuit breakers, 1200 A and larger, shall be provided with an energy-reducing active arc flash mitigation capability. The energy-reducing active arc flash mitigation system shall allow the operator to enable a maintenance mode using a switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. An LED on the trip unit shall indicate the trip unit is in the maintenance mode.
  - 2. Fuses, 1200 A and larger, shall have a clearing time of 0.07 seconds or less at the available arcing current, or shall be provided with an energy-reducing active arc flash mitigation capability. The energy-reducing active arc flash mitigation system shall allow the operator to enable a maintenance mode using a switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. An LED on the trip unit shall indicate the trip unit is in the maintenance mode.
  - 3. Documentation shall be provided in accordance with the NEC for location of overcurrent device and method of clearing time reduction.

## **2.5 FUSED LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS (30 TO 400A MAINS)**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable products by one of the following, the first listed manufacturer was used as the basis of design:
- 1. Eaton/Bussman Quik Spec Coordination Panelboards type QSCP
  - 2. Mersen
- B. Bus Bars: Shall be copper or tin-plated copper.
- C. Panelboards: listed to UL 67
- 1. Provide space behind locking door for a minimum of 6 spaces to store replacement branch circuit fuses.
- D. Mains:
- 1. Permanently installed lockout means shall be provided.
  - 2. Quick-make, quick-break type.

- E. Branch Overcurrent Protective Devices:
  - 1. Device shall have visible circuit ON/OFF indication with colored and international symbol markings
  - 2. Device shall provide open fuse indication via permanently installed neon or LED indicating light.
  - 3. Fuse and disconnect assembly shall be a finger-safe component with trim installed.
  - 4. No special tools shall be required for fuse removal.
  - 5. Devices shall have bolt-on style bus connectors.
  - 6. Device housing shall be clearly marked with device amperage.
  - 7. Permanently installed lockout means shall be provided on the device for lockout tagout procedures. Permanently installed means for locking device in the ON position shall also be provided.
  - 8. Device shall provide fuse amp rating rejection at the following ampacities to ensure continued circuit protection at the specified circuit rating: 15A, 20A, 30A, 40A, 50A, 60A, 70A, 90A & 100A.
  - 9. Branch circuit overcurrent protection shall be 600Vac UL Listed minimum 200kA IR and CSA Certified minimum 200kA IR finger-safe fuse with Class J or CC performance characteristics.
- F. Device Ratings:
  - 1. Continuous ampere rating: as indicated on drawings.
  - 2. Voltage and frequency rating: same as panelboard.
  - 3. Short-circuit current rating (SCCR): Same as requirements for panelboard.
  - 4. Ampere Interrupting Current (AIC) rating: Rated to interrupt symmetrical short-circuit current available at terminals. Panelboards shall be fully-rated, unless series-rated is indicated on the drawings.

## 2.6 SURGE PROTECTION DEVICES

- A. Provide surge protective devices as required by Division 26 Section "Surge Protective Devices".
- B. Panelboards requiring SPD and the location of the devices shall be as indicated on the Drawings.

## 2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

## 2.8 IDENTIFICATION

- A. Nameplates: Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine panelboards before installation. Reject equipment that is damaged, or rusted, or have been subjected to water saturation.
- B. Examine areas, surfaces, substrates, and elements to receive panelboards with Installer present, for compliance with requirements for installation tolerances, structural support, ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  - 1. Verify that field measurements are as indicated.
  - 2. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment will be installed, before installation begins.

- C. Examine roughing-in of conduits and grounding systems to verify the following:
  - 1. Wiring entries comply with layout requirements.
  - 2. Entries are within conduit-entry tolerances specified by manufacturer.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1 and manufacturer's instructions.
- B. Coordinate layout and installation of equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- C. Wall-Mounted Panelboards: Install panelboards on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For panelboards not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- D. Floor-Mounted Panelboards: Install panelboards on concrete bases.
  - 1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 3 inches (75 mm) in all directions beyond the maximum dimensions of panelboards unless otherwise indicated or unless required for seismic anchor support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
  - 2. Anchor panelboards to concrete bases according to manufacturer's written instructions, and requirements in Division 26 Sections "Hangers and Supports for Electrical Systems".
  - 3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
  - 4. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 6. Install anchor bolts to elevations required for proper attachment to panelboards.
  - 7. Attach panelboards to the vertical finished or structural surface behind the panelboards.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Mount top of trim 72 inches (1788 mm) above finished floor unless otherwise indicated.
- G. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- H. Install overcurrent protective devices and controllers not already factory installed.
- I. Install fuses in fusible devices.
- J. Install filler plates in unused spaces.
- K. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
  - 1. Empty conduits shall be provided with pull strings.
  - 2. Cap and label empty conduits for future use.
- L. Comply with NECA 1.

**3.3 CONNECTIONS**

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools for control wiring.

**3.4 IDENTIFICATION**

- A. Equipment Nameplates: Label each contiguous main, or entrance section with equipment nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- C. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- D. Diagram and Instructions:
  - 1. Engraved, Laminated Acrylic or Melamine Label. Mount on front of panelboard.
    - a. Operating Instructions: Printed operating instructions for panelboard, including key interlocking, control sequences, elementary single-line diagram, and emergency procedures.
- E. Warning Labels: Label each panelboard with a warning label in accordance with NFPA 70 and NFPA 70E.
  - 1. Exception: Do not install NFPA 70 working clearance requirements on flush panelboards and similar equipment in finished spaces.
- F. Panel Directories
  - 1. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
  - 2. Note the date the directory was created/updated.
  - 3. Create directory after loads have been balanced to reflect actual as-built conditions.
  - 4. Circuit descriptions shall be per code and shall be distinguishable from all others.

**3.5 CLEANING**

- A. After completing equipment installation and before energizing, inspect unit components. Vacuum dirt and debris from interior of equipment; do not use compressed air to assist in cleaning. Remove paint splatters and other spots. Repair exposed surfaces to match original finish.

**3.6 PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

**3.7 ADJUSTING**

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Power System Studies."

### 3.8 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control tests and inspections:
- B. Acceptance Testing Preparation:
  - 1. After installing equipment but before equipment is energized, test for compliance with requirements.
  - 2. Verify that grounding system at the equipment tested at the specified value or less.
  - 3. Test insulation resistance for each bus, component, connecting supply, feeder, and control circuit.
  - 4. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. After electrical circuitry has been energized, test for compliance with requirements.
  - 2. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 26 Sections.
  - 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
  - 5. Report results of tests and inspections in writing. Record adjustable settings and measured insulation resistances. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- D. Infrared Scanning: Perform the following infrared scan tests and inspections and prepare reports:
  - 1. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
  - 2. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
  - 3. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Voltage Monitoring and Adjusting: After Substantial Completion, if requested by Owner, but not more than six months after Final Acceptance, perform the following voltage monitoring:
  - 1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at the main incoming section of each service entrance panelboard. Use voltmeters with calibration traceable to the National Institute of Science and Technology standards. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from the nominal value by more than plus or minus 5 percent during the test period, is unacceptable.
  - 2. Corrective Action: If test results are unacceptable, perform the following corrective action, as appropriate:
    - a. Rebalance loads.
    - b. Prepare written request for voltage adjustment by electric utility in accordance with Division 26 section "Provisions for Electric Utility Service".
  - 3. Retests: Repeat monitoring, after corrective action has been performed, until satisfactory results are obtained.
- F. Panelboards will be considered defective if they do not pass tests and inspections.

- G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

**3.9 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain panelboards, overcurrent protective devices, instrumentation, and accessories.
- B. Video record demonstrations presentation for Owner's records.

END OF SECTION

**SECTION 26 27 26 - WIRING DEVICES****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
  - 1. Receptacles: Single, duplex, USB/duplex, USB-only, twist-lock, ground-fault circuit interrupters (GFCI), surge protective device (SPD), isolated ground (IG) and tamper resistant (TR).
  - 2. AC Wall Switches: Single- and double-pole, three- and four-way, maintained and momentary, pilot light and lighted toggle.
  - 3. Device Wall Plates.
  - 4. Multi-Outlet Assemblies.
  - 5. Emergency Power Off Buttons

**1.2 DEFINITIONS**

- A. GFCI: Ground-fault circuit interrupter.
- B. IG: Isolated Ground
- C. PIR: Passive Infrared.
- D. RFI: Radio Frequency Interference
- E. SPD: Surge Protective Device
- F. USB: Universal Serial Bus
- G. TR: Tamper Resistant

**1.3 SUBMITTALS**

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements".
- B. Product data for the following products:
  - 1. Provide manufacturer's catalog information specifically marked to indicate which devices are being furnished, and showing dimensions, colors, and configurations for all devices, including, but not limited to: Receptacles, AC wall switches, cover plates, power poles, and multi-outlet assemblies.
- C. Shop drawings for:
  - 1. List of legends and description of materials and process used for pre-marking wall plates.
- D. Warranty: Special warranties specified in this Section.

**1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type of wiring device and associated cover plate from a single manufacturer and through one source. Where practical and possible, obtain all wiring devices and associated cover plates from a single manufacturer and one source.
- B. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 10 years.
- C. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that are acceptable to authorities having jurisdiction.
  2. Marked for intended use.
- D. Comply with NFPA 70.

### 1.5 COORDINATION

- A. Receptacles for Equipment Furnished by Owner or Under Other Divisions or Contracts: Match plug configurations.

### 1.6 SPARES

- A. Furnish spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Wall Plates: One for every 10 of each type (i.e., style, size, and finish) installed, but no fewer than two of each type.

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 GENERAL

- A. Wiring devices are defined as single discrete units of electrical distribution systems, such as convenience receptacles, switches, special purpose receptacles, and similar, which are intended to carry, but not use electrical energy. Install wiring devices as required by the Specifications and where indicated on the Drawings.

### 2.2 MANUFACTURERS

- A. Manufacturers:
1. Receptacles and Switches:
    - a. Eaton.
    - b. Hubbell Incorporated.
    - c. Legrand.
    - d. Leviton.
  2. Multioutlet Assemblies:
    - a. Hubbell Incorporated.
    - b. Legrand.
  3. Emergency Power Off Buttons:
    - a. Eaton.
    - b. GE Industrial.
    - c. Schneider Electric.
- B. In other Part 2 articles below, where manufacturers and device catalog numbers are included, the following additional requirements apply to product selection:
1. Product manufacturer and model numbers listed are to establish the quality of the wiring devices. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include manufacturers listed in individual articles below, in addition to those listed in Paragraph "Manufacturers" above.
  2. Coordinate the proper suffixes in order to provide the correct color as specified below.

### 2.3 FINISHES

- A. Color:
1. Wiring devices connected to normal power systems: As selected by Architect, unless otherwise indicated or required by NFPA 70. Cover plates: The same as the wiring device.



2. Wiring devices connected to emergency power systems: Red. Cover plates: The same as the wiring device and engraved with "EMERGENCY POWER" with white filler in the engraving. Engrave the panelboard designation and circuit number serving the emergency device into the cover plate.

## 2.4 CONVENIENCE RECEPTACLES

- A. The catalog numbers listed below are generally for 20A rated devices. Where 15A rated devices are indicated on the Drawings or required for circuit rating limitations, provide receptacles equivalent to those specified for 20A, but rated for 15A.
- B. Duplex convenience receptacles: Heavy Duty Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.  
Basis of Design: Legrand 5362 duplex; similar for simplex.
- C. Duplex tamper resistant convenience receptacles: Heavy Duty Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.  
Basis of Design: Legrand TR5362.
- D. Duplex weather resistant convenience receptacles: Heavy Duty Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.  
Basis of Design: Legrand WR5862.
- E. Twist-Locking type receptacles: NEMA L5-20R, 125V, 20A, grounding type, UL listed and labeled, nylon face, side and back wired, self-grounding.  
Basis of Design: Legrand L520-R.
- F. USB/duplex convenience receptacles: NEMA 5-20R, 125V, 20A, tamper resistant, 3-wire, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding; with integral USB charger having two ports, USB 2.0 compatible, 5VDC, 3A output (min).  
Basis of Design: Legrand TR5362USB.

## 2.5 GFCI RECEPTACLES

- A. Ground fault circuit interrupter type receptacles: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles down stream on the same circuit.  
Basis of Design: Legrand2097
- B. Ground fault circuit interrupter type weather-resistant receptacles: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles down stream on the same circuit.  
Basis of Design: Legrand2097TRWR

- C. Ground fault circuit interrupter type tamper and weather-resistant receptacles: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles down stream on the same circuit.  
Basis of Design: Legrand2097TRWR
- D. Ground fault circuit interrupter with Blank Face: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles down stream on the same circuit.  
Basis of Design: Legrand 2085.

## 2.6 SPECIAL MISCELLANEOUS DEVICES

- A. Special purpose receptacles: Grounding type, UL listed with NEMA configurations as indicated below or on the Drawings.  
Basis of Design: Legrand:
- |                         |       |
|-------------------------|-------|
| Dryer 14-30R            | 3864  |
| Range 14-50R            | 3849  |
| Switch/Receptacle Combo | 671   |
| Clock 5-15R             | S3733 |

## 2.7 SWITCHES

- A. The catalog numbers listed below are generally for 20A rated devices. Where 15A rated devices are indicated on the Drawings or required for circuit rating limitations, provide switches equivalent to those specified for 20A, but rated for 15A.
- B. Switches: Heavy Duty Specification grade, rated for 120/277V, 20A, back and side wired, and UL listed and labeled.  
Basis of Design: Legrand:
- |        |         |
|--------|---------|
| 1 pole | PS20AC1 |
| 2 pole | PS20AC2 |
| 3-way  | PS20AC3 |
| 4-way  | PS20AC4 |
- C. Pilot Light switches: 20A, single pole switch with red lighted handle. Toggle shall be illuminated when the switch is in the "ON" position. Provide appropriate voltage option.  
Basis of Design: Legrand:
- |        |             |
|--------|-------------|
| 1 pole | PS20AC1-XPL |
| 2 pole | PS20AC2-XPL |
| 3-way  | PS20AC3-XPL |
- D. Lighted Handle switches: 20A, single pole switch with clear lighted handle. Toggle shall be illuminated when the switch is in the "OFF" position. Provide appropriate voltage option.  
Basis of Design: Legrand:
- |        |             |
|--------|-------------|
| 1 pole | PS20AC1-XSL |
| 2 pole | PS20AC2-XSL |
| 3-way  | PS20AC3-XSL |
- E. Key operated light switches: Same as standard light switches except toggle handle shall be operated by a factory provided key.  
Basis of Design: Legrand:

1 pole	PS20AC1-L
2 pole	PS20AC2-L
3-way	PS20AC3-L
4-way	PS20AC4-L

- F. Switches for use with mechanically-held, electrically-operated lighting contactors: Single pole, double throw, momentary, center off switch, rated for 120/277V, and UL listed and labeled.  
Basis of Design: Legrand 1251.

## 2.8 MULTI-OUTLET ASSEMBLIES

- A. Surface type "plug-in" strips: Extruded aluminum 3-wire, single circuit with single grounding type, 15A, 125V receptacles, pre-wired on 18-inch centers. Provide all fittings, devices, end closures, elbows, boxes and conduit entrance fittings as required for a complete installation.  
Basis of Design: Hubbell ALU20.

## 2.9 EMERGENCY POWER OFF BUTTONS

- A. Push Button Operators: 30MM, watertight/oiltight, heavy duty, 600V maximum ac/dc, 10A continuous, momentary, non-illuminated, shrouded push button operator. Provide with 1 normally open and 1 normally closed contact block.  
Basis of Design: Schneider 9001KR1RH13.

## 2.10 REMOTE GROUND FAULT CIRCUIT INTERRUPTER (GFCI) DEVICES

- A. Manufacturers:
1. Hubbell
  2. Littlefuse
  3. North Shore Safety
- B. UL 943 Class A Ground Fault Circuit Interrupter (GFCI) device in NEMA 4X wet location enclosure, voltage, phase, and current rating as shown on drawings. UL 943. Device shall have power and fault status indication lights and manual test and reset buttons on exterior of enclosure. Device shall allow for reset as follows:
1. Automatic reset: Allows power downstream as long as power is available and will allow power downstream upon restoration of lost power. Requires reset button be pressed if unit trips due to fault condition.

## 2.11 COVER PLATES

- A. Damp Location Weatherproof Receptacle Cover Plates: UL-listed Wet Location (cover closed, not in use); die-cast, gasketed (factory-installed) self-closing covers, for vertical mounting:  
Basis of Design: Legrand 4512 vertical.
- A. Wet Location Weatherproof Receptacle Cover Plates (Outlet Box Hood): NEMA 3R weather resistant recessed or flush mount, die cast aluminum lockable cover. Configure cover for horizontal mounting of receptacle or as indicated otherwise. Back box must be suitable for conduit connections. Coordinate back box with wall depth.

Basis of Design: Leviton IUM1H-GY.

- B. Damp and Wet Location Weatherproof switch cover plates: Fabricated of cast aluminum or cast zinc, sealed water-tight and UL listed for wet locations.  
Basis of Design: Appleton FSK.
- C. Other locations: Single and combination types to match corresponding wiring devices and manufacturer of wiring devices specified herein.
  - 1. Plate securing screws: Metal with head color to match finish plate.
  - 2. Material for Finished Spaces: Brushed stainless steel Type 302 for back of house spaces. High impact nylon, minimum 0.10-inch thick for premium spaces. Refer to "Finishes" above for color.
  - 3. Material for Unfinished Spaces and surface mounted wiring devices: Galvanized steel.
  - 4. Masonry walls and oversized wall openings: Jumbo size plates with same material as indicated above.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Outlets are only approximately located on the small scale Drawings. Use great care in the actual location by consulting the various large scale detailed Drawings used by other Division trades, and by securing definite locations from the Contract Administrator.
- B. Do not use multi-conductor circuits, with a shared neutral, for any GFCI receptacle circuit. Provide a separate neutral conductor with all GFCI receptacle circuits.
- C. Provide twist-locking type receptacles or other special type receptacles where indicated on the Drawings.

#### **3.2 EXAMINATION**

- A. Verify existing conditions prior to beginning work.
- B. Verify that outlet boxes are installed at proper height and are flush with the finished surface.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that floor boxes are adjusted properly and are flush with the finished surface.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

#### **3.3 PREPARATION**

- A. If required, provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from in and around outlet boxes.

#### **3.4 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install all wiring devices plumb, level, and square with building lines. Wiring device bodies shall extend to the finished surface of the walls, ceiling or floor, as applicable, without projecting beyond them.

- C. Connect wiring devices by wrapping conductors around screw terminals. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Connect wiring device grounding terminal to branch circuit equipment grounding conductor and bond to metal outlet box. Exception: Do not bond grounding terminals of isolated ground receptacles to the outlet box.
- E. Install devices shown on wood trim, cases or other fixtures symmetrically and, where necessary, set with the long dimensions of the plate horizontal, or ganged in tandem.
- F. Unless dimensioned otherwise, install wiring devices a minimum of 24 inches from the closest edge of any sink.
- G. Install switches with OFF position down.
- H. Install cover plates on all switches, receptacles, and blank outlets.
- I. Locate wiring devices so that the cover plate does not have to be cut to be installed.
- J. Where devices are shown near wall openings, coordinate location if corner guards are to be installed so that cover plates do not require cutting.
- K. Install cover plates after the wall has been finished (painted, wall paper, etc).
- L. Install device boxes in brick or block walls such that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
- M. Provide engraved nameplate on emergency off buttons.
- N. Provide ground fault circuit interruption capability for all 120V receptacles 50A or less and all 208/240V receptacles 100A or less in code required locations. Locations include, but are not limited to: bathrooms, kitchens/food prep areas, exterior locations and within 6' of sinks. Interruption capability can be achieved via a GFCI circuit breaker or a GFCI receptacle.
- O. Provide type and quantity of normally open and/or normally closed contacts for emergency off buttons to meet the sequence of operations shown.
- P. Install wiring devices shown back-to-back on a common wall offset a minimum of 12" horizontally to reduce sound transmission between rooms.

### 3.5 MOUNTING HEIGHTS

- A. Coordinate locations of outlet boxes provided under Division 26 Section "Common Work Results for Electrical".
- B. Unless noted otherwise, install wiring devices at mounting heights indicated in the Electrical Symbols Legend on the construction drawings.
  - 1. Receptacles:
    - a. General:
      - 1) Unless indicated otherwise, install vertically with the ground slot mounted at the top.
      - 2) Where Installed horizontally, install neutral slot mounted at the top.
    - b. Above counters:
      - 1) Mount vertically.
    - c. Mechanical and electrical equipment rooms and janitors closets:
      - 1) Mount horizontally.
    - d. Garages:
      - 1) Wet location: Mount horizontally.
      - 2) Other locations: Mount vertically.
    - e. Weatherproof exterior receptacles:
      - 1) Mount horizontally.

- f. GFCI receptacles: Same as general receptacles.
  - g. Concrete Block Walls: Dimensions above may be adjusted slightly, as required to compensate for variable joint dimensions, such that bottom or top of boxes, as applicable, are at block joints.
- 2. Switches:
    - a. Above counters: Same as for receptacles.
    - b. Concrete Block Walls: Dimension may be adjusted slightly, as required to compensate for variable joint dimensions, such that bottom of boxes are at block joints.
    - c. Walls with wainscoting: 6 inches minimum above wainscoting, but not exceeding 48 inches above finished floor.
  - 3. Multi-outlet assemblies:
    - a. 6 inches below counter top.
  - 4. Telephone/Data Outlet Boxes:
    - a. General: Match mounting height of adjacent wiring device listed above.
  - 5. Emergency Power Off Buttons and Break Glass Operators:
    - a. General: Match requirements of switches listed above.
    - b. Wall-mounted telephone: 40 inches above finished floor.

### 3.6 IDENTIFICATION

- A. Label all devices fed down stream of GFCI protected receptacles as "GFCI PROTECTED".
- B. Comply with Division 26 Section "Identification for Electrical Systems."
  - 1. Receptacles and Switches: Identify panelboard and circuit number from which served, using:
    - a. Durable wire markers or tags inside outlet boxes.
    - b. Adhesive film label, but with letter/number height of 1/4 inch, on face of plate.
    - c. Adhesive Film Label with Clear Protective Overlay, but with letter/number height of 1/4 inch, on face of plate, for exterior and damp/wet locations.

### 3.7 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
- D. Test all wiring devices for electrical continuity and proper polarity of connections.
- E. Test each GFCI receptacle device for proper operation.
- F. Correct wiring devices incorrectly installed.
- G. Repair or replace all damaged items or damaged finishes at no expense to the Owner.

### 3.8 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

### 3.9 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

**SECTION 26 28 13 - FUSES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Cartridge fuses rated 600-V ac and less for use in:
    - a. Control circuits
    - b. Enclosed switches
    - c. Panelboards
    - d. Switchboards
    - e. Enclosed controllers
  - 2. Spare-fuse cabinets.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Fault-Current Study, Coordination Study, and Overcurrent Protective Device Settings report must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. If studies have not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the contractor at no additional cost to the project. Refer to specification section "Power System Studies."

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
  - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  - 2. Current-limitation curves for fuses with current-limiting characteristics.
  - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
  - 4. Coordination charts and tables and related data.
  - 5. Fuse sizes for elevator feeders and elevator disconnect switches.
- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. All items requested under "Product Data".

**1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248.

**1.5 PROJECT CONDITIONS**

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

**1.6 COORDINATION**

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.
- B. Coordinate location of and access to spare fuse cabinet(s) with final electrical equipment layouts within electrical equipment rooms.

**1.7 EXTRA MATERIALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

**PART 2 - PRODUCTS****2.1 GENERAL**

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Selectivity: Where selectivity is required by the Documents, furnish products as required to achieve selective coordination.

**2.2 MANUFACTURERS**

- A. Manufacturers:
  - 1. ABB Ltd.
  - 2. Eaton Corporation Plc
  - 3. Mersen Electrical Power
  - 4. Littelfuse, Inc.
  - 5. Schneider Electric SE
  - 6. Siemens AG

**2.3 CARTRIDGE FUSES**

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

**2.4 ACCESSORIES**

- A. Provide the following accessories where indicated or where required to complete installation:
  - 1. Fuseholders: Compatible with indicated fuses.
  - 2. Fuse Reducers: For adapting indicated fuses to permit installation in switch designed for fuses with larger ampere ratings.



3. Plug-Fuse Adapters: For using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

## 2.5 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
  1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
  2. Finish: Gray, baked enamel.
  3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
  4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install in accordance with manufacturer's instructions.
- C. Install fuses in fusible devices. Arrange fuses so manufacturer, type and rating information is readable without removing fuse.
- D. Install spare-fuse cabinet(s).

### 3.3 FUSE APPLICATIONS

- A. Cartridge Fuses:
  1. Service Entrance:
    - a. Greater than 600A:
      - 1) Class L, time delay
    - b. 600A or less:
      - 1) Class RK1, time delay
  2. Feeders:
    - a. Greater than 600A:
      - 1) Class L, time delay
    - b. 600A or less:
      - 1) Class RK1, time delay
      - 2) Class J, time delay
  3. Motor Branch Circuits:

- a. Class RK1 time delay
- 4. Other Branch Circuits:
  - a. Class RK1, time delay
- 5. Control Circuits:
  - a. Class CC fast acting

### **3.4 IDENTIFICATION**

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

**SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Fusible switches.
- B. Non-fusible switches.
- C. Shunt trip switches.
- D. Enclosures.

**1.2 DEFINITIONS**

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate layout and installation of enclosed switches, circuit breakers and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Fault-Current Study, Coordination Study, and Overcurrent Protective Device Settings report must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. If studies have not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the contractor at no additional cost to the project. Refer to specification section "Power System Studies".

**1.4 SUBMITTALS**

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements".
- B. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensions and Manufacturer's technical data on features, performance, electrical characteristics, ratings, weights, furnished options, specialties, accessories, and finishes.
- C. Shop Drawings: For enclosed switches and circuit breakers.
  - 1. Include dimensioned plans, elevations, sections, and details, including required clearances, service space around equipment, and attachments to other work. Show tabulations of installed devices, equipment features, and ratings.
    - a. Tabulate features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 2. Detail enclosure types and details for other than NEMA 250, Type 1.

3. Include general arrangement drawing showing dimensions and weights of each assembled section.
  4. Detail bus configuration, current, and voltage ratings, including size and number of bus bars and current rating for each bus. Indicate mains and branches of phase, neutral, and ground buses.
  5. Detail short-circuit current rating of enclosed switch or circuit breaker assembly and overcurrent protective devices.
  6. Include descriptive documentation of barriers specified for electrical insulation and isolation.
  7. Include time-current coordination curves for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit electronic files, in an SKM-compatible format.
  8. Include schematic and wiring diagrams for power, signal, and control wiring.
  9. Include nameplate legends.
  10. Include list of materials.
- D. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around enclosed switches and circuit breakers where pipe and ducts are prohibited. Show enclosed switch and circuit breaker layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- E. Sustainable Design Documentation: Submit manufacturer's product data on materials and assemblies showing compliance with building rating standard(s) requirements.
- F. Field quality-control reports.
1. Test procedures used.
  2. Test results that comply with requirements.
  3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- G. Sample Warranty: For warranty.
- H. Project Record Documents: Record actual installed equipment and circuiting arrangements. Record actual routing for underground circuits. Record actual installed location of ground rods.
- I. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for enclosed switches, circuit breakers and all installed components.
  2. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
  3. Time-current curves; include selectable ranges for each type of overcurrent protective device.
  4. Features and operating sequences, both automatic and manual.
  5. Video recording of operation training and demonstration.
- J. Follow-up service reports.

## 1.5 QUALITY ASSURANCE

- A. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

### 1.6 PROJECT CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
- B. Environmental Limitations:
  - 1. Do not deliver or install enclosed switches and circuit breakers until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above equipment is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
    - b. Altitude: Not exceeding 6600 feet (2010 m).

### 1.7 DELIVERY STORAGE AND HANDLING

- A. Deliver enclosed switches and circuit breakers in sections or lengths that can be moved past obstructions in delivery path.
- B. Coordinate delivery of equipment to allow movement into designated space.
- C. Store in a clean, dry space, protected from weather and so condensation will not form on or in units. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic. Handle carefully in accordance with manufacturer's instructions to avoid damage to equipment components, enclosure, and finish. Provide temporary heating according to manufacturer's written instructions.
- D. Handle and prepare enclosed switches and circuit breakers components according to manufacturer's written instructions. Use factory-installed lifting provisions.

### 1.8 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components and/or products of the enclosed switches and circuit breakers that fail in materials or workmanship within the specified warranty period.
- B. Warranty Period: Three years from date of Substantial Completion.

### 1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Refer to Division 26 section "Fuses" for spare fuse requirements. At a minimum, include spares for the following:
    - a. Potential transformer fuses.
    - b. Control power fuses.
    - c. Fuses for fusible devices.
  - 2. Indicating Lights: Four of each type installed.
  - 3. Primary Switch Contact Lubricant: One container.
  - 4. Enclosure Keys: Two for each enclosure type. All distribution equipment keyed alike.

**PART 2 - PRODUCTS****2.1 FUSIBLE SWITCHES**

- A. Manufacturers:
  - 1. ABB Inc.
  - 2. Eaton.
  - 3. Schneider Electric.
  - 4. Siemens Energy & Automation, Inc.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Short Circuit Current Rating: 100,000 rms symmetrical amps when fuses applied.
- E. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  - 4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
  - 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
  - 6. Lugs: Mechanical or Compression type, suitable for number, size, and conductor material.
- F. Arc Flash Mitigation
  - 1. Fuses, 1200 A and larger, shall have a clearing time of 0.07 seconds or less at the available arcing current, or shall be provided with an energy-reducing active arc flash mitigation capability. The energy-reducing active arc flash mitigation system shall allow the operator to enable a maintenance mode using a switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. An LED on the trip unit shall indicate the trip unit is in the maintenance mode.
  - 2. Documentation shall be provided in accordance with the NEC for location of overcurrent device and method of clearing time reduction.

**2.2 NONFUSIBLE SWITCHES**

- A. Manufacturers:
  - 1. ABB Inc.
  - 2. Eaton.
  - 3. Schneider Electric.
  - 4. Siemens Energy & Automation, Inc.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
4. Hookstick Handle: Allows use of a hookstick to operate the handle.
5. Lugs: Mechanical or Compression type, suitable for number, size, and conductor material.

### 2.3 SHUNT TRIP SWITCHES

- A. Manufacturers:
  1. Eaton.
  2. Littelfuse, Inc.
  3. Mersen
  4. Siemens Energy & Automation, Inc.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- E. Accessories:
  1. Oiltight key switch for key-to-test function.
  2. Oiltight red ON pilot light.
  3. Isolated neutral lug; 100 percent rating.
  4. Form C alarm contacts that change state when switch is tripped.
- F. Arc Flash Mitigation
  1. Fuses, 1200 A and larger, shall have a clearing time of 0.07 seconds or less at the available arcing current, or shall be provided with an energy-reducing active arc flash mitigation capability. The energy-reducing active arc flash mitigation system shall allow the operator to enable a maintenance mode using a switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. An LED on the trip unit shall indicate the trip unit is in the maintenance mode.
  2. Documentation shall be provided in accordance with the NEC for location of overcurrent device and method of clearing time reduction.

### 2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
  1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  2. Outdoor Locations: NEMA 250, Type 3R.
  3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
  4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
  5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

## 2.5 IDENTIFICATION

- A. Nameplates: Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine enclosed switches and circuit breakers before installation. Reject equipment that is damaged, or rusted, or have been subjected to water saturation.
- B. Examine areas, surfaces, substrates, and elements to receive enclosed switches and circuit breakers with Installer present, for compliance with requirements for installation tolerances, structural support, ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  - 1. Verify that field measurements are as indicated.
  - 2. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment will be installed, before installation begins.
- C. Examine roughing-in of conduits and grounding systems to verify the following:
  - 1. Wiring entries comply with layout requirements.
  - 2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install enclosed switches and circuit breakers and accessories in accordance with manufacturer's instructions.
- B. Coordinate layout and installation of equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- C. Wall-Mounted Switches and Circuit Breakers: Install enclosed switches and circuit breakers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For enclosed switches and circuit breakers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- D. Floor-Mounted Switches and Circuit Breakers: Install enclosed switches and circuit breakers on concrete bases.
  - 1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 3 inches (75 mm) in all directions beyond the maximum dimensions of enclosed switches and circuit breakers unless otherwise indicated or unless required for seismic anchor support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
  - 2. Anchor enclosed switches and circuit breakers to concrete bases according to manufacturer's written instructions, and requirements in Division 26 Sections "Hangers and Supports for Electrical Systems".
  - 3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
  - 4. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.



5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  6. Install anchor bolts to elevations required for proper attachment to enclosed switches and circuit breakers.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
  - F. Mount equipment plumb and rigid without distortion of enclosure.
  - G. Install fuses in fusible devices.
  - H. Comply with NECA 1.
  - I. Where installed on either side of a VFD, provide one normally open and one normally closed auxiliary contacts interlocked with the VFD.

### 3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools for control wiring.

### 3.4 IDENTIFICATION

- A. Equipment Nameplates: Label each section with equipment nameplate.
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- C. Diagrams and Instructions:
  1. Engraved, Laminated Acrylic or Melamine Label. Mount on front of equipment.
    - a. Operating Instructions: Printed operating instructions for switches and circuit breakers, including key interlocking, control sequences, elementary single-line diagram, and emergency procedures.
- D. Warning Labels: Label equipment with a warning label in accordance with NFPA 70 and NFPA 70E.
  1. Exception: Do not install NFPA 70 working clearance requirements on enclosed switches and circuit breakers in finished spaces.

### 3.5 CLEANING

- A. After completing equipment installation and before energizing, inspect unit components. Vacuum dirt and debris from interior of equipment; do not use compressed air to assist in cleaning. Remove paint splatters and other spots. Repair exposed surfaces to match original finish.

### 3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

**3.7 AD USTING**

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

**3.8 FIELD QUALITY CONTROL**

- A. Testing: Perform the following field quality-control tests and inspections:
- B. Acceptance Testing Preparation:
1. After installing equipment but before equipment is energized, test for compliance with requirements.
  2. Verify that grounding system at the equipment tested at the specified value or less.
  3. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
  4. Test continuity of each circuit.
- C. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. After electrical circuitry has been energized, test for compliance with requirements.
  2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
  4. Report results of tests and inspections in writing. Record adjustable settings and measured insulation resistances. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- D. Infrared Scanning: Perform the following infrared scan tests and inspections and prepare reports:
1. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
  2. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
  3. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Voltage Monitoring and Adjusting: After Substantial Completion, if requested by Owner, but not more than six months after Final Acceptance, perform the following voltage monitoring:
1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at the main incoming section of each service entrance equipment. Use voltmeters with calibration traceable to the National Institute of Science and Technology standards. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from the nominal value by more than plus or minus 5 percent during the test period, is unacceptable.
  2. Corrective Action: If test results are unacceptable, perform the following corrective action, as appropriate:
    - a. Rebalance loads.
    - b. Prepare written request for voltage adjustment by electric utility in accordance with Division 26 section "Provisions for Electric Utility Service".
- F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

**3.9 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain equipment, overcurrent protective devices, instrumentation, and accessories.
- B. Video record demonstrations presentation for Owner's records.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 26 32 13 - PACKAGED ENGINE-DRIVEN GENERATORS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Gas-engine generator sets for emergency power supply with the following features and accessories:
  - 1. Engine-generator set.
  - 2. Battery charger.
  - 3. Starting battery
  - 4. Muffler/silencer.
  - 5. Generator overcurrent and fault protection.
  - 6. Outdoor enclosure.
  - 7. Vibration isolation devices.
  - 8. Remote annunciator.
  - 9. Unit-mounted cooling system.
  - 10. Unit-mounted control and monitoring.
  - 11. Remote stop switch.
  - 12. Load bank.

**1.2 DEFINITIONS**

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- B. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in Hertz or cycles per second.
- C. LP: Liquid petroleum.
- D. EPS: Emergency power supply.
- E. EPSS: Emergency power supply system.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate layout and installation of generators and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

**1.4 SUBMITTALS**

- A. Product Data: Include the following:
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 2. Thermal damage curve for generator.
  - 3. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Include the following:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  2. Dimensioned plan and elevation drawings of engine-generator set and other components specified.
  3. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
  4. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
  5. Diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for engine generators and functional relationship between all electrical components.
- C. Coordination Drawings: For each equipment room and equipment yard, provide dimensioned layout of the electrical equipment within the space, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved.
1. Dimensioned concrete base, outline of equipment, conduit entries, and ground rod locations; including equipment working clearances and manufacturer required access space.
  2. Indicate structural members, light fixtures, sprinkler piping and heads, HVAC equipment, ducts and diffusers, plumbing piping and access fittings. Include maintenance access clearances.
  3. Location of structural supports for structure-supported raceways.
  4. Location and clearance of electrical equipment and raceways impacting equipment installation.
- D. Welding certificates.
- E. Qualification Data:
1. For Installer.
- F. Source Quality-Control Reports: Including, but not limited to, the following
1. Certified summary of prototype-unit test report.
  2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
  3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria.
  4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
  5. Report of sound generation.
  6. Report of exhaust emissions showing compliance with applicable regulations.
    - a. For installations where field-deployed after treatment devices are utilized to meet emission standards, provide manufacturer certification.
  7. Certification of Torsional Vibration Compatibility: Comply with NFPA 110.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
    - a. List of tools and replacement items recommended to be stored at the Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
    - b. Operating instructions laminated and mounted adjacent to generator location.
    - c. Training plan.

## I. Warranty

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of packaged generator sets and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with NFPA 54
- G. Comply with NFPA 37.
- H. Comply with NFPA 70.
- I. Comply with NFPA 110 requirements for Level 1, Type 10, Class "X" emergency power supply system.
- J. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- K. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

**1.6 COORDINATION**

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

**1.7 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

**1.8 MAINTENANCE SERVICE**

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Maintenance agreements shall include parts and supplies as used in manufacture and installation of original equipment.

**1.9 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: One for every 10 of each type and rating, but not less than one of each.
  - 2. Indicator Lamps: Two for every six of each type used, but not less than two of each.
  - 3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. Basis-of-Design Product: Subject to compliance with requirements provided in Generator Sizing Schedule on drawings, provide comparable products by one of the following, the manufacturer used as the basis of design is listed in schedule:
  - 1. Caterpillar; Engine Div.
  - 2. Cummins Power Generation, Inc
  - 3. MTU Onsite Energy
  - 4. Kohler Power Systems

**2.2 SERVICE CONDITIONS**

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
  - 1. Ambient Temperature: 5 to 40 deg C.
  - 2. Relative Humidity: 0 to 95 percent.
  - 3. Altitude: Sea level to 1000 feet (300 m).
- B. Unusual Service Conditions: Engine-generator equipment and installation are required to operate under the following conditions:
  - 1. High salt-dust content in the air due to sea-spray evaporation.

**2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION**

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and use.
- C. Power Rating: Standby.
- D. Service Load: Generator system shall be sized to handle load scheduled on drawings.
- E. Power Factor: 0.8, lagging.
- F. Frequency: 60 Hz.
- G. Voltage: 480 V ac.
- H. Phase: Three-phase, four wire, wye.
- I. Governor: Adjustable isochronous, with speed sensing.
- J. Mounting Frame: Adequate strength and rigidity to maintain alignment of mounted components without depending on concrete foundation. Mounting frame shall be free from sharp edges and corners and shall have lifting attachments arranged for lifting with slings without damaging components.



1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- K. Capacities and Characteristics:
1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries, with capacity as required to operate as a unit as evidenced by records of prototype testing.
  2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- L. Generator-Set Performance
1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
  2. Transient Voltage Performance: Refer to Generator Sizing Schedule on drawings. Voltage shall recover and remain within the steady-state operating band within three seconds.
  3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
  4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
  5. Transient Frequency Performance: Refer to Generator Sizing Schedule on drawings. Frequency shall recover and remain within the steady-state operating band within five seconds.
  6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
  7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, the system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
  8. Start Time: Refer to Generator Sizing Schedule on drawings. Comply with NFPA 110, Type 10, system requirements.

## 2.4 ENGINE

- A. Fuel: Natural gas.
- B. Rated Engine Speed: 1800 rpm.
- C. Lubrication System: The following items are mounted on engine or skid:
1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
  2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
  3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- D. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- E. Integral Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
  2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.

3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
  4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
    - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
    - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- F. Muffler/Silencer
1. Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
    - a. Minimum sound attenuation of 25 dB at 500Hz.
    - b. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge shall be 85 dBA or less.
- G. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- H. Starting System: 24-V electric, with negative ground .
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Environmental Conditions" Paragraph in "Service Conditions" Article.
  2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
  3. Cranking Cycle: As required by NFPA 110 for system level specified.
  4. Battery: Adequate capacity within ambient temperature range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article to provide specified cranking cycle at least twice without recharging.
  5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
  6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article. Include accessories required to support and fasten batteries in place.
  7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
  8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
    - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
    - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

- f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.
- i. Installation of equipment required for emissions compliance shall include a complete manufacturer certified system, including, but not limited to any additional piping, heating and structural support.

## 2.5 FUEL SUPPLY SYSTEM

- A. Natural Gas, Vapor-Withdrawal System:
  1. Comply with NFPA 54.
  2. Carburetor.
  3. Secondary Gas Regulators: One for each fuel type, with atmospheric vents piped to building exterior.
  4. Fuel-Shutoff Solenoid Valves: NRTL-listed, normally closed, safety shutoff valves; one for each fuel source.
  5. Fuel Filters: One for each fuel type.
  6. Manual Fuel Shutoff Valves: One for each fuel type.
  7. Flexible Fuel Connectors: Minimum one for each fuel connection.
  8. Fuel change gas pressure switch.

## 2.6 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of the generator set. When mode-selector switch is switched to the on position, the generator set starts. The off position of the same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down the generator set.
- B. Configuration:
  1. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration. Panel shall be powered from the engine generator battery.
- C. Control and Monitoring Panel:
  1. Digital controller with integrated LCD, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
  2. Instruments: Located on the control and monitoring panel and viewable during operation.
    - a. Engine lubricating-oil pressure gage.
    - b. DC voltmeter (alternator battery charging).
    - c. Engine-coolant temperature gage.
    - d. Running-time meter.
    - e. AC voltmeter, for each phase
    - f. AC ammeter, for each phase
    - g. AC frequency meter.
    - h. Generator-voltage adjusting rheostat.
  3. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication, including the following:
    - a. Cranking control equipment.
    - b. Run-Off-Auto switch.
    - c. Control switch not in automatic position alarm.
    - d. Start-stop switch.
    - e. Overcrank alarm.
    - f. Overcrank shutdown device.
    - g. Low water temperature alarm.

- h. High engine temperature prealarm.
  - i. High engine temperature.
  - j. High engine temperature shutdown device.
  - k. Low lub oil pressure alarm
  - l. Low lub oil pressure shutdown
  - m. Overspeed alarm.
  - n. Overspeed shutdown device.
  - o. Coolant low-level alarm.
  - p. Coolant low-level shutdown device.
  - q. EPS load indicator.
  - r. Battery high-voltage alarm.
  - s. Low cranking voltage alarm.
  - t. Battery-charger malfunction alarm.
  - u. Battery low-voltage alarm.
  - v. Contacts for local and remote common alarm.
  - w. Lamp test.
  - x. Coolant high-temperature prealarm.
  - y. Coolant high-temperature alarm.
  - z. Coolant low-temperature alarm.
  - aa. Coolant high-temperature shutdown device.
  - bb. Hours of operation.
  - cc. Engine generator metering, including voltage, current, Hz, kW, kVA, and power factor.
  - dd. Remote manual stop shutdown device.
  - ee. Air shutdown damper alarm when used.
  - ff. Air shutdown damper shutdown device when used.
  - gg. Generator overcurrent protective device not closed alarm.
- D. Remote Alarm Annunciator: An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- 1. Overcrank alarm.
  - 2. Coolant low-temperature alarm.
  - 3. High engine temperature prealarm.
  - 4. High engine temperature alarm.
  - 5. Low lube oil pressure alarm.
  - 6. Overspeed alarm.
  - 7. Low fuel main tank alarm.
  - 8. Low coolant level alarm.
  - 9. Low cranking voltage alarm.
  - 10. Contacts for local and remote common alarm.
  - 11. Audible-alarm silencing switch.
  - 12. Air shutdown damper when used.
  - 13. Run-Off-Auto switch.
  - 14. Control switch not in automatic position alarm.
  - 15. Low cranking voltage alarm.
- E. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.
- F. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

**2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION**

- A. Overcurrent protective devices shall be coordinated to optimize selective tripping when a short circuit occurs.
- B. Generator Overcurrent Protective Device:
  - 1. Generator Circuit Breaker: Insulated-case, electronic-trip type; 100 percent rated; complying with UL 489.
    - a. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
    - b. Trip Settings: Matched to generator thermal damage curve as closely as possible.
    - c. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
    - d. Mounting: Adjacent to or integrated with control and monitoring panel.
- C. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.
  - 1. Indicate ground fault with other engine generator alarm indications.
  - 2. Trip generator protective device on ground fault.

**2.8 GENERATOR EXCITER AND VOLTAGE REGULATOR**

- A. Comply with NEMA MG 1 and specified performance requirements.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Excitation shall use no slip or collector rings, or brushes, and shall be arranged to sustain generator output under short-circuit conditions as specified.
- G. Enclosure: Drip-proof.
- H. Instrument Transformers: Mounted within generator enclosure.
- I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
  - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- L. Subtransient Reactance: 12 percent, maximum.

**2.9 LOAD BANK**

- A. Description:
  - 1. Permanent, radiator-mounted, resistive unit capable of providing a balanced three-phase, delta-connected load to engine generator at 70 percent rated-system capacity. Unit shall be capable of selective control of load in 25 percent steps of load-bank rating and with minimum step changes of approximately 5 and 10 percent available.
- B. Resistive Load Elements: Corrosion-resistant chromium alloy with ceramic and steel supports. Elements shall be double insulated and designed for repetitive on-off cycling. Elements shall be mounted in removable aluminized-steel heater cases.

- C. Reactive Load Elements: Epoxy-encapsulated reactor coils.
- D. Load-Bank Heat Dissipation: Integral fan with totally enclosed motor shall provide uniform cooling airflow through load elements. Airflow and coil operating current shall be such that, at maximum load, with ambient temperature at the upper end of the specified range, load-bank elements operate at not more than 50 percent of maximum continuous temperature rating of the resistance elements.
- E. Load Element Switching: Remote-controlled contactors switch groups of load elements. Contactor coils are rated 120 V. Contactors shall be located in a separate NEMA 250, Type 3R enclosure within load-bank enclosure, accessible from exterior through hinged doors with tumbler locks.
- F. Contactor Enclosures: Heated by thermostatically controlled strip heaters to prevent condensation.
- G. Load-Bank Enclosures: NEMA 250, Type 3R, complying with NEMA ICS 6. Louvers at cooling-air intake and discharge openings shall prevent entry of rain and snow. Openings for airflow shall be screened with 1/2-inch- (13-mm-) square, galvanized-steel mesh. Reactive load bank shall include automatic shutters at air intake and discharge.
- H. Protective Devices: Power input circuits to load banks shall be fused, and fuses shall be selected to coordinate with generator circuit breaker. Fuse blocks shall be located in contactor enclosure. Cooling airflow and overtemperature sensors shall automatically shut down and lock out load bank until manually reset. Safety interlocks on access panels and doors shall disconnect load power, control, and heater circuits. Fan motor shall be separately protected by overload and short-circuit devices. Short-circuit devices shall be noninterchangeable fuses with 200,000-A interrupting capacity.
- I. Remote-Control Panel: Separate from load bank in NEMA 250, Type 1 enclosure with a control power switch and pilot light, and switches controlling groups of load elements.
- J. Control Sequence: Control panel may be preset for adjustable single-step loading of generator during automatic exercising.

## 2.10 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description:
  - 1. Vandal-resistant, sound-attenuating, weatherproof steel housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
    - a. Sound Attenuation Level: Level II
  - 2. Prefabricated or preengineered, galvanized-steel-clad, integral structural-steel-framed, walk-in enclosure erected on concrete foundation.
- B. Construction:
  - 1. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph (160 km/h).
  - 2. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.
  - 3. Hinged Doors: With padlocking provisions.
  - 4. Space Heater: Thermostatically controlled and sized to prevent condensation.
  - 5. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.
  - 6. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
- C. Muffler Location: Within enclosure.

- D. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
  - 1. Louvers: Fixed-engine cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
    - a. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
  - 2. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.
- E. Interior Lights with Switch: Factory-wired, vaporproof-type fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
- F. Convenience Outlets: Factory-wired, GFCI. Arrange for external electrical connection.

## 2.11 VIBRATION ISOLATION DEVICES

- A. Elastomeric Isolator Pads: Oil and water resistant and factory cut to sizes that match requirements of the equipment supported.
  - 1. Rubber Isolator Pads: Elastomer (neoprene or silicone) arranged in single or multiple layers and molded with a nonslip pattern and steel baseplates of sufficient stiffness to provide uniform loading over the pad area.
  - 2. Fiberglass or cork isolator pads: molded cork or glass fiber not less than 1 inch thick and pre-compressed through 10 compression cycles at 3 times the rated load.
  - 3. Load range: from 10 to 50 psig and a deflection not less than 0.08 inch per 1 inch of thickness. Do not exceed a loading of 50 psig.
- B. Rubber Isolator Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements, with encapsulated top- and baseplates. Factory-drilled and tapped top plate for bolted equipment mounting. Factory-drilled baseplate for bolted connection to structure. Color-code to indicate capacity range.
- C. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
  - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment-mounting and -leveling bolt that acts as blocking during installation.
  - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
  - 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
  - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 6. Finishes: Baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.
- D. Comply with requirements in Div. 23 "Vibration Isolation for HVAC" " for vibration isolation and flexible connector materials for steel piping, exhaust shroud and ductwork..

## 2.12 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer.

## 2.13 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests:
    - a. Comply with IEEE 115.
    - b. Comply with NFPA 110, Level 1 energy converters.
  2. Components and Accessories: Items furnished with installed unit that are not identical to those on tested prototype shall have been factory tested to demonstrate compatibility and reliability.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
  2. Test generator, exciter, and voltage regulator as a unit.
  3. Full load run.
  4. Maximum power.
  5. Voltage regulation.
  6. Transient and steady-state governing.
  7. Single-step load pickup.
  8. Safety shutdown.
  9. Observation of Factory Tests: Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
- C. Report factory test results within 10 days of completion of test.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Comply with engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
  1. For installations where field-deployed after treatment equipment is utilized, install equipment in accordance with manufacturer's requirements to ensure the final installation meets the manufacturer's definition of a factory-certified arrangement.
- B. Equipment Mounting:
  1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
  3. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure to anchor bolts installed in concrete base.
- C. Install cooling-system piping, accessories, hangers and supports, and anchors for complete installation.



1. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports." Comply with requirements below for maximum spacing of supports.
- D. Install exhaust-system piping. Extend to point of termination outside structure. Size piping according to manufacturer's written instructions.
  1. Install condensate drain piping for engine exhaust system. Extend drain piping from low points of exhaust system and from muffler to condensate traps and to point of disposition.
  2. Support exhaust piping and muffler with pipe hangers spaced a maximum of 20 feet (6 m) horizontally and at each floor vertically. Pipe hangers are specified in Division 23 Section "Hangers and Supports."
  3. Restrain exhaust piping and mufflers with cable-type bracing assemblies. Cable-type bracing assemblies are specified in Division 26 Section "Electrical Supports and Seismic Restraints."
- E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
  1. Install fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
  2. Connect cooling-system water supply and drain piping to gas-engine heat exchangers. Install flexible connectors at connections to engine generator and remote radiator.
  3. Connect fuel piping to engines with a gate valve and union.
    - a. Natural- and LP-gas piping, valves, and specialties for gas distribution outside the building are specified in Division 02 Section "Natural Gas Distribution."
    - b. Natural- and LP-gas piping, valves, and specialties for gas piping inside the building are specified in Division 23 Section "Fuel Gas Piping."
  4. Connect exhaust-system piping to engines.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.4 IDENTIFICATION

- A. Identify system components according to Division 23 Section "Identification for HVAC piping and Equipment" and Division 26 Section "Identification for Electrical Systems."
- B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency:
  1. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.
    - a. Visual and Mechanical Inspection:
      - 1) Compare equipment nameplate data with Drawings and the Specifications.
      - 2) Inspect physical and mechanical condition.
      - 3) Inspect anchorage, alignment, and grounding.
      - 4) Verify that the unit is clean.
    - b. Electrical and Mechanical Tests:
      - 1) Perform insulation-resistance tests according to IEEE 43.
        - a) Machines Larger Than 200 hp (150 kW): Test duration shall be 10 minutes. Calculate polarization index.
        - b) Machines 200 hp (150 kW) or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.
      - 2) Test protective relay devices.
      - 3) Verify phase rotation, phasing, and synchronized operation as required by the application.
      - 4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
      - 5) Verify correct functioning of the governor and regulator.
  2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
  3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
    - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    - c. Verify acceptance of charge for each element of the battery after discharge.
    - d. Verify that measurements are within manufacturer's specifications.
  4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
  5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
  6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
  7. Exhaust Emissions Test: Comply with applicable government test criteria.
  8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
  9. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
  10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
- D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of the National Institute for Standards and Technology, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

### **3.6 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
- C. Complete installation and startup checks according to manufacturer's written instructions.
- D. Provide sufficient fuel for testing, commissioning and start up, and turn the generator over to the owner with a full tank upon the Owner's acceptance of the completed generator and standby/emergency power distribution systems.
- E. For installations that utilize a Diesel Exhaust Fluid (DEF) or other type of urea dosing system as part of the field-deployed after-treatment, Provide sufficient DEF for testing, commissioning and start up, and turn the generator over to the owner with a full tank upon the Owner's acceptance of the completed generator and standby/emergency power distribution systems.

### **3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.
  - 1. Coordinate this training with that for transfer switches..

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 26 33 53 - STATIC UNINTERRUPTIBLE POWER SUPPLIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Three-phase, on-line, double-conversion, static-type, UPS units with the following features:
  2. Surge suppression.
  3. Input harmonics reduction.
  4. Rectifier-charger.
  5. Inverter.
  6. Static bypass transfer switch.
  7. Battery and battery disconnect device.
  8. Remote UPS monitoring provisions.
  9. Battery monitoring.

**1.2 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include data on features, components, ratings, and performance.
- B. Shop Drawings: For UPS. Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, components, and location and identification of each field connection. Show access, workspace, and clearance requirements; details of control panels; and battery arrangement.
  2. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.
- D. Manufacturer Certificates: For each product, from manufacturer.
- E. Factory Test Reports: Comply with specified requirements.
- F. Field quality-control reports.
- G. Performance Test Reports: Indicate test results compared with specified performance requirements, and provide justification and resolution of differences if values do not agree.
- H. Operation and Maintenance Data: For UPS units to include in emergency, operation, and maintenance manuals.
1. Manufacturer's written instructions for testing central battery equipment.
  2. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
  3. Manufacturer's written instructions for selecting and setting field-adjustable controls and status and alarm points.
- I. Warranties: Sample of special warranties.

**1.3 DEFINITIONS**

- A. EMI: Electromagnetic interference.
- B. LCD: Liquid-crystal display.
- C. LED: Light-emitting diode.
- D. PC: Personal computer.

- E. THD: Total harmonic distortion.
- F. UPS: Uninterruptible power supply.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL acceptable to authorities having jurisdiction.
  - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. UL Compliance: Listed and labeled under UL 1778 by an NRTL.
- E. NFPA Compliance: Mark UPS components as suitable for installation in computer rooms according to NFPA 75.

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Less than 0 deg F (minus 18 deg C) or exceeding 104 deg F (40 deg C), with an average value exceeding 95 deg F (35 deg C) over a 24-hour period.
  - 2. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C).
  - 3. Humidity: More than 95 percent (condensing).
  - 4. Altitude: Exceeding 3300 feet (1000 m).
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for central battery equipment, including clearances between central battery equipment and adjacent surfaces and other items.

#### 1.6 WARRANTY

- A. Special UPS and Lithium Battery Warranties: Specified form in which manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within special warranty period.
  - 1. Special Warranty Period: Two years from date of Substantial Completion.

#### 1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
  - 2. Cabinet Ventilation Filters: One complete set(s).

### PART 2 - PRODUCTS

#### 2.1 OPERATIONAL REQUIREMENTS

- A. Automatic operation includes the following:

1. Normal Conditions: Load is supplied with power flowing from the normal power input terminals, through the rectifier-charger and inverter, with the battery connected in parallel with the rectifier-charger output.
  2. Abnormal Supply Conditions: If normal supply deviates from specified and adjustable voltage, voltage waveform, or frequency limits, the battery supplies energy to maintain constant, regulated inverter power output to the load without switching or disturbance.
  3. If normal power fails, energy supplied by the battery through the inverter continues supply-regulated power to the load without switching or disturbance.
  4. When power is restored at the normal supply terminals of the system, controls automatically synchronize the inverter with the external source before transferring the load. The rectifier-charger then supplies power to the load through the inverter and simultaneously recharges the battery.
  5. If the battery becomes discharged and normal supply is available, the rectifier-charger charges the battery. On reaching full charge, the rectifier-charger automatically shifts to float-charge mode.
  6. If any element of the UPS system fails and power is available at the normal supply terminals of the system, the static bypass transfer switch switches the load to the normal ac supply circuit without disturbance or interruption.
  7. If a fault occurs in the system supplied by the UPS, and current flows in excess of the overload rating of the UPS system, the static bypass transfer switch operates to bypass the fault current to the normal ac supply circuit for fault clearing.
  8. When the fault has cleared, the static bypass transfer switch returns the load to the UPS system.
  9. If the battery is disconnected, the UPS continues to supply power to the load with no degradation of its regulation of voltage and frequency of the output bus.
- B. Manual operation includes the following:
1. Turning the inverter off causes the static bypass transfer switch to transfer the load directly to the normal ac supply circuit without disturbance or interruption.
  2. Turning the inverter on causes the static bypass transfer switch to transfer the load to the inverter.
- C. Environmental Conditions: The UPS shall be capable of operating continuously (non-derated) in the following environmental conditions without mechanical or electrical damage or degradation of operating capability, except battery performance.
1. Ambient Temperature for Electronic Components: 32 to 104 deg F (0 to 40 deg C).
  2. Ambient Temperature for Battery: 41 to 95 deg F (5 to 35 deg C).
  3. Relative Humidity: 0 to 95 percent, noncondensing.
  4. Altitude: Sea level to 4000 feet (1220 m).

## 2.2 PERFORMANCE REQUIREMENTS

- A. The UPS shall perform as specified in this article while supplying rated full-load current, composed of any combination of linear and nonlinear load, up to 100 percent nonlinear load with a load crest factor of 3.0, under the following conditions or combinations of the following conditions:
1. Inverter is switched to battery source.
  2. Steady-state ac input voltage deviates up to plus or minus 10 percent from nominal voltage.
  3. Steady-state input frequency deviates up to plus or minus 5 percent from nominal frequency.
  4. THD of input voltage is 15 percent or more with a minimum crest factor of 3.0, and the largest single harmonic component is a minimum of 5 percent of the fundamental value.
  5. Load is 50 100 percent unbalanced continuously.
- B. Minimum Duration of Supply: If battery is sole energy source supplying rated full UPS load current at 80 percent power factor, duration of supply is 5 minutes.

- C. Input Voltage Tolerance: System steady-state and transient output performance remains within specified tolerances when steady-state ac input voltage varies plus 10, minus 15 percent from nominal voltage.
- D. Overall UPS Efficiency: Equal to or greater than 89 percent at 100 percent load, 88 percent at 75 percent load, and 87 percent at 50 percent load.
- E. Maximum Acoustical Noise: 75 dBA, "A" weighting, emanating from any UPS component under any condition of normal operation, measured 5 feet from nearest surface of component enclosure.
- F. Maximum Energizing Inrush Current: Five times the normal full-load current.
- G. Maximum AC Output-Voltage Regulation for Loads up to 50 Percent Unbalanced: Plus or minus 2 percent over the full range of battery voltage.
- H. Power Walk-In: Configurable from 20% to 100% over 20 seconds
- I. Output Frequency: 60 Hz, plus or minus 0.5 percent over the full range of input voltage, load, and battery voltage.
- J. Limitation of harmonic distortion of input current to the UPS shall be as follows:
  - 1. Description: Either a tuned harmonic filter or an arrangement of rectifier-charger circuits shall limit THD to 10 percent, maximum, at rated full UPS load current, for power sources with X/R ratio between 2 and 30.
- K. Maximum Harmonic Content of Output-Voltage Waveform: 5 percent rms total and 3 percent rms for any single harmonic, for rated full load with THD up to 50 percent, with a load crest factor of 3.0.
- L. Minimum Overload Capacity of UPS at Rated Voltage: 125 percent of rated full load for 10 minutes, and 150 percent for 30 seconds in all operating modes.
- M. Maximum Output-Voltage Transient Excursions from Rated Value: For the following instantaneous load changes, stated as percentages of rated full UPS load, voltage shall remain within stated percentages of rated value and recover to, and remain within, plus or minus 2 percent of that value within 100 ms:
  - 1. 50 Percent: Plus or minus 5 percent.
  - 2. 100 Percent: Plus or minus 8 percent.
  - 3. Loss of AC Input Power: Plus or minus 1 percent.
  - 4. Restoration of AC Input Power: Plus or minus 1 percent.
  - 5. Manual Return of Load to UPS: Plus or minus 45 percent.
- N. Input Power Factor: A minimum of 0.85 lagging when supply voltage and current are at nominal rated values and the UPS is supplying rated full-load current without input filter.
- O. EMI Emissions: Comply with FCC Rules and Regulations and with 47 CFR 15 for Class A equipment.
- P. Fault Clearing Current: Up to 1000% for 16 milliseconds or up to 500% for 40 milliseconds.
- Q. Output Phase Balance: 120 degrees plus or minus 1 degree for balanced loads, 120 degrees plus or minus 3 degrees for 50% unbalanced load.
- R. Overload: 125% of full load for 5 minutes. 150% of full load for 30 seconds.
- S. Load Power Factor: Unity to rated lagging power factor with no derating.

### 2.3 UPS SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. ABB.
  - 2. Eaton Corporation Inc.



3. Emerson Electric Co.
  4. APC; Schneider Electric.
  5. Mitsubishi Electric Automation, Inc.
  6. Toshiba Power Electronics.
  7. Vertiv Group Corp.
- B. Electronic Equipment: Solid-state devices using hermetically sealed, semiconductor elements. Devices include rectifier-charger, inverter, static bypass transfer switch, and system controls.
- C. Enclosures: Comply with NEMA 250, Type 1, unless otherwise indicated.
- D. Control Assemblies: Mount on modular plug-ins, readily accessible for maintenance.
- E. Surge Suppression: Protect internal UPS components from surges that enter at each ac power input connection including main disconnect switch, static bypass transfer switch. Protect rectifier-charger, inverter, controls, and output components.
1. Use factory-installed surge suppressors tested according to IEEE C62.41.1 and IEEE C62.41.2, Category B.
  2. Additional Surge Protection: Protect internal UPS components from low-frequency, high-energy voltage surges described in IEEE C62.41.1 and IEEE C62.41.2. Design the circuits connecting with external power sources and select circuit elements, conductors, conventional surge suppressors, and rectifier components and controls so input assemblies will have adequate mechanical strength and thermal and current-carrying capacity to withstand stresses imposed by 40-Hz, 180 percent voltage surges described in IEEE C62.41.1 and IEEE C62.41.2.

## 2.4 RECTIFIER-CHARGER

- A. Capacity: Adequate to supply the inverter during rated full output load conditions and simultaneously recharge the battery from fully discharged condition to 95 percent of full charge within 10 times the rated discharge time for duration of supply under battery power at full load.
- B. Output Ripple: Limited by output filtration to less than 0.5 percent of rated current, peak to peak.
- C. Control Circuits: Immune to frequency variations within rated frequency ranges of normal and emergency power sources.
1. Response Time: Field adjustable for maximum compatibility with local generator-set power source.
- D. Battery Float-Charging Conditions: Comply with battery manufacturer's written instructions for battery terminal voltage and charging current required for maximum battery life.

## 2.5 INVERTER

- A. Description: Pulse-width modulated, with sinusoidal output. Include a bypass phase synchronization window adjustment to optimize compatibility with local engine-generator-set power source.

## 2.6 STATIC BYPASS TRANSFER SWITCH

- A. Description: Solid-state switching device providing uninterrupted transfer. A contactor or electrically operated circuit breaker automatically provides electrical isolation for the switch.
- B. Switch Rating: Continuous duty at the rated full UPS load current, minimum.

## 2.7 BATTERY

- A. Description: Lithium-ion, factory assembled in an isolated compartment of UPS cabinet, complete with battery disconnect switch.

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Schneider Electric (Galaxy)
  2. C&D Technologies, Inc.; Standby Power Division.
  3. Eaton Corporation; Powerware Division.
  4. EnerSys.
  5. Panasonic Corporation of North America; Panasonic Industrial Company

## 2.8 CONTROLS AND INDICATIONS

- A. Description: Group displays, indications, and basic system controls on a common control panel on front of UPS enclosure.
- B. Minimum displays, indicating devices, and controls include those in lists below. Provide sensors, transducers, terminals, relays, and wiring required to support listed items. Alarms include audible signals and visual displays.
- C. Indications: Plain-language messages on a digital LCD or LED.
1. Quantitative indications shall include the following:
    - a. Input voltage, each phase, line to line.
    - b. Input current, each phase, line to line.
    - c. Bypass input voltage, each phase, line to line.
    - d. Bypass input frequency.
    - e. System output voltage, each phase, line to line.
    - f. System output current, each phase.
    - g. System output frequency.
    - h. DC bus voltage.
    - i. Battery current and direction (charge/discharge).
    - j. Elapsed time discharging battery.
  2. Basic status condition indications shall include the following:
    - a. Normal operation.
    - b. Load-on bypass.
    - c. Load-on battery.
    - d. Inverter off.
    - e. Alarm condition.
  3. Alarm indications shall include the following:
    - a. Bypass ac input overvoltage or undervoltage.
    - b. Bypass ac input overfrequency or underfrequency.
    - c. Bypass ac input and inverter out of synchronization.
    - d. Bypass ac input wrong-phase rotation.
    - e. Bypass ac input single-phase condition.
    - f. Bypass ac input filter fuse blown.
    - g. Internal frequency standard in use.
    - h. Battery system alarm.
    - i. Control power failure.
    - j. Fan failure.
    - k. UPS overload.
    - l. Battery-charging control faulty.
    - m. Input overvoltage or undervoltage.
    - n. Input transformer overtemperature.
    - o. Input circuit breaker tripped.
    - p. Input wrong-phase rotation.
    - q. Input single-phase condition.
    - r. Approaching end of battery operation.
    - s. Battery undervoltage shutdown.
    - t. Maximum battery voltage.

- u. Inverter fuse blown.
- v. Inverter transformer overtemperature.
- w. Inverter overtemperature.
- x. Static bypass transfer switch overtemperature.
- y. Inverter power supply fault.
- z. Inverter transistors out of saturation.
- aa. Identification of faulty inverter section/leg.
- bb. Inverter output overvoltage or undervoltage.
- cc. UPS overload shutdown.
- dd. Inverter current sensor fault.
- ee. Inverter output contactor open.
- ff. Inverter current limit.
- 4. Controls shall include the following:
  - a. Inverter on-off.
  - b. UPS start.
  - c. Battery test.
  - d. Alarm silence/reset.
  - e. Output-voltage adjustment.
- D. Dry-form "C" contacts shall be available for remote indication of the following conditions:
  - 1. UPS on battery.
  - 2. UPS on-line.
  - 3. UPS load-on bypass.
  - 4. UPS in alarm condition.
  - 5. UPS off (maintenance bypass closed).
- E. Emergency Power Off Switch: Capable of local operation and operation by means of activation by external dry contacts.

## 2.9 MONITORING BY REMOTE STATUS AND ALARM PANEL

- A. Description: Labeled LEDs on panel faceplate indicate five basic status conditions. Audible signal indicates alarm conditions. Silencing switch in face of panel silences signal without altering visual indication.
  - 1. Cabinet and Faceplate: Surface or flush mounted to suit mounting conditions indicated.

## 2.10 BASIC BATTERY MONITORING

- A. Manufacturers:
  - 1. Albercorp.
  - 2. Schnieder Electric.
  - 3. BTECH, Inc.
  - 4. Eaton.
- B. Battery Ground-Fault Detector: Initiates alarm when resistance to ground of positive or negative bus of battery is less than 5000 ohms.
- C. Battery compartment smoke/high-temperature detector initiates an alarm when smoke or a temperature greater than 75 deg C occurs within the compartment.
- D. Annunciation of Alarms: At UPS control panel.

## 2.11 SOURCE QUALITY CONTROL

- A. Factory test complete UPS system before shipment. Use simulated battery testing. Include the following:
  - 1. Test and demonstration of all functions, controls, indicators, sensors, and protective devices.

2. Full-load test.
3. Transient-load response test.
4. Overload test.
5. Power failure test.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Equipment Mounting: Install UPS on concrete base for locations at concrete slabs. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
  1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- D. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams unless otherwise indicated.

#### **3.2 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for conditions affecting performance of the UPS.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.3 IDENTIFICATION**

- A. Identify components and wiring according to Division 26 Section "Identification for Electrical Systems."
  1. Identify each battery cell individually.

#### **3.4 BATTERY EQUALIZATION**

- A. Equalize charging of battery cells according to manufacturer's written instructions. Record individual-cell voltages.

#### **3.5 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  1. Comply with manufacturer's written instructions.
  2. Inspect interiors of enclosures, including the following:
    - a. Integrity of mechanical and electrical connections.

- b. Component type and labeling verification.
    - c. Ratings of installed components.
  3. Inspect batteries and chargers according to requirements in NETA Acceptance Testing Specifications.
  4. Test manual and automatic operational features and system protective and alarm functions.
  5. Test communication of status and alarms to remote monitoring equipment.
  6. Load the system using a variable-load bank to simulate kilovolt amperes, kilowatts, and power factor of loads for unit's rating. Use instruments calibrated within the previous six months according to NIST standards.
    - a. Simulate malfunctions to verify protective device operation.
    - b. Test duration of supply on emergency, low-battery voltage shutdown, and transfers and restoration due to normal source failure.
    - c. Test harmonic content of input and output current less than 25, 50, and 100 percent of rated loads.
    - d. Test output voltage under specified transient-load conditions.
    - e. Test efficiency at 50, 75, and 100 percent of rated loads.
    - f. Test remote status and alarm panel functions.
    - g. Test battery-monitoring system functions.
- D. The UPS system will be considered defective if it does not pass tests and inspections.
- E. Record of Tests and Inspections: Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, inspections, and retests.
- F. Prepare test and inspection reports.

### 3.6 PERFORMANCE TESTING

- A. Monitoring and Testing Schedule: Perform monitoring and testing in a single 10-day period .
  1. Schedule monitoring and testing activity with Owner, through Architect, with at least 14 days' advance notice.
  2. Schedule monitoring and testing after Substantial Completion, when the UPS is supplying power to its intended load.
- B. Monitoring and Testing Instruments: Three-phase, recording, power monitors. Instruments shall provide continuous simultaneous monitoring of electrical parameters at UPS input terminals and at input terminals of loads served by the UPS. Instruments shall monitor, measure, and graph voltage current and frequency simultaneously and provide full-graphic recordings of the values of those parameters before and during power-line disturbances that cause the values to deviate from normal beyond the adjustable threshold values. Instruments shall be capable of recording either on paper or on magnetic media and have a minimum accuracy of plus or minus 2 percent for electrical parameters. Parameters to be monitored include the following:
  1. Current: Each phase and neutral and grounding conductors.
  2. Voltage: Phase to phase, phase to neutral, phase to ground, and neutral to ground.
  3. Frequency transients.
  4. Voltage swells and sags.
  5. Voltage Impulses: Phase to phase, phase to neutral, phase to ground, and neutral to ground.
  6. High-frequency noise.
  7. Radio-frequency interference.
  8. THD of the above currents and voltages.
  9. Harmonic content of currents and voltages above.
- C. Monitoring and Testing Procedures:
  1. Exploratory Period: For the first two days, make recordings at various circuit locations and with various parameter-threshold and sampling-interval settings. Make these

- measurements with the objective of identifying optimum UPS, power system, load, and instrumentation setup conditions for subsequent test and monitoring operations.
2. Remainder of Test Period: Perform continuous monitoring of at least two circuit locations selected on the basis of data obtained during exploratory period.
    - a. Set thresholds and sampling intervals for recording data at values selected to optimize data on performance of the UPS for values indicated, and to highlight the need to adjust, repair, or modify the UPS, distribution system, or load component that may influence its performance or that may require better power quality.
    - b. Perform load and UPS power source switching and operate the UPS on generator power during portions of test period according to directions of Owner's power quality specialist.
    - c. Operate the UPS and its loads in each mode of operation permitted by UPS controls and by the power distribution system design.
    - d. Using loads and devices available as part of the facility's installed systems and equipment, create and simulate unusual operating conditions, including outages, voltage swells and sags, and voltage, current, and frequency transients. Maintain normal operating loads in operation on system to maximum extent possible during tests.
    - e. Make adjustments and repairs to UPS, distribution, and load equipment to correct deficiencies disclosed by monitoring and testing and repeat appropriate monitoring and testing to verify success of corrective action.
  - D. Coordination with Specified UPS Monitoring Functions: Obtain printouts of built-in monitoring functions specified for the UPS and its components in this Section that are simultaneously recorded with portable instruments in this article.
    1. Provide the temporary use of an appropriate PC and printer equipped with required connections and software for recording and printing if such units are not available on-site.
    2. Coordinate printouts with recordings for monitoring performed according to this article, and resolve and report any anomalies in and discrepancies between the two sets of records.
  - E. Monitoring and Testing Assistance by Contractor:
    1. Open UPS and electrical distribution and load equipment and wiring enclosures to make monitoring and testing points accessible for temporary monitoring probe and sensor placement and removal as requested.
    2. Observe monitoring and testing operations; ensure that UPS and distribution and load equipment warranties are not compromised.
    3. Perform switching and control of various UPS units, electrical distribution systems, and load components as directed by power quality specialist. Specialist shall design this portion of monitoring and testing operations to expose the UPS to various operating environments, conditions, and events while response is observed, electrical parameters are monitored, and system and equipment deficiencies are identified.
    4. Make repairs and adjustments to the UPS and to electrical distribution system and load components, and retest and repeat monitoring as needed to verify validity of results and correction of deficiencies.
    5. Engage the services of the UPS manufacturer's factory-authorized service representative periodically during performance testing operations for repairs, adjustments, and consultations.
  - F. Documentation: Record test point and sensor locations, instrument settings, and circuit and load conditions for each monitoring summary and power disturbance recording. Coordinate simultaneous recordings made on UPS input and load circuits.
  - G. Analysis of Recorded Data and Report: Review and analyze test observations and recorded data and submit a detailed written report. Include the following in report:
    1. Description of corrective actions performed during monitoring and survey work and their results.

2. Recommendations for further action to provide optimum performance by the UPS and appropriate power quality for non-UPS loads. Include a statement of priority ranking and a cost estimate for each recommendation that involves system or equipment revisions.
  3. Copies of monitoring summary graphics and graphics illustrating harmonic content of significant voltages and currents.
  4. Copies of graphics of power disturbance recordings that illustrate findings, conclusions, and recommendations.
  5. Recommendations for operating, adjusting, or revising UPS controls.
  6. Recommendation for alterations to the UPS installation.
  7. Recommendations for adjusting or revising generator-set or automatic transfer switch installations or their controls.
  8. Recommendations for power distribution system revisions.
  9. Recommendations for adjusting or revising electrical loads, their connections, or controls.
- H. Interim and Final Reports: Provide an interim report at the end of each test period and a final comprehensive report at the end of final test and analysis period.

### **3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the UPS.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 26 36 00 - TRANSFER SWITCHES****PART 1 - GENERAL REQUIREMENTS****1.1 SUMMARY**

- A. This section includes transfer switches rated 600 V and less, including the following:
  - 1. Automatic transfer switches.
  - 2. Nonautomatic transfer switches.
  - 3. Remote annunciation systems.
  - 4. Remote annunciation and control systems.
- B. This section does not include the following:
  - 1. Double throw (manual type) switches. Refer to Division 26 section "Enclosed Switches and Circuit Breakers" for this equipment.

**1.2 DEFINITIONS**

- A. Closed Transition (Make-Before-Break): In a switching device, a configuration in which the new connection path is established before the previous contacts are opened. This prevents the switched path from ever seeing an open circuit.
- B. Open Transition (Break-Before-Make): A switch that is configured to break (open) the first set of contacts before engaging (closing) the new contacts. This prevents the momentary connection of the old and new circuit paths together.
- C. Withstand duration: The withstand rating value is the level of fault current that must be withstood for a specified length of time, i.e., 42000 amps at 3 cycles.
- D. Level 1 Equipment: Level 1 is the more stringent NFPA emergency life safety requirement and is imposed when failure of the emergency system, including the transfer equipment could result in loss of human life or serious injury.
- E. Level 2 Equipment: Level 2 is the less stringent NFPA emergency life safety requirement and is imposed when failure of the emergency system including the transfer equipment is less critical to human life safety.
- F. NETA ATS: InterNational Electrical Testing Association Acceptance Testing Specification.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Fault-Current Study, Coordination Study, and Overcurrent Protective Device Settings report must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. If studies have not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the contractor at no additional cost to the project. Refer to specification section "Overcurrent Protective Device Coordination Study"

**1.4 SUBMITTALS**

- A. Product Data: For each type of transfer switch, switching and overcurrent protective device, instrumentation, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each transfer switch and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details, including required clearances, service space around equipment, and attachments to other work. Show tabulations of installed devices, equipment features, and ratings.
    - a. Tabulate features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 2. Detail enclosure types and details for other than NEMA 250, Type 1.
  - 3. Include general arrangement drawing showing dimensions and weights of each assembled section.
  - 4. Detail bus configuration, current, and voltage ratings, including size and number of bus bars and current rating for each bus. Indicate mains and branches of phase, neutral, and ground buses. Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
  - 5. Detail short-circuit current rating of transfer switch assembly and overcurrent protective devices.
  - 6. Include descriptive documentation of barriers specified for electrical insulation and isolation.
  - 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 8. Include schematic and wiring diagrams for power, signal, and control wiring.
  - 9. Include nameplate legends.
  - 10. Include list of materials.
- C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around transfer switches where pipe and ducts are prohibited. Show transfer switch layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
  - 1. For each equipment room, provide dimensioned layout of the electrical equipment within the space, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved.
  - 2. Dimensioned concrete base, outline of transfer switch, conduit entries, and ground rod locations; including equipment working clearances and manufacturer required access space.
  - 3. Indicate structural members, light fixtures, sprinkler piping and heads, HVAC equipment, ducts and diffusers, plumbing piping and access fittings. Include maintenance access clearances.
  - 4. Location of structural supports for structure-supported raceways.
  - 5. Location and clearance of electrical equipment and raceways impacting equipment installation.
- D. Sustainable Design Documentation: Submit manufacturer's product data on materials and assemblies showing compliance with building rating standard(s) requirements.
- E. Sustainable Design Documentation: Submit manufacturer's product data on materials and assemblies showing compliance with building rating standard(s) requirements.
- F. Qualification Data: For qualified manufacturer and testing agency.
- G. Factory test reports.
- H. Field Quality-Control Reports:
  - 1. Test procedures used.

2. Test results that comply with requirements.
- I. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- J. Manufacturer's field service report.
- K. Sample Warranty: For warranties.
- L. Project Record Documents: Record actual installed equipment and circuiting arrangements. Record actual routing for underground circuits. Record actual installed location of ground rods.
- M. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  1. Routine maintenance requirements for panelboards and all installed components.
  2. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
  3. Time-current curves; include selectable ranges for each type of overcurrent protective device. Provide relay-settings and calibration instructions, including software, where applicable.
  4. Features and operating sequences, both automatic and manual.
  5. Video recording of operation training and demonstration.
- N. Follow-up service reports.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Source Limitations: Obtain automatic transfer switches, non-automatic transfer switches and remote annunciator and control panels through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NEMA ICS 1.
- E. Comply with NFPA 70.
- F. Comply with NFPA 110.
- G. Comply with UL 1008 unless requirements of these Specifications are stricter.

## 1.6 PROJECT CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
- B. Environmental Limitations:
  1. Do not deliver or install transfer switches until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above equipment is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).

- b. Altitude: Not exceeding 6600 feet (2000 m).

### 1.7 DELIVERY STORAGE AND HANDLING

- A. Deliver transfer switches in sections or lengths that can be moved past obstructions in delivery path.
- B. Coordinate delivery of equipment to allow movement into designated space.
- C. Store in a clean, dry space, protected from weather and so condensation will not form on or in units. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic. Handle carefully in accordance with manufacturer's instructions to avoid damage to equipment components, enclosure, and finish. Provide temporary heating according to manufacturer's written instructions.
- D. Handle and prepare transfer switch components according to manufacturer's written instructions. Use factory-installed lifting provisions.

### 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of the Transfer Switch that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Damage from transient voltage surges.
- B. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.

### 1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Indicating Lights: Four of each type installed.
  2. Switching Contact Lubricant: One container.
  3. Alarm Contacts: Equal to 10 percent of quantity supplied, but no fewer than two of each type.
  4. Touchup Paint: Two containers of paint matching enclosure finish, each 0.5 pint (250 mL).
  5. Enclosure Keys: Two for each enclosure type. All distribution equipment keyed alike.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Manufacturers:
  1. Contactor Transfer Switches:
    - a. Caterpillar; Engine Div.
    - b. Eaton Electrical Inc.; Cutler-Hammer
    - c. Emerson; ASCO Power Technologies, LP.
    - d. GE Zenith Controls.
    - e. Kohler Power Systems; Generator Division.
    - f. Onan/Cummins Power Generation; Industrial Business Group.
    - g. Russelectric, Inc.
    - h. Spectrum Detroit Diesel.

- B. Indicated Voltage and Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated. Voltage ratings shall be consistent with applications from 115 volts AC to 600 volts and single or three phase as required by the application. Current ratings and the number of poles shall be as indicated on the plans.
- C. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
  - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
  - 2. Where the transfer switch internal fault-current protection can not exceed the indicated fault-current values, an enclosed fused switch with current limiting fuses shall be installed ahead of the transfer switch.
- D. Controls: Solid State control having repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C. All internal controls components shall be accessible from the equipment front.
- E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- F. Electrical Operation: Accomplish by a non-fused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
  - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
  - 2. Switch Action: Double throw; mechanically held in both directions.
  - 3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- H. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- I. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- J. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. All factory wiring shall be accessible from the equipment front. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
  - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
  - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated. Power terminals shall be rated for 90 degree C and copper or aluminum cable.
  - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- K. Enclosures: General-purpose NEMA 250, Type 1 3R 12, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.
- L. Bus and Wiring: All Bus and cable /control wire shall be copper.
- M. Cable Entry: Cable entry shall be from the top and bottom.

## 2.2 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- E. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- F. Automatic open-transition transfer switches: Include the following functions and characteristics:
  - 1. Fully automatic break-before-make.
- G. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
- H. Automatic Transfer-Switch Features:
  - 1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
  - 2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
  - 3. Frequency: Monitor the frequency of the incoming normal power circuit. For the normal source, initiate transfer if the frequency varies more than 5% from the rated nominal value. For the emergency source, inhibit transfer if the normal source circuit frequency varies more than 5% from the rated nominal value.
  - 4. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
  - 5. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
  - 6. Test Switch: Simulate normal-source failure.
  - 7. Switch-Position Pilot Lights: Indicate source to which load is connected.
  - 8. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
    - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
  - 9. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.

10. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
  - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
  - b. Push-button programming control with digital display of settings.
  - c. Integral battery operation of time switch when normal control power is not available.
13. Elevator Application: Provide the following functions if automatic transfer is for elevator control:
  - a. Auxiliary contact closure upon the transfer to the alternate source to signal the elevator controller(s) for emergency operation.
  - b. Auxiliary contact closure, adjustable from 0 to 20 seconds before retransfer to normal source to allow for elevator motor-generator sets to disconnect from the power source.
  - c. Auxiliary contact closure, adjustable from 0 to 20 seconds before testing transfer operation to signal the elevator controller(s) for emergency operation.

### 2.3 NONAUTOMATIC TRANSFER SWITCHES

- A. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- B. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.
- C. Nonautomatic Transfer-Switch Accessories:
  1. Pilot Lights: Indicate source to which load is connected.
  2. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternate-source sensing circuits.
    - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    - b. Emergency Power Supervision: Red light with nameplate engraved "Alternate Source Available."
  3. Unassigned Auxiliary Contacts: One set of normally closed contacts for each switch position, rated 10 A at 240-V ac.

### 2.4 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

- A. Functional Description: Include the following functions for indicated transfer switches:
  1. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
  2. Indication of switch position.
  3. Indication of switch in test mode.
  4. Indication of failure of digital communication link.
  5. Key-switch or user-code access to control functions of panel.
  6. Control of switch-test initiation.
  7. Control of switch operation in either direction.

8. Control of time-delay bypass for transfer to normal source.
- B. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.
- C. Remote Annunciation and Control Panel: Solid-state components. Include the following features:
  1. Controls and indicating lights grouped together for each transfer switch.
  2. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
  3. Digital Communication Capability: Matched to that of transfer switches supervised.
  4. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

## 2.5 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

## 2.6 IDENTIFICATION

- A. Nameplates: Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine transfer switches before installation. Reject equipment that is damaged, or rusted, or have been subjected to water saturation.
- B. Examine areas, surfaces, substrates, and elements to receive transfer switches with Installer present, for compliance with requirements for installation tolerances, structural support, ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  1. Verify that field measurements are as indicated.
  2. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment will be installed, before installation begins.
- C. Examine roughing-in of conduits and grounding systems to verify the following:
  1. Wiring entries comply with layout requirements.
  2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install transfer switches and accessories in accordance with manufacturer's instructions.
- B. Coordinate layout and installation of equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.



- C. Wall-Mounted Switch: Install transfer switches on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For transfer switches not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- D. Floor-Mounted Switch: Install transfer switches on concrete bases.
  - 1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 3 inches (75 mm) in all directions beyond the maximum dimensions of transfer switches unless otherwise indicated or unless required for seismic anchor support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
  - 2. Anchor transfer switches to concrete bases according to manufacturer's written instructions, , and requirements in Division 26 Sections "Hangers and Supports for Electrical Systems".
  - 3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
  - 4. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 6. Install anchor bolts to elevations required for proper attachment to transfer switches.
- E. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.
- F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from enclosure and components.
- G. Mount equipment plumb and rigid without distortion of enclosure.
- H. Arrange conductors in auxiliary compartments and gutters into groups and bundle and wrap with wire ties.
- I. Comply with NECA 1.

### 3.3 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools for control wiring.

### 3.4 IDENTIFICATION

- A. Equipment Nameplates: Label each contiguous main, or entrance, section with equipment nameplate.
- B. Device Nameplates: Label each main and bypass device with a nameplate.
- C. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

- D. Diagram and Instructions:
  - 1. Engraved, Laminated Acrylic or Melamine Label. Mount on front of transfer switch.
    - a. Operating Instructions: Printed operating instructions for transfer switch, including key interlocking, control sequences, elementary single-line diagram, and emergency procedures.
    - b. System Power One-Line Diagrams: Provide color-coded, large-format one-line diagram showing the new work is to be provided and installed in the associated electrical room. Depict power sources, feeders, distribution components, and major loads.
  - 2. Storage for Maintenance Instructions: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.
- E. Warning Labels: Label each panelboard with a warning label in accordance with NFPA 70 and NFPA 70E.

### 3.5 CLEANING

- A. After completing equipment installation and before energizing, inspect unit components. Vacuum dirt and debris from interior of equipment; do not use compressed air to assist in cleaning. Remove paint splatters and other spots. Repair exposed surfaces to match original finish.

### 3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

### 3.7 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

### 3.8 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control tests and inspections:
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, to assist in testing, and to assist in adjusting device settings.
- B. Coordinate tests with tests of generator and run them concurrently.
- C. Acceptance Testing Preparation:
  - 1. After installing equipment but before equipment is energized, test for compliance with requirements.
  - 2. Test insulation resistance for each bus, component, connecting supply, feeder, and control circuit.
  - 3. Test continuity of each circuit.
- D. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. After electrical circuitry has been energized, test for compliance with requirements.
  - 2. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
    - a. Check for electrical continuity of circuits and for short circuits.

- b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    - c. Verify that manual transfer warnings are properly placed.
    - d. Perform manual transfer operation.
  3. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
    - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    - c. Verify time-delay settings.
    - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
    - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
    - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
  4. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
    - a. Verify grounding connections and locations and ratings of sensors.
    - b. Observe reaction of circuit-interrupting devices when simulated fault current is applied at sensors.
  5. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  6. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- E. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
  1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
  2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- F. Transfer switches will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies transfer switches included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment, instrumentation, and accessories, and to use and reprogram microprocessor-based control, monitoring, and display functions.
- B. Video record demonstrations presentation for Owner's records.
- C. Coordinate this training with that for generator equipment.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 26 41 13 - LIGHTNING PROTECTION FOR STRUCTURES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes requirements for UL 96A Master Labeled lightning protection system consisting of air terminals on roofs, roof mounted mechanical equipment, stacks, bonding of structure and miscellaneous metal objects; Grounding electrodes; and interconnecting conductors.
- B. System Design: Contractor shall perform all calculations and develop all plan and detail drawings required, in conjunction with these specifications, for installation of a complete and fully functional lightning protection system.

**1.2 CODES REFERENCES AND STANDARDS**

- A. Applicable Codes and Standards
  1. NFPA 70 – National Electrical Code
  2. UL 96 – Lightning Protection Components
  3. UL 96A – Installation requirements for Lightning Protection Systems
  4. NFPA 780 – Lightning Protection Systems
  5. LPI 175 – Standard of Practice for the Design – Installation – Inspection of Lightning Protection Systems

**1.3 DEFINITIONS**

- A. The following definitions apply to terms used in this section:
  1. Air Terminal: A strike termination device that is a receptor for attachment of flashes to the lightning protection system and is UL listed for that purpose.
  2. Bonding: An electrical connection between an electrically conductive object and a component of a lightning protection system that is intended to significantly reduce potential differences created by lightning currents.
  3. Class I Materials: Lightning conductors, air terminals, ground terminals, and associated fittings required by NFPA 780 for protection of structures not exceeding 75 feet (23 meters) in height.
  4. Class II Materials: Lightning conductors, air terminals, ground terminals, and associated fittings required by NFPA 780 for the protection of structures exceeding 75 feet (23 meters) in height.
  5. Bonding conductor: A conductor intended to be used for equalization between grounded metal bodies and a lightning protection system.
  6. Main conductor: A conductor intended to be used to carry lightning currents between strike termination devices (air terminals) and ground terminals.
  7. UL: Underwriters Laboratories, Inc.
  8. LPI: Lightning Protection Institute

**1.4 SUBMITTALS**

- A. Product Data: Submit product data showing dimensions and materials of each component including listing in accordance with UL 96A.
- B. Shop Drawings: For air terminals and mounting accessories.
  1. Layout of the lightning protection system showing layout of air terminals grounding electrodes, and bonding connections, along with details of the components to be used in the installation.

2. Include indications for use of raceway, conductor sizes, roof and/or floor penetrations, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.
  3. Layout and installation drawings shall be fully coordinated with other trades. Failure of the lightning protection contractor to perform this coordination shall not relieve said contractor from properly completing the work.
- C. Qualification Data: For qualified manufacturer. Include data on listing or certification by UL.
1. Manufacturer: A company specializing in lightning protection equipment with minimum 3 years documented experience and membership in good standing with the Lightning Protection Institute.
- D. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.
- E. Field quality-control reports.
- F. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.
- G. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:
1. Ground rods.
  2. Ground loop conductor.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
1. Certified by UL, trained and approved for installation of units required for this Project.
  2. The contractor shall be recognized as being regularly engaged in the design and installation of lightning protection systems with a minimum of 3 years documented experience.
  3. Include documentation of certification and experience with all submitted bids.
- B. System Certificate:
1. UL Master Label.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

## 1.6 COORDINATION

- A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.
- B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.
- C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

## PART 2 - PRODUCTS

### 2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. All materials used in the installation shall be new and shall comply in weight, size, and composition with UL 96 and NFPA 780. Materials shall be labeled or listed by UL for use on lightning protection systems.
- B. Roof-Mounted Air Terminals: NFPA 780, Class II, aluminum unless otherwise indicated.

1. Available Manufacturers:
    - a. East Coast Lightning Equipment Inc.
    - b. ERICO International Corporation.
    - c. Harger.
    - d. Heary Bros. Lightning Protection Co. Inc.
    - e. Independent Protection Co.
    - f. Preferred Lightning Protection.
    - g. Robbins Lightning, Inc.
    - h. Thompson Lightning Protection, Inc.
    - i. VFC
  2. Air Terminals More than 24 Inches (600 mm) Long: With brace attached to the terminal at not less than half the height of the terminal.
  3. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in Division 07 roofing Sections.
- C. Main and Bonding Conductors: Aluminum and Class II.
- D. Ground Loop Conductor: The same size and type as the main conductor except tinned.
- E. Ground Rods: Copper-clad steel; 5/8 inch (16 mm) in diameter by 96 inches (2400 mm) long.
- F. Heavy-Duty, Stack-Mounted, Lightning Protection Components:
1. Stainless steel.
  2. Main and Bonding Conductors: Lead (1/16" thick) covered copper from the top of the stack to 25 feet below the top of the stack.

## 2.2 SURGE PROTECTIVE DEVICES

- A. Surge Protective Devices SPD's required to meet UL 96A for UL Master Labeling shall be as specified in Division 26 Section "Surge Protective Devices".

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install lightning protection components and systems according to UL 96A and NFPA 780.
- C. Install conductors with two direct paths from air terminals to ground connections. Avoid sharp bends. Follow the manufacturer's written installation instructions.
- D. Conceal the following conductors:
1. System conductors.
  2. Down conductors.
  3. Interior conductors.
  4. Conductors within normal view of exterior locations at grade within 200 feet (60 m) of building.
- E. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.
- F. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.
1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.

- G. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.
- H. Air Terminals on Mechanical Equipment: Air terminals on mechanical equipment shall be mounted such that maintenance operations can be performed without relocation of the air terminal or interconnecting conductors.
- I. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.
- J. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of structure.
  - 1. Bury ground ring not less than 24 inches (600 mm) from building foundation.
  - 2. Bond ground terminals to the ground loop.
  - 3. Bond grounded building systems to the ground loop conductor within 12 feet (3.6 m) of grade level.
  - 4. Interconnect lightning protection ground loop with the building electrical service grounding electrode system at one place only.
- K. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot (18-m) intervals.

### **3.2 CORROSION PROTECTION**

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

### **3.3 FIELD QUALITY CONTROL**

- A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.
- B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

END OF SECTION



**SECTION 26 43 13 - SURGE PROTECTIVE DEVICES****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. This section includes field-mounted Surge Protective Devices (SPDs) for low-voltage (120 to 600 V) power distribution and control equipment, including:
  - 1. Surge Protection Devices at Service Entrance Equipment
  - 2. Surge Protection Devices at Distribution Equipment
  - 3. Surge Protection Devices at Branch Panelboards

**1.2 DEFINITIONS**

- A. ATS: Acceptance Testing Specifications.
- B. *In* or *Inominal*: Nominal Discharge Current. Peak value of surge current, selected by the manufacturer, through the SPD having current wave shape of 8/20 microseconds where the SPD remains functional after 15 surges. *In* is posted on the device UL label.
- C. MCOV: Maximum Continuous Operating Voltage. The maximum continuous operating voltage rating of a Metal Oxide Varistor (MOV) that can be applied without the MOV being damaged and/or destroyed by thermal runaway. MCOV is posted on the device UL label.
- D. SCCR: Short Circuit Current Rating. The maximum current rating the SPD can sustain without being damaged and/or destroyed. SCCR is posted on the device UL label.
- E. SPD: Surge Protective Device. A broad class of protective devices, installed parallel with the distribution panel or service disconnect, meant to protect downstream electrical distribution equipment from the effects of high voltage surges on the line.
- F. SPD Type definitions:
  - 1. TYPE 1: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, as well as the load side, including watt-hour meter socket enclosures and intended to be installed without an external overcurrent protective device. Type 1 devices are required for Master Certification of Lightning Protection System installations under UL 96A.
  - 2. TYPE 2: Permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device, including SPDs located at the branch circuit panel.
  - 3. TYPE 3: Point-of-utilization SPDs, installed at a minimum conductor length of 10 meters (30 feet) from the electrical service panel to the point of utilization, e.g., cord-connected, direct plug-in, receptacle type and SPDs installed at the utilization equipment being protected. The distance (10 meters or 30 feet) is exclusive of conductors provided with or used to attach SPD's.
  - 4. TYPE 4: Component SPDs, including discrete components as well as component assemblies for installation on panelboards or control panels.
- G. VPR: Voltage Protection Rating. The average of measured limiting voltage before and after Nominal Discharge Testing (*In*), rounded up to one of UL's VPR categories (indicated in the latest ANSI/UL 1449 edition) such as 330 volt, 400 volt, 500 volt, etc. VPR is posted on each device UL label.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate layout and installation of SPDs and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment,

raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access.

- B. Fault-Current Study, Coordination Study, and Overcurrent Protective Device Settings report must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. If studies have not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the contractor at no additional cost to the project. Refer to specification section "Overcurrent Protective Device Coordination Study".
- C. Do not energize or connect any electrical or low voltage equipment to their sources until SPDs are installed and connected.
- D. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect before conducting insulation resistance tests and reconnect immediately after the testing is over.

#### 1.4 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements".
- B. Product Data: For each SPD type, accessory, component and enclosure indicated. Include dimensions and Manufacturer's technical data on features, performance, electrical characteristics, ratings, weights, furnished options, specialties, accessories, and finishes. Tabulate model number, SPD type, system voltage, phases, modes of protection, MCOV, VPR, and  $I_n$ .
- C. Shop Drawings: For SPDs.
  - 1. Detail enclosure types and details.
  - 2. Include general arrangement drawing showing dimensions and weights of each assembled device.
  - 3. Include installation and mounting details for SPDs internal to equipment.
  - 4. Detail bus connection configuration, current, and voltage ratings, including size and number of bus bars and current rating for each bus.
  - 5. Detail short-circuit current rating of SPD assembly and overcurrent protective devices.
  - 6. Include schematic and wiring diagrams for power, signal, and control wiring.
  - 7. Include nameplate legends.
  - 8. Include list of materials.
- D. Product Certificates: For SPDs, from manufacturer.
- E. Sustainable Design Documentation: Submit manufacturer's product data on materials and assemblies showing compliance with building rating standard(s) requirements.
- F. Field quality-control reports.
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- G. Sample Warranty: For warranty.
- H. Project Record Documents: Record actual installed equipment and circuiting arrangements.
- I. Operation and Maintenance Data: For SPDs to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Routine maintenance requirements for SPDs and all installed components.
  - 2. Manufacturer's written instructions for testing and adjusting SPDs.
  - 3. Time-current curves for each type of overcurrent protective device.

4. Features and operating sequences, both automatic and manual.
  5. Video recording of operation training and demonstration.
- J. Follow-up service reports.

### 1.5 QUALITY ASSURANCE

- A. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."
- B. Source Limitations: Obtain SPDs of each type and associated components and accessories through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.
- D. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.
- E. Comply with NEMA LS 1.
- F. Comply with ANSI/ UL 1449.
- G. Comply with NFPA 70.
- H. The SPDs shall be compliant with the restrictions of the Hazardous Substances (RoHS) Directive 2002/95/EC.

### 1.6 PROJECT CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
- B. Environmental Limitations:
  1. Do not install SPDs until spaces are enclosed and weathertight. Equipment shall be protected from any remaining wet work in the space and work above equipment. Provide temporary HVAC system for maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
    - b. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
    - c. Humidity: 0 to 85 percent, noncondensing.
    - d. Altitude: Less than 20,000 feet (6090 m) above sea level.
- C. Interruption of Existing Electrical Service: Refer to Division 26, Section "General Electrical Requirements".

### 1.7 DELIVERY STORAGE AND HANDLING

- A. Store in a clean, dry space, protected from weather and so condensation will not form on or in units. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic. Handle carefully in accordance with manufacturer's instructions to avoid damage to equipment components, enclosure, and finish.
- B. Handle and prepare SPD components according to manufacturer's written instructions.

**1.8 WARRANTY**

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

**1.9 EXTRA MATERIALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Replaceable Protection Modules: One of each size and type installed.

**PART 2 - PRODUCTS****2.1 GENERAL**

- A. Manufacturers:
  - 1. ABB USA.
  - 2. Eaton.
  - 3. Intermatic, Inc.
  - 4. LEA International.
  - 5. Leviton Mfg. Company Inc.
  - 6. Siemens.
  - 7. Schneider Electric.
  - 8. Surge Suppression Incorporated.
  - 9. Vertiv.
- B. Surge Protective Device Ratings: Device type ratings shall be:
  - 1. Type 1 - Service entrances
  - 2. Type 2 - Service entrance equipment or distribution equipment
  - 3. Type 3 - Utilization equipment or point of use.
- C. Nominal System Voltage: Match the system voltage to which the SPD is connected, as indicated on the drawings.
- D. Maximum Continuous Operating Voltage: Not less than 125 percent of nominal system voltage for 240V or less power systems, and not less than 115 percent of nominal system voltage for 600V and 480V power systems.
- E. Comply with ANSI/UL 1449.
- F. SPDs for Lightning Protection: For Lightning Protection Systems specified or otherwise required to be "Master Labeled" per UL 96A utilize Type 1 (20kA rated  $I_n$ ) SPDs.
- G. SPDs for PV systems: For Photovoltaic Systems specified, SPDs shall be either DC rated or Dual Rated for AC and DC.

**2.2 SURGE PROTECTION DEVICES AT SERVICE ENTRANCE EQUIPMENT**

- A. Surge Protection Devices: Integrally mounted, wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, short-circuit current rating matching or exceeding the available short-circuit indicated on the plans, and with the following features and accessories:
  - 1. Fuses, rated at 200-kA interrupting capacity.
  - 2. Fabrication using bolted compression lugs for internal wiring.
  - 3. Redundant suppression circuits; with individually fused metal-oxide varistors,
  - 4. Redundant replaceable modules.

5. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
  6. LED indicator lights for power and protection status.
  7. Audible alarm, with silencing switch, to indicate when protection has failed.
  8. Six-digit transient-event counter set to totalize transient surges.
- B. Nominal Discharge current ( $I_n$ ): The SPD shall be tested to meet UL 1449 Nominal Discharge Current requirements. All modes of protection shall be tested including any required overcurrent protection.
1. Type 1 SPD's shall be tested and labeled at 20kA per mode.
  2. Type 2 SPD's shall be tested and labeled at 20kA per mode.
- C. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 200 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
- D. Protection Modes:
1. Protection mode VPR for grounded wye circuits 3-phase, 4-wire circuits shall be as follows:

	480Y/277 V	208Y/120 V	600Y/347 V
Line to Neutral	1200	700	1500
Line to Ground	1200	700	1500
Neutral to Ground	1200	700	1500
  2. Protection mode VPR for 240/120 V circuits shall be as follows:

	240/120V, 1ph, 3w	240/120V, 3ph, 4w (high leg)
Line to Neutral	700	700, 1400 from high leg
Line to Ground	1000	1000, 1400 from high leg
Neutral to Ground	700	700
  3. Protection mode VPR for 3-phase, 3-wire, delta circuits shall be as follows:

	240V	240V (Delta)	480V	600V
Line to Line	1000	1500	2000	2500
Line to Ground	800		2000	2500

### 2.3 SURGE PROTECTION DEVICES AT DISTRIBUTION EQUIPMENT

- A. Surge Protection Devices: Integrally mounted, wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, short-circuit current rating matching or exceeding the available short-circuit indicated on the plans, and with the following features and accessories:
1. Fuses, rated at 200-kA interrupting capacity.
  2. Fabrication using bolted compression lugs for internal wiring.
  3. Redundant suppression circuits; with individually fused metal-oxide varistors,
  4. Redundant replaceable modules.
  5. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
  6. LED indicator lights for power and protection status.
  7. Audible alarm, with silencing switch, to indicate when protection has failed.
- B. Nominal Discharge current ( $I_n$ ): The SPD shall be tested to meet UL 1449 Nominal Discharge Current requirements. All modes of protection shall be tested including any required overcurrent protection.
1. Type 1 SPD's shall be tested and labeled at 20kA per mode.
  2. Type 2 SPD's shall be tested and labeled at 20kA per mode.
- C. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 150 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.

## D. Protection Modes:

1. Protection mode VPR for grounded wye circuits, 3-phase, 4-wire circuits shall be as follows:

	480Y/277 V	208Y/120 V	600Y/347 V
Line to Neutral	1200	700	1500
Line to Ground	1200	700	1500
Neutral to Ground	1200	700	1500

2. Protection mode VPR for 1-phase, 3-wire circuits shall be as follows:

	240/120V, 1ph, 3w	240/120V, 3ph, 4w (high leg)
Line to Neutral	700	700, 1500 from high leg
Line to Ground	1000	1000
Neutral to Ground	700	700

3. Protection mode VPR for 3-phase, 3-wire, delta circuits shall be as follows:

	240V	240V (Delta)	480V	600V
Line to Line	1000	1500	2000	2500
Line to Ground	800		1500	2500

## 2.4 SURGE PROTECTION DEVICES AT BRANCH PANELBOARDS

- A. Surge Protection Device: Externally or Integrally mounted, wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, short-circuit current rating matching or exceeding the available short-circuit indicated on the plans, and with the following features and accessories:

1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Redundant suppression circuits; with individually fused metal-oxide varistors,
4. Redundant replaceable modules.
5. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
6. LED indicator lights for power and protection status.
7. Audible alarm, with silencing switch, to indicate when protection has failed.
8. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.

- B. Nominal Discharge current ( $I_n$ ): The SPD shall be tested to meet UL 1449 Nominal Discharge Current requirements. All modes of protection shall be tested including any required overcurrent protection.

1. Type 2 SPD's shall be tested and labeled at 20kA per mode.

- C. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 100 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.

## D. Protection Modes:

1. Protection mode VPR for grounded wye circuits, 3-phase, 4-wire circuits shall be as follows:

	480Y/277 V	208Y/120 V	600Y/347 V
Line to Neutral	1200	700	1500
Line to Ground	1200	700	1500
Neutral to Ground	1200	700	1500

2. Protection mode VPR for 1-phase, 3-wire circuits shall be as follows:

	240/120V, 1ph, 3w	240/120V, 3ph, 4w (high leg)
Line to Neutral	700	700, 1500 from high leg
Line to Ground	1000	1000
Neutral to Ground	700	700

3. Protection mode VPR for 3-phase, 3-wire, delta circuits shall be as follows:

	240V	240V (Delta)	480V	600V
Line to Line	1000	1500	2000	2500
Line to Ground	800		1500	2500

## 2.5 ENCLOSURES

- A. All SPD Units shall be fully enclosed unless otherwise noted. Provide enclosures suitable for the locations indicated and as described below:
1. Indoor Enclosures:
    - a. NEMA 250 Type 1 constructed of a polymer or steel material
    - b. NEMA 250 Type 12 constructed of a polymer or steel material with a gasket to exclude dust.
  2. Outdoor Enclosures:
    - a. NEMA 250 Type 3R constructed of steel material and with a gasket to exclude dirt, windblown dust, and water (rain, sleet, and snow) from entering the enclosure when shut.
    - b. NEMA 250 Type 4 constructed of steel material and with a gasket to exclude dirt, windblown dust, and water (rain, sleet, snow, splashing water or hose directed water) from entering the enclosure when shut.
    - c. NEMA 250 Type 4X constructed of stainless steel material and with a gasket to exclude dirt, windblown dust, and water (rain, sleet, snow, splashing water or hose directed water) from entering the enclosure when shut.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surge suppression devices before installation. Reject equipment that is damaged, or rusted, or have been subjected to water saturation.
- B. Examine areas, surfaces, substrates, and elements to receive SPDs with Installer present, for compliance with requirements for installation tolerances, structural support, ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  1. Verify that field measurements are as indicated.
  2. Verify that manufacturer's written instructions for environmental conditions have been established in spaces where equipment will be installed, before installation begins.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install SPDs and accessories in accordance with manufacturer's instructions.
- B. Coordinate layout and installation of equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access.
- C. Wall-Mounted Surge Protective Devices: Install SPDs on walls adjacent to equipment served, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall.

For SPDs not at walls, mount to similar support structure for equipment served by device. Comply with Division 26 Section "Hangers and Supports for Electrical Systems."

- D. Install SPD devices at service entrance on load side, with ground lead bonded to service entrance ground.
- E. Install SPD devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
  - 1. Provide circuit breaker as a dedicated disconnecting means for SPD unless otherwise indicated.
- F. Mount equipment plumb and rigid without distortion of enclosure.
- G. Install fuses in fusible devices.
- H. Comply with NECA 1.

### **3.3 CONNECTIONS**

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools for control wiring.

### **3.4 IDENTIFICATION**

- A. Nameplates: Label external device enclosures with equipment served.
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- C. Warning Labels: Label device with a warning label in accordance with NFPA 70 and NFPA 70E.

### **3.5 CLEANING**

- A. After completing equipment installation and before energizing, inspect unit components. Vacuum dirt and debris from interior of equipment; do not use compressed air to assist in cleaning. Remove paint splatters and other spots. Repair exposed surfaces to match original finish.

### **3.6 ADJUSTING**

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

### **3.7 FIELD QUALITY CONTROL**

- A. Testing: Perform the following field quality-control tests and inspections:
- B. Acceptance Testing Preparation:
  - 1. After installing SPD but before equipment is energized, test for compliance with requirements.
  - 2. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
  - 3. Complete startup checks according to manufacturer's written instructions.



4. Test continuity of each circuit.
- C. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  3. Report results of tests and inspections in writing. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- D. SPDs will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.8 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain equipment, overcurrent protective devices, instrumentation, and accessories.
- B. Video record demonstrations presentation for Owner's records.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 26 51 00 - INTERIOR LIGHTING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Included in the work of this section are labor, material, and appurtenances required to complete the work of this Section as specified herein, including, but not limited to:
1. Interior light fixtures, lamps, LEDs, reflectors, lenses or faceplates, ballasts, transformers, drivers and power supplies (includes exterior light fixtures normally installed on exterior surfaces of buildings).
  2. Exit signs.
  3. Light fixture supports.
  4. Coordination.
  5. Quality assurances.
  6. Specific requirements.

**1.2 SUBMITTALS**

- A. General:
1. Only those light fixtures and manufacturers per each fixture type designated and listed in the Light Fixture Schedule or on the Drawings, and approved in accordance with paragraph 1.4-SUBSTITUTIONS of this Section, or both, will be accepted. Where the Light Fixture Schedule indicates an allowance to be made for a specific light fixture, the price is a contractor price and monies shall be allotted for freight, installation, and lamping (if designated). Alternate manufacturers presented at bid shall be disqualified.
  2. Submit all light fixtures, specified for use on this Project, in a single submittal package of portfolios, so that all light fixtures can be reviewed at one time.
  3. Prepare portfolios from manufacturer's standard specification sheets, and include the fixture tag indicated on the Light Fixture Schedule to identify each light fixture. Do not combine more than one light fixture type on a single sheet.
  4. Fixture or other materials shall not be shipped, stored, or installed into the work without approval of shop drawings.
  5. Modifications to fixtures shall be in accordance with Architect's comments.
- B. Product Data: For each type of light fixture, collated and bound in sets, and arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
1. Summary page with the following for each light fixture type
    - a. The number, type and wattage of the light fixture lamps or LEDs (including, but not limited to, assemblies, arrays, bars or modules).
    - b. Light fixture ballast, driver or auxiliary device manufacturer, number and type.
  2. Fixture cut sheets with name of manufacturer and options to be provided marked, including, but not limited to, voltage, lensing, and finish/color.
    - a. Descriptive information providing physical characteristics of light fixture, including, but not limited to, materials, dimensions, fixture efficacy and/or efficiency, and verification of indicated parameters.
    - b. For LED fixtures, include also L70 lifetime and wattage of luminaire including driver/power supply losses.
      - 1) Include MacAdam ellipse step information for:
        - a) All interior light fixtures
        - b) Exterior luminaires installed on exterior building surfaces specified with 80 CRI or greater.
  3. Light fixture mounting details, including non-standard outlet boxes.
  4. Construction of light fixture housing and door (if applicable).

5. Ballast cut sheet with options marked, providing physical description of ballast including, but not limited to, voltage, lamp, ballast factor, power factor, amperage and wattage.
  6. Power supply, transformer, and/or driver cut sheet with options marked, providing physical description of auxiliary device including, but not limited to, voltage, power factor, amperage, wattage, and maximum remote distance charts between device and light fixture.
  7. Light fixture finish and color (if applicable).
  8. Lamp cut sheet with options marked, providing physical description of lamps, including, but not limited to, voltage, wattage, efficacy, CCT, CRI, lumens, and life expectancy.
    - a. For LED lamps, include also number of MacAdam ellipse steps and L70 lifetime.
  9. Photometric data, in IESNA format, including LM-79 for LED luminaires, based on laboratory tests of each light fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the light fixture as applied in this Project.
    - a. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
- C. Shop Drawings: Show details of non-standard or custom light fixtures. Indicate dimensions, finish color, including, but not limited to, custom color, weights, methods of field assembly, components, features, accessories, and modifications. Scaled documents shall be provided for custom fixtures.
- D. Submittal Schedule
1. Within 30 days of Division 26 contractor award, shop drawings covering all light fixtures within this section shall be forwarded to architect to begin approval process. Any shop drawings submitted after the required time frame will require the contractor to submit only the 1st named manufacturer and associated specification data listed on the fixture schedule as the only approved manufacturer. No substitutions will be allowed after the specified time frame.
  2. Within 15 days of "approved" and "approved as noted" shop drawings, contractor shall forward to Architect a guaranteed ship date for each specified fixture.
  3. Within 15 days after contractor's receipt of "reject and resubmit" or "not approved" shop drawings, contractor shall provide Architect with resubmitted shop drawings for only those fixtures deemed unacceptable.
  4. Contractor is responsible to call to the attention of the Architect any submittals that have not been returned to him in a timely manner that may affect delivery of fixtures or as otherwise affecting Section 1.4.D of this specification.
- E. Control Wiring
- F. Coordination Drawings: Refer to architectural reflected ceiling plans or details for exact location of light fixtures; engineering documents shall not be referenced for exact fixture positions. Contractor shall check and verify dimensions and details on drawings before proceeding with the work. If any question arises about the true meaning of drawings, refer the matter to the Architect, whose decision is final. In no case proceed with work with any uncertainty. Architectural documents shall show and coordinate with assistance from installers of items involved:
1. Light fixtures.
  2. Suspended ceiling components.
  3. Structural members to which suspension systems for light fixtures will be attached.
  4. Other items in finished ceiling including the following:
  5. Air outlets and inlets.
  6. Speakers.
  7. Sprinklers.
  8. Smoke and fire detectors.
  9. Occupancy sensors.
  10. Access panels.
  11. Perimeter moldings.

- G. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- H. Field quality-control test reports.
- I. Operation and Maintenance Data: For lighting equipment and fixtures to include in operation and maintenance manuals.
- J. Warranties: Special warranties specified in this Section.

### 1.3 SUBSTITUTIONS

- A. Refer to Division 26 Section "General Electrical Requirements".
- B. Prior to the Bid Date, substitutions will not be considered unless the Architect/Engineer have received written request for approval at least ten calendar days prior to the date for receipt of Bids. Include in each such request the Light Fixture Schedule designation, name of the material or equipment for which it is to be substituted and complete Product Data for the proposed substitute, as defined in SUBMITTALS above, and all other information necessary for an evaluation. Provide interior point-by-point photometric calculations, under both normal and emergency lighting conditions, as applicable, if required by the Engineer. Submit a 100.00 review fee to the Engineer with each such point-by-point calculation for use of electronic base files. The fee will be returned if the substitution is added to the specification.
- C. During the Bid
  - 1. Any proprietary, sole-sourced light fixture listed in the fixture schedule shall be unit priced only. Unit prices shall be clearly identified on the bid form.
  - 2. Representative agents shall be allowed to offer mini-lot pricing (MLP). MLP shall be defined as:
    - a. Agents can group only specified fixtures they represent, and
    - b. Only represent in the region where the specification originated, and
    - c. Exclude all fixtures outside their represented lines from the MLP, and
    - d. Sole-sourced (proprietary) light fixtures shall not be included in the MLP.
  - 3. Packaging of light fixtures will not be considered nor approved. Packaging is defined as: distributor(s) providing a single price for a light fixture package made up of specified and non-specified light fixtures. Any submittal package containing non-specified light fixtures or inclusion of lighting control systems will be immediately rejected in its entirety.
- D. After the Bid Date, proposals to substitute light fixtures for those shown on the Drawings or specified herein, will only be considered as a deduct. Submit proposed substitutions separately, in Submittal form, with a list of proposed substitutions together with a deduct price for each substitution. Proposed substitutions will then be reviewed by the Architect/Engineer.
- E. During the construction period, no substitutions shall be considered if product delay is due to contractor's failure to order products in a timely manner after presentation of fixture schedules and specifications. Additional costs associated with air freight or special factory runs to meet schedule due to contractor's error shall be at the expense of contractor.
- F. The Architect/Engineer has the final authority as to whether the light fixture is an acceptable replacement to the specified item. The proposed substitution may also be rejected for aesthetic reasons if felt necessary or desirable. In the event the proposed substitutions herein described are rejected, provide the specified item(s).

### 1.4 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature
- C. CFL: Compact Fluorescent

- D. CRI: Color-rendering index.
- E. CU: Coefficient of utilization.
- F. EISA: Energy Independence and Security Act of 2007.
- G. HID: High-intensity discharge.
- H. L70: minimum 70% maintained initial-rated lumens at average rated life for LEDs
- I. LED: Light Emitting Diode
- J. LED Lamp: Replaceable LED light source with an integral driver within envelope of lamp. Lamp/Base types may include MR16/bi-pin, PAR/medium base, etc.
- K. LED Module: Light source that contains LEDs, and may include additional components such as lenses, reflectors, or refractors, however do not include drivers.
- L. LER: Light fixture (Luminaire) efficiency rating.
- M. Light Fixture: Complete light fixture, including ballast housing if provided.
- N. RCR: Room cavity ratio.

### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories:
  - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
  - 2. Marked for intended use.
- B. Comply with NFPA 70.
- C. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- D. Regulatory Agencies: Provide fixtures conforming to nationally- or internationally-recognized accredited testing agencies, such as U.S., ETL, ARL, or others in acceptance with local code enforcement policy.
- E. Electrical Components and Devices: Provide only fixtures that comply with National Electric Code (NEC), and in particular to Section 410. All ceiling recessed fixtures, whether indicated in a catalog number or not, shall be equipped with an integral thermal protection device.
- F. Mockups: Provide interior light fixtures for room or module mockups, complete with power and control connections.
  - 1. Obtain Architect's approval of fixtures for mockups before starting installations. Costs shall not be added to the base bid if Owner or Architect does not approve mockup.
  - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work and documenting of final conditions.
  - 3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### 1.6 COORDINATION

- A. Unless otherwise noted, perform all electrical Work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other Divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.
- B. Coordinate layout and installation of light fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including, but not limited to, HVAC equipment,

fire-suppression system, and partition assemblies. Contractor shall arrange his installation in proper relation to other work so that there shall be no interference, damage or delay to other trades' work

- C. Give ample notice of any special openings or rough-in work required for placing electrical/lighting work so as to avoid cutting or removal of completed work.
- D. Where work of this Section is to be flush or concealed, install it so it does not project beyond finished lines of walls, ceilings or floor surface.
- E. Verify all ceiling systems and coordinate light fixture type and accessories prior to ordering light fixtures. Coordinate and cooperate with ceiling installer in regards to the location and installation of light fixtures.

## 1.7 WARRANTY

- A. General Guarantee: For a period of one year after Owner's initial acceptance and establishment of the beginning date of the guarantee period, and at no cost to the Owner, Contractor shall promptly furnish and install replacements for any fixtures or components deemed by the Owner as defective in workmanship under normal operating conditions, excluding lamp replacement as noted in Section 1.10.A.1. Contractor shall repair installed equipment on the job site to Owner's satisfaction. For any time during said guarantee period that fixtures are not fully functional due to defects in material or workmanship, Contractor shall provide or pay for suitable temporary light fixtures, and shall remove said temporary fixtures upon installation of replacement elements. Contractor shall furthermore guarantee replacement fixtures for a period of one year following replacement.
- B. Contractor shall not be held responsible for damage of fixtures or equipment components occurring after the beginning of the guarantee period due to acts of vandalism, acts of war, or acts of God.
- C. LED Warranties: Shall be free from defects in materials and workmanship for the period indicated from date of factory shipment.
  - 1. LED Luminaires, including LED modules, arrays and drivers: Five years.
  - 2. LED Lamps: Three years.

## 1.8 SPARES

- A. Furnish spare materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
  - 2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
  - 3. Battery and Charger Data: One for each emergency lighting unit.
  - 4. Ballasts and/or Drivers: 2 for every 100 of each type and rating installed. Furnish at least one of each type.
  - 5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

## PART 2 - PRODUCTS AND MATERIALS

### 2.1 MANUFACTURERS

- A. In Light Fixture Schedule, the following requirements apply to product selection:
  - 1. Basis-of-Design Product: The design for each light fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a

comparable product by one of the other manufacturers specified that meets or exceeds performance characteristics of the named product.

## 2.2 LIGHT FIXTURES AND COMPONENTS GENERAL REQUIREMENTS

- A. Provide light fixtures as shown on the drawings and/or specified. This shall include all lamps, material and labor to securely hang light fixtures, clean them and make them completely ready for use. Provide all hangers, supports, and miscellaneous hardware required to install light fixtures. Provide additional tie wires connected to structure to conform to applicable seismic requirements where required.
- B. Light fixture models scheduled on the Drawings are to show the manufacturer, grade and style of light fixtures required. Regardless of the manufacturer's catalog number suffixes indicated, provide all options and features as described in the Light Fixture Schedule.
- C. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures. Manufacturer of recessed fixtures shall provide mounting brackets suitable for connection to ceiling system structure. Modifications to standard mounting brackets shall be coordinated with contractor and delivered with fixture so that no delays to product delivery shall be allowed.
- D. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A. Minimum gauge of sheet steel to be 18 gauge.
- E. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable. Minimum gauge of sheet steel to be 22 gauge.
- F. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- G. Metal Parts: Free of burrs and sharp corners and edges.
- H. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- I. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
  - 4. Laminated Silver Metallized Film: 90 percent.
- K. Plastic Diffusers, Covers, and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass, unless otherwise indicated.
- L. Where located within structural concrete, light fixture housing and any other luminaire components in direct contact with concrete shall be effectively coated and/or covered to prevent chemical reactions with the concrete in accordance with the American Concrete Institute Code.
- M. Fixture Finishes:
  - 1. Apply fixture finishes after fabrication in a manner that assures a durable wear-resistant surfacing. Give exposed metal surfaces (brass, bronze, aluminum and others) and finished castings, except chromium-plated or stainless steel parts, an even coat of high-grade meth/acrylate lacquer or transparent epoxy.



2. For corrosive or salt water environments, manufacturer shall provide fixtures with low copper/zinc cast aluminum (AB-47100 aluminum with less than 0.6% copper – classified for corrosive areas) housings to prevent salts from “pitting” aluminum housing. Manufacturer shall provide, in addition to or in lieu of, AB-47100 aluminum, ion added or pre-anodized polyester powder cast finish for “marine grade” applications. Manufacturer shall otherwise provide all stainless steel housing in conjunction with stainless steel hardware.
  3. Recessed downlights in corrosive or salt water interior environments shall be equipped with a “natatorium” finish comprised of a zinc-chromated and phosphated process, then powder-coated on the exterior of the housing.
- N. Reflectors:
1. Provide aluminum reflectors or reflecting cones for downlight style fixtures comprised of #12 aluminum reflector sheet, 0.57 inch (15 gauge) or heavier and free of tool-making indentations, including spinning lines caused by assembly techniques. All reflectors shall be of first-quality, anodized finish :Alzak” with specular or semi-specular finish and color as selected. Provide specular reflectors with no apparent brightness above 45 degrees from Nadir and semi-specular, diffuse reflectors with no apparent brightness above 75 degrees from Nadir.
- O. Mounting hardware and trims:
1. Coordinate as need to suit ceiling conditions.
  2. Light fixtures near or in contact with insulation shall comply with code.
  3. Maintain a 3” minimum working clearance between non-IC rated light future housings and insulation on all adjacent ductwork, piping, walls and ceilings.
- P. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps, LEDs, ballasts and/or drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp, LEDs, ballast and/or driver characteristics:
    - a. "USE ONLY" and include specific lamp or LED type.
    - b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires. Indicate maximum allowed wattage.
    - d. LED type, wattage, beam angle (if applicable) for LED luminaires. Indicate maximum allowed wattage.
    - e. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
    - f. ANSI ballast type (M98, M57, etc.) for HID luminaires.
    - g. CCT and CRI for all luminaires.

## 2.3 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

## 2.4 DRIVERS FOR LED LUMINAIRES

- A. Description: Designed for type and quantity of LED diodes of light fixture. Drivers shall tolerate sustained open circuit and short circuit output conditions without damage. Driver shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Sound Rating: A.

2. Total Harmonic Distortion Rating: Less than 20 percent. Shall comply with ANSI C82.77.
  3. Transient Voltage Protection: IEEE C62.41, Category A or better.
  4. Power Factor: 0.90 or higher at full load.
  5. Interference: Comply with 47 CFR, Chapter 1, Part 15, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
  6. Driver shall operate with maximum sustained variations of +/-10% input voltage and frequency with no damage to driver.
  7. Driver output shall be regulated to maximum +/- 5% published load range or requirements of downstream LED fixture.
  8. LED Current Crest Factor: 1.5 or less.
  9. LED drivers shall not over-drive LEDs at a current or voltage above LED rated values in order to increase LED lumen output.
  10. Meets EN610000 for input harmonics.
  11. ROHS Compliant.
- B. Dimming Drivers:
1. Dimming Range: Visually flicker-free, strobe-free, continuous dimming of source as follows, unless specifically noted otherwise in the Light Fixture Schedule whichever is more stringent:
    - a. Luminaires: 100 to 10 percent of rated lumens.
    - b. Lamps: 100 to 20 percent of rated lumens.
  2. 0-10V dimming drivers: Compliant with IEC 60929 standard for 4-wire dimming.
  3. Compatibility: Certified by manufacturer for use with specific dimming control system and LED indicated.
  4. Control: Coordinate to ensure that the dimming driver, power supply, controller, dimming module, and/or wallbox dimmer and connecting wiring are compatible.

## 2.5 LED LAMPS AND LUMINAIRES

- A. Comply with ANSI C78.377 for white light LED color range. Unless noted otherwise in the Light Fixture Schedule, LED color quality characteristics shall be 80 CRI minimum and 3500K CCT.
- B. LED binning specification tolerance to be within 3 MacAdam ellipses of rated values or as indicated in the Light Fixture Schedule, whichever is more stringent. All LEDs used for same fixture type throughout the project to originate from same production bin.
- C. Unless indicated otherwise in the Light Fixture Schedule, minimum 70% maintained initial-rated lumens at average rated life of as follows:
  1. LED lamps: 20,000 hours
  2. LED luminaires: 50,000 hours
- D. ROHS compliant
- E. Manufacturer of LED chips will be evaluated based on the manufacturer's product literature and data. At a minimum, LED fixtures or lamps will incorporate Bridgelux, Cree, Nichia, Osram or Xicato LEDs; additional manufacturers may be considered however the Architect or Engineer has the authority to reject other manufacturers for technical or aesthetic reasons if felt necessary or desirable.

## 2.6 AUXILIARY DEVICES FOR LOW VOLTAGE AND LED FIXTURES

- A. Provide remote power supplies, drivers and/or transformers for light fixtures as required for a complete and operational system. Where equipment is not indicated as plenum rated, provide an additional enclosure for the device(s) suitable for the installed environment.

**2.7 LIGHT FIXTURE SUPPORT COMPONENTS**

- A. Comply with Sections "260548 Seismic Controls for Electrical" and "260529 - Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

**2.8 TRANSFORMERS FOR LOW VOLTAGE FIXTURES**

- A. Provide transformers to low voltage lamps which are suitable for the electrical characteristics of the supply circuits to which they are to be connected. For remote electronic or magnetic transformers, contractor shall remote transformers so as to reduce voltage drop. For 25 amp low-voltage linear systems, contractor shall not daisy-chain 25A loaded runs together. Contractor shall provide home-run from end of run to remote transformer.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Verify conditions of equipment and installation prior to beginning work.
- B. Verify that equipment is ready for connecting, wiring, and energizing.

**3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Light Fixtures: All work shall be executed to present a neat appearance. Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- C. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- D. Support for Light Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
  - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from light fixture corners.
  - 2. Support Clips: Fasten to light fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
  - 4. Install at least one independent support rod or wire from structure to a tab on light fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- E. Suspended Light Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end. Provide suitable connectors or collars to connect adjoining units to appear as a continuous unit.
4. Decorative pendant mounted light fixtures
  - a. Provide cord and/or stem lengths to match elevations above finished floor as indicated on architectural elevations. If architectural elevations do not indicate suspension heights, coordinate with Architect to determine final suspension heights. Regardless, contractor shall not field cut pendants or order rigid stems without elevation approval from Architect. Pendant suspensions on electrical documents are for reference only.
    - 1) Cord-mounted: Manufacturers shall supply luminaires with flexible, field cutting cords. Contractor shall field cut cords as required.
    - 2) Field-cuttable, rigid-stem mounted: Manufacturers shall supply luminaires with field cutting rigid stems. Contractor shall field cut stems as required.
    - 3) Factory-cut rigid stem mounted: Contractor shall provide rigid stem dimensions to the manufacturer as required.
  - b. Junction boxes used to feed light fixtures shall be covered by manufacturer supplied canopy plates.
- F. Installation within non-standard ceilings, including, but not limited to, wood and metal ceilings.
  1. For recessed downlight light fixtures, specification is based on standard throats to accommodate ceiling thicknesses of  $\frac{3}{4}$ " or less. If non-standard ceiling (such as wood, thickened gypsum ceilings and metal plank type) require throats greater than  $\frac{3}{4}$ ", modifications to manufacturer's standard  $\frac{3}{4}$ " throat shall be determined by Architect and Contractor prior to shop drawing submission.
  2. For light fixtures recessed into metal ceilings, rigidly support light fixture to ensure that trim fits flush with ceiling plane.
- G. Connect wiring according to Section "260519 - Low-Voltage Electrical Power Conductors and Cables."
- H. Through wiring of recessed light fixtures, in suspended ceilings, is not permitted. Connect each light fixture by a whip to a junction box. The whip shall be of sufficient length to allow the light fixture to be relocated within a 6-foot radius.
- I. Wall Mounted Light fixtures
  1. Unless otherwise noted, conceal all raceways and back boxes for wall mounted light fixtures. Coordinate all wall-mounted light fixtures with interior elevations. Where specific elevations or dimensions are not indicated, verify the correct location with Architect prior to installation. Contractor shall supply structure to support weight of fixture.
- J. Contractor shall construct light coves according to architectural details. Contractor shall ensure, unless otherwise directed, that top of fixture lamp is flush with top of cove lip. Contractor shall provide blocking as needed under fixture to ensure stated requirement.
- K. Auxiliary Devices for low voltage and LED Fixtures
  1. Install device within maximum remote distances and with wiring sized per manufacturer's recommendations.
  2. In public areas or other areas where remote device visibility is undesirable, install device where concealed from view, well ventilated and accessible. Provide access panels as required.
  3. Provide label on device indicating fixture type and location/room served along with panelboard circuit number.
  4. Properly support remote lighting devices, including transformers, power supplies, and drivers, per Code and manufacturer's recommendations.

**3.3 DIMMING**

- A. For dimmable light fixtures, provide both control and power wiring between light fixture and control device and between light fixtures. Quantity of low voltage and line voltage wiring and wire type shall be per manufacturer's recommendations. At a minimum, provide the following based on control type at either 120V or 277V, unless recommended otherwise by the manufacturer:
  - 1. 0-10V – two low voltage conductors and two line voltage conductors plus ground
  - 2. 2-Wire dimming – two line voltage conductors plus ground
  - 3. 3-Wire dimming – three line voltage conductors (1 for control and two for power) plus ground
  - 4. DALI – two low voltage conductors and two line voltage conductors plus ground
  - 5. Proprietary digitally addressable – as required per the manufacturer
  - 6. DMX – two line voltage conductors plus ground and DMX cabling
- B. Coordinate light fixture and control device dimming types for compatibility.

**3.4 COORDINATION**

- A. Light fixtures shown on the Electrical Drawings represent general arrangements only. Refer to Architectural Drawings for exact locations.
- B. Coordinate the installation and location of light fixtures with other work and all other trades before installation to avoid conflicts. Coordinate light fixture locations in mechanical rooms with final installed piping and ductwork layouts.
- C. Verify all ceiling systems and coordinate light fixture type and accessories prior to ordering light fixtures. Coordinate and cooperate with ceiling installer in regards to the location and installation of light fixtures.
- D. Coordinate final light fixture locations in walk-in coolers and freezers with refrigeration coils and other trades.
- E. Wall-Mounted Light fixtures
  - 1. Coordinate all wall-mounted light fixtures with the architectural features of the building. Where specific elevations or dimensions are not indicated, verify the correct location with the Architect prior to beginning any work.

**3.5 ADJUSTING**

- A. Contractor shall adjust all light fixture sockets to match the lamp specified and aim all adjustable light fixtures as directed by the Architect.
- B. At the time of substantial completion, aim all track lights, flood lights, spot lights, and other fixtures requiring aiming per the Architect's direction. Contractor shall make provisions for supplying all scaffolds, lifts, and other tools and equipment as required.
- C. Where required, focusing shall be done during hours of darkness. Upon notification by contractor that all fixtures are correct as per shop drawings and functioning, that specified lamps have been verified, lighting designer or Architect shall coordinate with contractor as to a mutually agreed upon time to complete focusing. Failure of contractor to notify Architect during substantial completion will result in failure to comply with specifications.

**3.6 FIELD QUALITY CONTROL**

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

- B. Clean light fixtures of dirt and debris upon completion of the installation. Protect installed light fixtures from damage during the remainder of the construction period.
- C. Upon completion of the installation of light fixtures, and after building circuits have been energized, energize lighting branch circuits to demonstrate capability and compliance with the requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- D. At the time of final acceptance of this project by the Owner, ensure that all lamps are in working order and all light fixtures are fully lamped.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### **3.7 STARTUP SERVICE**

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

### **3.8 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
  - 1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION

**SECTION 26 5300 - INDOOR ARENA LIGHTING****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. The following specifications detail the minimum performance and related criteria for illumination of indoor arena playing surfaces and associated spectator areas including luminaires, support and mounting components and accessories. Any deviations from this specification must be documented in writing and submitted to the Engineer for approval, in addition to the submittal requirements listed in this document.
- B. System Design: The Contractor shall perform all calculations and develop all plan and detail drawings required, in conjunction with these specifications, for installation of a complete and operational athletic field lighting system.
- C. This specification section is intended to define the performance and design requirements for illumination of the arena and spectator area. The Contractor shall provide the arena lighting system to meet or exceed the requirements set forth by the criteria in these specifications.

**1.2 SYSTEM DESCRIPTION**

- A. Scope:
  - 1. The arena lighting system shall be designed to include the necessary equipment in order to provide the illumination required for the following functions:
    - a. Multi-level floor event lighting.
    - b. Lower level event seating lighting.
    - c. Upper level event seating lighting.
    - d. Maintenance work lighting.
    - e. Emergency egress lighting.
- B. General:
  - 1. Interior arena lighting system complete with fixtures, lamps and accessories. Securely attach fixtures to supports, wired, tested, adjusted and cleaned when necessary.
  - 2. Provide light fixtures on the light rigging grid as indicated.
  - 3. Fixture location and counts are based on a specific manufacturer. If additional fixtures are required by other manufacturers that are listed in the "Lighting Fixture Schedule" in order to meet the Design Requirements for Illumination and Uniformity Levels, the fixtures, including all associated mounting equipment, relays, dimmer modules, protective devices, glare shields, shutters/shades, conduit, wiring, and increased size of distribution equipment (if applicable), shall be provided at no additional cost to the Owner. In no case will fewer fixtures be provided unless approved by the Engineer.

**1.3 DEFINITIONS**

- A. Definition of "maintained average illuminance" is based on the minimum average value of illuminance over a given area that must be maintained based on the manufacturer's lamp data and "normal" or "regular" maintenance for the life of the system.
- B. Vertical illuminance is defined as illuminance perpendicular to a referenced camera location unless otherwise indicated.
- C. Definition of areas for specified illuminance values:

1. If project requires additional activities beyond Basketball, add playing and seating area specifics per additional activity needs.
  2. Basketball Primary Playing Area (BPPA): This area is defined as the boundary lines of the court (110' x 60').
  3. Basketball Seating Area (BSA): The area from the edge of the BPPA up to Row 5 on the sidelines.
- D. Lp: Lumen maintenance percentage.
- E. L70: Lumen maintenance of 70 percent. Time in hours when the light output from the LED has dropped to 70% of its initial light output.
1. Calculated: Life (in hours) extrapolated from LM-80 test data and formulae that represents the theoretical time point where the luminous flux output decreases to the minimum acceptable 70% level.
  2. Reported: Life (in hours) limitation set by TM-21-11. One example is the reported life can not exceed 6 times the total test duration, i.e. 6 X 10,000 hours testing 60,000 hours reported.
- F. LM-79-08: IES (Illuminating Engineering Society) Electrical and Photometric Measurements of Solid-State Lighting Products
- G. nm: nanometers
- H. TM-21-11: Projecting Long Term Lumen Maintenance of LED Light Sources
- I. TM-30-15: IES (Illuminating Engineering Society) Method for Evaluating Light Source Color Rendition
- J. TLCI: Television Lighting Consistency Index
- K. CRI: Color-rendering index.
- L. CU: Coefficient of utilization.
- M. CV: Coefficient of Variation; a statistical measure of the weighted average of all relevant illumination values for the playing area, expressed as the ratio of the standard deviation for all illuminance values to the mean illuminance value.
- N. Delegated-Design Submittals: Documents, including drawings, calculations, and material and product specifications prepared as a responsibility of Contractor to obtain acceptance by Owner and Authorities Having Jurisdiction.
- O. Illuminance: The density of luminous flux, or flow of light, reaching a surface divided by the area of that surface.
1. Horizontal Illuminance: Measurement in foot-candles (lux), on a horizontal surface 36 inches (915 mm) above the ground, unless otherwise indicated.
  2. Vertical Illuminance: Measurement in foot-candles (lux) on a vertical surface at an elevation coinciding with plane height of horizontal measurements.
- P. HID: High-intensity discharge.
- Q. LED: Light Emitting Diode.
- R. LER: Light fixture efficacy rating.
- S. Light fixture: Used interchangeably in this section with "Luminaire."
- T. Light Trespass: Light spill into areas outside the playing areas, which is either annoying or unwanted.
- U. LLD: Lamp Lumen Depreciation, which is the decrease in lamp output as the lamp ages.
- V. LLF: Light Loss Factor, which is the product of all factors that contribute to light loss of the system.



- W. Luminaire: Complete lighting fixture.
- X. NRTL: National Recognized Testing Laboratory.
- Y. NVLAP: National Voluntary Laboratory Accreditation Program.
- Z. Playing Surface: Area of athletic play such as the field, court, pool, track, or pitch.
- AA. Spectator Area: Seating and egress areas designed for spectators adjacent to and facing the Playing Surface, including but not limited to grand stands, seating bowls, walkways, and aisles.
- BB. Support Structure: Free-standing or building mounted structure used for support and mounting of luminaires and accessories. Includes but is not limited to arms, brackets and truss systems.
- CC. Target Illumination: Average maintained illumination level, calculated by multiplying initial illuminance by LLF.
- DD. UG: Uniformity Gradient; the rate of change of illuminance on the playing field, expressed as a ratio between the illuminances of adjacent measuring points on a uniform grid.

#### 1.4 SUBMITTALS

- A. General:
  - 1. Submit all components of the arena lighting system specified for use on this Project, in a single submittal package of portfolios, so that all components can be reviewed at one time.
  - 2. Prepare portfolios from manufacturer's standard specification sheets and identify each component. Do not combine more than one component on a single sheet.
  - 3. Submit Shop Drawings as required by Division 1.
- B. Product Data: For each luminaire and support/mounting component, arranged in order of luminaire designation. Include data on features, accessories, finishes, and the following:
  - 1. Name of manufacturer.
  - 2. Descriptive cut sheets providing physical description of luminaire including materials, dimensions, effective projected area, and verification of indicated parameters.
    - a. Fixture efficacy.
    - b. Coefficient of utilization tables.
    - c. Light fixture voltage.
    - d. The number, type and wattage of the light fixture lamps (including product data, where applicable).
    - e. Lens type (if applicable).
  - 3. Light fixture options that are to be provided.
  - 4. Details of attaching light fixtures, mounting and accessories.
  - 5. Construction of light fixture housing and door (if applicable).
  - 6. Driver cut sheet with options marked, providing physical description of ballast including, but not limited to, voltage, lamp, power factor, amperage and wattage. Include energy-efficiency data (if applicable).
  - 7. Light fixture finish and color (if applicable).
  - 8. Life, output, and energy-efficiency data for lamps. Lamp data certified by NVLAP, or NRTL. Energy data shall comply with IESNA LM-47.
  - 9. Details of installation and construction.
  - 10. Photometric data based on laboratory tests of each light fixture type, complete with indicated lamps, ballasts, and accessories. Comply with IESNA LM-5.
    - a. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

11. Dimensions, and finishes of poles/light fixture supports. Means of attaching light fixtures to supports, and indication that attachment is suitable for components involved.
- C. Delegated-Design Submittals: For arena lighting indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified Professional Engineer responsible for their preparation:
1. Drawings and specifications for construction of the arena lighting system.
  2. Manufacturer's determination of LLF used in design calculations. Lighting calculations shall include a LLF of 0.90. Provide a list of recoverable and non-recoverable LLFs used in the submitted calculations for review by the Engineer.
  3. Manufacturer Cut-sheets: For support structures, including mounting brackets, arms, appurtenances and anchorages from manufacturer.
  4. Design calculations for the following:
    - a. Illumination Calculations: Computer-analyzed point method complying with IESNA RP-6 to optimize selection, location, and aiming of luminaires. Scans for both initial and maintained light levels shall be submitted along with the specified spill light calculations. Target illuminance.
      - 1) Point Calculations of horizontal and vertical illuminance, CV, and UG at minimum grid size and area.
  5. Electrical system design calculations for the following:
    - a. Short-circuit current calculations for rating of panelboards, where applicable.
    - b. Total connected and estimated peak-demand electrical load, in kilowatts, of lighting system.
    - c. Ampacity requirements of feeder required to supply the lighting system.
  6. Wiring requirements, including required conductors and cables and wiring methods.
- D. Informational Submittals:
1. Shop Drawings:
    - a. Wiring Diagrams: Power and control wiring.
    - b. Aiming Diagrams: Playing surface and spectator area plans showing aiming points for light fixtures.
  2. Qualification Data: For qualified manufacturer.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For light fixtures, support structures, and mounting equipment to include in operation and maintenance manuals.
- G. Warranty: Sample of special warranties specified in this Section.

## 1.5 SUBSTITUTIONS

- A. Refer to Division 26 Section "General Electrical Requirements".
- B. Prior to the Bid Date, substitutions will not be considered unless the Architect/Engineer have received written request for approval at least ten calendar days prior to the date for receipt of Bids. Include in each such request the fixture designation, name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including cut sheets, photometric data, and all other information necessary for an evaluation.
- C. After the Bid Date, proposals to substitute light fixtures for those shown on the Drawings or specified herein, will only be considered as a deduct. Submit proposed substitutions separately, in Submittal form, with a list of proposed substitutions together with a deduct price for each substitution. Proposed substitutions will then be reviewed by the Architect/Engineer.

- D. The Architect/Engineer have the final authority as to whether the light fixture is an acceptable replacement to the specified item. The proposed substitution may also be rejected for aesthetic reasons if felt necessary or desirable. In the event the proposed substitutions herein described are rejected, provide the specified item(s).

**1.6 PERFORMANCE REQUIREMENTS**

- A. Facility Type: Collegiate.
- B. Illumination Criteria:
  - 1. Athletic Playing surface type: Basketball and Hockey.
    - a. IESNA RP-6, Class of Play: Class I.
    - b. Speed of Sport: Moderate
    - c. Athletic organization standard: NCAA, National Championship Final Site National Broadcast.
  - 2. Performance Requirements:
    - a. Lighting (and associated controls) will be designed to include at least the following events:
      - 1) Basketball
      - 2) Hockey
    - b. Television camera locations in accordance with NCAA requirements and per locations indicated on the architectural and broadcast drawings.
    - c. Athletic Playing Surfaces and Spectator Areas shall be lit to the levels specified in the charts below. Manufacturer shall provide computer models guaranteeing average maintained light levels on the field and spectator areas for the length of the warranty.
      - 1) Basketball Primary Playing Area (BPPA): Maintained average illumination levels and maximum uniformity ratios in accordance with the following schedule:

Basketball Primary Playing Area (BPPA)		
Illuminance (fc)	Vertical Uniformity Ratio	Horizontal Uniformity Ratio
Horizontal Illumination	--	125 fc
Main Cameras	125 fc	--
End Cameras	75 fc	--
Max./Min. Uniformity Ratio for Main Cameras	1.5:1	1.5:1
Max./Min. Uniformity Ratio for End Cameras	2.5:1	--
Horizontal Uniformity	--	1.5:1
Uniformity Gradient	1.35:1	1.35:1
Coefficient of Variance	0.15	--

- 1) Hockey Primary Playing Area (HPPA): Maintained average illumination levels and maximum uniformity ratios in accordance with the following schedule:

Hockey Primary Playing Area (HPPA)		
Illuminance (fc)	Vertical Uniformity Ratio	Horizontal Uniformity Ratio
Horizontal Illumination	--	125 fc
Main Cameras	125 fc	--
End Cameras	75 fc	--

Max./Min. Uniformity Ratio for Main Cameras	1.5:1	1.5:1
Max./Min. Uniformity Ratio for End Cameras	2.5:1	--
Horizontal Uniformity	--	1.5:1
Uniformity Gradient	1.35:1	1.35:1
Coefficient of Variance	0.15	--

- 2)
- 2) Maintained average illumination levels and maximum uniformity ratios for miscellaneous function in accordance with the following schedule:

A	H I	H U R	
Lower Level Seating	10 fc	Average to Minimum	1.5:1
		Maximum to Minimum	2.0:1
Upper Level Seating	10 fc	Average to Minimum	3.0:1
		Maximum to Minimum	6.0:1
Event Floor Work Lights	20 fc	Average to Minimum	1.4:1
		Maximum to Minimum	1.5:1
Seating Worklights	10 fc	Average to Minimum	2.5:1
		Maximum to Minimum	3.5:1
Event Floor Emergency Lights	5 fc	Average to Minimum	2.5:1
		Maximum to Minimum	3.5:1
Seating Emergency Lights	2 fc	Maximum to Minimum	40:1

- 3. Recoverable Light Loss Factor of 0.90 for LED, per standards from the NCAA shall be applied to the initial light level design to achieve the maintained light levels listed above. Lighting Systems that use the IESNA recognized time power adjustments (IESNA 10th edition handbook) will be acceptable and must achieve the specified Target Illumination. Lighting calculations shall be developed based on the grid spacing as specified in the chart above.
- 4. Measured average illumination level shall meet or exceed the requirements listed above, be +/- 10% of predicted mean in accordance with IESNA RP-6-01, and measured at the first 100 hours of operation. If measured initial average illumination levels in manufacturer's submittals cannot be met additional fixtures shall be added to meet the requirements at no additional cost to the Owner. Increases to electrical distribution system including but not limited to additional panelboards, transformers, circuit breakers, feeders, and branch circuits caused by additional fixtures shall also be provided at no additional cost to the Owner.
- 5. CV and maximum-to-minimum uniformity ratios for each lighted area shall be equal to or less than those listed in IESNA RP-6 for the indicated class of play.
- 6. UG levels within each lighted area equal to or less than those listed in IESNA RP-6 for the indicated speed of sport.
- 7. Lighting shall be directed at the playing surface and spectator areas.

- C. Illumination Calculations: Computer-analyzed point method complying with IESNA RP-6 to optimize selection, location, and aiming of luminaires. Scans for both initial and maintained light levels shall be submitted with the bid.
1. Grid Pattern Dimensions: For playing areas of each sport and areas of concern for spill-light control, correlate and reference calculated parameters to the grid areas and intersection points of the indicated grid pattern. Grid Spacing specified charts above.
  2. Building reflectance shall not be included in the lighting design calculations.
  3. Determine LLF according to IESNA RP-6 and manufacturer's test data.
    - a. Use LLD at 70 percent of rated lamp life for LED lamp sources. LLF shall be applied to initial illumination to ensure that target illumination is achieved at 100 percent of lamp life and shall include consideration of field factor.
    - b. LLF shall not be higher than 70 percent, and may be lower when determined by manufacturer after application of the ballast output and optical system output according to IESNA RP-6.
  4. Use a field factor of 15 percent according to IESNA RP-6, in establishing initial illuminance.
  5. Light Fixture Mounting Height: as indicated on the Drawings, with consideration for requirements to minimize spill light and glare.
  6. Luminaire Placement: Luminaire clusters shall be outside of glare zones defined by NCAA.
- D. Emergency Egress Lighting: In case of normal power failure, provide minimum illumination levels of 1.0 fc average with a minimum point calculation of 0.1 fc and maximum to minimum illumination ratio of 40 to 1 measured at the level of the playing surface, in spectator areas, and at egress paths illuminated by the arena lighting system.
1. Emergency illumination levels shall be available within 10 seconds of normal power failure.
  2. Duration of emergency illumination shall be not less than 90 minutes.
- E. Electrical Power Distribution Requirements:
1. Electrical power available for Arena Lighting System:
    - a. Normal Power: 480Y/277 volts, three phase, four wire.
    - b. Emergency Power: 480Y/277 volts, three phase, four wire.
      - 1) Only luminaires required for emergency egress lighting shall be connected to emergency power circuits.
  2. Include roughing-in of service indicated for non-sports improvements on the Project site.
  3. Balance load between phases. Install wiring to balance three phases at each support structure.
  4. Include required overcurrent protective devices and individual lighting control for the arena or venue.
  5. Include indicated feeder capacity and panelboard provisions for future lighted arena construction.
  6. Maximum Total Voltage Drop from Source to Load: 5 percent, including voltage drops in branch circuit, subfeeder and feeder.
- F. Lighting Controls System: Manual, low voltage, or digital; providing the following functions, integrated into a single control station with multiple subcontrol stations as indicated on the Drawings.
1. Control Station: Low voltage touch screen(s).
  2. Control Zones: Provide multiple levels of control as indicated below. Each level of control shall have a dedicated switch labeled with the zone it controls. Provide an additional master control switch that turns all zones on and off via a single switch.
    - a. Event Floor: Provide one level of control for all luminaires aimed at the event floor.

- b. Event Floor: Provide two levels of control for all luminaires aimed at the event floor. Each level shall provide 50 percent illumination uniformly over the playing surface. The first level shall provide 80 percent illumination and the second shall provide 33 percent illumination over the playing surface. Both levels shall provide uniform lighting over the playing surface.
  - c. Spectator Areas: Provide one level of control for all luminaires aimed at spectator seating areas.
  - d. Spectator Areas: Provide two levels of control for all luminaires aimed at the spectator seating areas and egress paths. Each level shall provide 50 percent illumination uniformly over the spectator areas and egress paths.
- G. Miscellaneous Obstructions:
- 1. To achieve the illumination and uniformity design levels required, the manufacturers design calculations and fixture aiming positions must compensate for miscellaneous obstructions, equipment sound system speakers, mechanical ducts, roof support cross bracing, rigging beams, support hangers, etc.

## 1.7 POWER DISTRIBUTION AND CONTROL

- A. Wiring Method for Subfeeders, Branch Circuits, and Control Wiring:
  - 1. Metallic raceway as specified within other sections or drawings; No. 10 AWG copper minimum conductor size for power wiring.
- B. Electrical Enclosures: NEMA 250, Type 1 enclosure constructed from steel, with hinged doors fitted with padlock hasps or lockable latches.
- C. All wiring for emergency luminaires shall be run in separate raceways from the normal lighting circuits.
- D. The circuit conductors, feeders, circuit breakers to lighting indicated are based on preliminary lighting system designs from the basis of design manufacturer. The final number of branch circuit/feeder conductors, the sizes of the branch circuit/feeder conductors, number of circuit breakers, sizes of circuit breakers and other system components required to provide a complete functioning lighting system shall be provided and included within the Contractor's bid based the final lighting system design that meets the illumination requirements specified herein and on the drawings.
- E. Voltage drop shall be considered for all branch/feeder conductors. Engineer may request a submittal for all voltage drop calculations for the lighting power distribution system.

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this project.
- B. Manufacturer Qualifications: Maintain, within 200 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Manufacturer's responsibilities include fabricating sports lighting and providing professional engineering services needed to assume engineering responsibility.
  - 1. Engineering Responsibility: Preparation of delegated-design submittals and comprehensive engineering analysis by a qualified Professional Engineer.
- D. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the NVLAP Program for Energy Efficient Lighting Products.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to Authorities Having Jurisdiction, and marked for intended use.

- F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel" and AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
- G. Comply with IEEE C2, "National Electrical Safety Code."
- H. Comply with NFPA 70 National Electrical Code (NEC).

### 1.9 FIELD VERIFICATION

- A. All testing and computer analysis shall generate values based upon the grid size and number of target points referenced in Illumination per LM-5, the IESNA guide for photometric testing of area and sports lighting installations as indicated below:

AREA OF ILLUMINATION	GRID SIZE	MIN. NUMBER OF TEST POINTS
BASKETBALL	10' x 10'	60
HOCKEY	14' x 14'	84

- B. Playing Surface and Spectator Area Measurements:
  - 1. Horizontal footcandles (fc): The light meter shall be in a horizontal position 36" above the playing surface. The cell of the meter shall be self-leveling and mounted on a tri-pod.
  - 2. Vertical footcandles (fc) the light meter shall be in a vertical position 36" above the playing surface pointed toward each camera position indicated in the Performance Requirements Section above.
  - 3. These readings shall be taken with the Owner or their representative present.
- C. Evaluation Procedures
  - 1. All luminaires shall be operating and properly aimed.
  - 2. All lamps shall have been in operation for at least 100 hours prior to testing. If the lamps and/or luminaires have been in operation for more than 100 hours, the approximate operating hours shall be recorded.
  - 3. The system shall be operating for at least 30 minutes prior to testing to allow for lamp stabilization.
  - 4. Testing shall be done when the air and sky are clear and extraneous light is at a minimum.
  - 5. The test personnel shall take all possible precautions not to cast shadows or reflect light from items such as clothing, PPE, or measurement instruments.
  - 6. The test personnel shall use a light meter that has been calibrated within 12 months of the test. The light meter shall have been calibrated to the lamp type or light source being used.
  - 7. A variation between computer generated performance and field measured results is expected. Field measured results shall be within plus or minus 10% of the predicted computer generated results.
- D. Prior to Project completion, the manufacturer's representative shall provide a final report from the test results that shall provide the following items:
  - 1. Name of installation.
  - 2. Date and time of the test.
  - 3. Description of the lighting system. This shall include the number and types of luminaire for each location, the mounting heights, and lamp manufacture and type, and other pertinent details.
  - 4. Type, make, model, serial number, and copy of calibration certificate for the light meter used. Light meter must display to the 0.01.
  - 5. Identification of number and location of test grid.
  - 6. Actual horizontal and vertical footcandle readings taken at each test point.
  - 7. Average illumination levels.
  - 8. Maximum to minimum ratios.

9. Coefficient of Variation.
10. Uniformity Gradient.

### 1.10 COORDINATION

- A. Unless otherwise noted, perform all electrical work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other Divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

### 1.11 WARRANTY & MAINTENANCE SERVICE

- A. 10-Year Warranty: Each manufacturer shall supply a signed warranty which shall include all parts, labor and equipment necessary to maintain the system for 10 years and shall include: all lamp replacements; guaranteed minimum light levels; routine maintenance.
  1. Warranty may exclude fuses, impact damage, vandalism, abuse and unauthorized repairs or alterations.
- B. Special Warranty: Include a full service product assurance and warranty program providing trouble-free lighting equipment operation, including parts and labor as well as group lamp replacements as often as required during the term of the warranty to ensure minimum lighting design levels are maintained each season.
  1. Warranty Period for Light fixtures: Free from defects in materials and workmanship (excluding fuses and lamps) for a period of 10 years from date of Substantial Completion.
  2. Warranty Period for Lamps: Replace lamps and fuses that fail within the terms of the warranty agreement for a period of 10 years.
  3. Warranty Period for Mounting Supports: Repair or replace light support structures and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than 10 years from date of Substantial Completion.
- C. The fixture mountings shall be warranted (Limited Warranty) for a period of 10 years and warrants to the purchaser that all assembly(s) shall be free from defects in materials and workmanship from the date of shipment. A copy of the manufacturer's warranty shall be submitted to the Owner.
- D. Alignment Warranty: Accuracy of alignment of light fixtures shall remain within specified illuminance uniformity ratios for a period of 5 years from date of successful completion of acceptance tests. Realign fixtures that become misaligned during the warranty period. Replace alignment products that fail within the warranty period. Retest distribution to verify proper realignment.
- E. Preventative and Spot Maintenance: Manufacturer shall provide all preventative and spot maintenance, including parts and labor for 10 years from the date of equipment shipment. Per IES individual lamp outages shall be repaired when the outage causes the light on the field to drop below 10% of the maintained light levels or when a fixture outage, at Owner's discretion, materially impacts safety and/or playability of the field. Owner agrees to check fuses in the event of a luminaire outage.
- F. Services: Repair or replace components of luminaires, lamps, and drivers; align luminaires. Provide lifting equipment as required.

### 1.12 SPARES

- A. Furnish spare materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. LED Boards – For LED light fixtures with LED boards that are field replaceable by electricians or non-factory technicians, 10% of each type and optical distribution of LED boards installed. Furnish at least two of each type.



2. Light Fixtures – For LED light fixtures with LED boards that require factory technician replacement either at the factory or on-site, 10% of each light fixture type with different optical distributions installed. Furnish at least two of each type.
3. Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
4. Drivers: 5 for every 100 of each type and rating installed. Furnish at least two of each type.
5. Visors and Shields: 2 for every 100 of each type and rating installed. Furnish at least one of each type.

### 1.13 DELIVERY STORAGE AND HANDLING

- A. Storage and Protection: Comply with manufacturer's recommendations.
  1. Protect from elements and damage.
  2. Fixtures not to be installed until the roof is completed sufficiently to protect the equipment from moisture.

## PART 2 - PRODUCTS

### 2.1 ARENA LIGHTING SYSTEM REQUIREMENTS

- A. Base bid:
  1. LED luminaires, NCAA National Championship Broadcast NCAA National Broadcast light lighting standards.

### 2.2 MANUFACTURERS

- A. Manufacturers:
  1. Ephesus;
  2. Hubbell;
  3. Musco;
- B. Substitutions of comparable products must provide a complete submittal package as outlined in this section for Engineer review at least (10) days prior to bid.
  1. Acceptance of a substitution does not negate the Contractor and lighting manufacturer's responsibility to comply fully with the requirements of these specifications. Any exceptions to the specifications must be clearly stated in the prior approval submittal documents.

### 2.3 LUMINAIRES – LED GENERAL REQUIREMENTS

- A. Luminaires: Listed and labeled, by an NRTL acceptable to Authorities Having Jurisdiction, for compliance with UL 1598 for installation in wet locations.
  1. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without using tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent their accidental falling during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lens.
  2. Exposed Hardware: Stainless-steel latches, fasteners, and hinges.
  3. Spill-Light Control Devices: Internal lenses, internal louvers, or external baffles furnished by manufacturer and designed for secure attachment to specific luminaire.
  4. All luminaires shall be constructed with a die-cast aluminum housing to protect the luminaire system.
  5. Luminaires shall be bracket-mounted, full-cutoff type with remote or integral drivers.

- B. Luminaires shall be provided with aiming devices, degree scale and position locks. Luminaires shall be factory marked to correspond with proper pole, position on pole, and aiming angles.
- C. For safety, the entire system shall be NRTL Listed as a complete system.
- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Formed and supported to prevent warping and sagging.
- F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed light fixtures.
- G. Light Shields: Metal baffles, louvers, or lenses, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field. Provide as applicable per AHJ requirements.
- H. Gaskets for Lenses and Refractors: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in light fixture doors.
- I. Light Fixture Finish: Manufacturer's standard paint applied to factory-assembled and -tested light fixture before shipping. Where indicated, match finish process and color of pole or support materials.
  - 1. Factory-Applied Finish for Steel Light Fixtures: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
    - a. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
    - b. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    - c. Color: As indicated on the Light Fixture Schedule.
  - 2. Factory-Applied Finish for Aluminum Light Fixtures: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
    - a. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
    - b. Color: Color as selected by the Architect from the Manufacturer's standard color options.
    - c. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
    - d. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
    - e. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
- J. LED Lamp Technology
  - 1. Minimum L70 of 100,000 hour lamp life, instant on/off and dimming capabilities.
  - 2. Color Temperature: Provide tunable white light color temperature.
  - 3. Color Rendering: 80 CRI minimum
  - 4. Maximum of 44,000 initial delivered fixture lumens to minimize glare potential.

5. Fixture Operating Temperature Range of -30 Degrees C to 55 Degrees C. Maximum Junction Temperature for the diodes of 80 Degrees C
6. Flicker of  $\leq 2\%$ .

## 2.4 ACCESSORIES

- A. All fixtures to be equipped with safety cables, unless otherwise indicated. Provide minimum 1/8-inch airplane cable unless otherwise indicated or required to be larger by the weight of the specific manufacturer's equipment.
- B. Custom Mounting Hardware: Manufacturer shall provide all design work, brackets, and hardware for mounting the lighting system to the facility's structural steel. Fixture mounting brackets must be customized to the structure to ensure a clean appearance and easy installation.
- C. Fixtures must have internal optic control to minimize glare in the seats and on the event floor. Fixtures must also have an external visor to minimize glare. Fixtures must include thermal management and come with a 10 year full coverage warranty.
- D. Secondary Wiring: Manufacturer shall supply all necessary wiring to connect the fixture to the driver enclosure. Wiring shall be protected with either a jacketed cord or conduit.
- E. Electronic Driver with an efficiency of 95% or greater. Maximum Starting inrush of 7 Amps at 25 degrees C.
- F. Electric Power Requirements for the Sports Lighting Equipment:
  1. Electric power: 277V
  2. Maximum total voltage drop: Voltage drop to the remote enclosure shall not exceed three (3) percent of the rated voltage.
- G. All fixtures shall be equipped with both horizontal and vertical degree aiming angle plates and adjustment locking devices, unless otherwise indicated. Details of plates with degree markings along with adjustment and locking devices shall be included with the shop drawings.

## 2.5 CONTROLS

- A. Control wiring shall be hardwired. Due to RF frequency interference and possible security concerns, wireless controls are not acceptable.
- B. For DMX controls, preference is for use of DMX over Ethernet cabling.

## 2.6 FABRICATION

- A. Shop/Factory Finish:
  1. Fixtures, wireways, ballast boxes, drivers, connector strip back boxes, and other miscellaneous equipment associated with the arena lighting system (that is installed on the rigging grid or in the ceiling of the arena) shall be powder-coat painted.
  2. All components shall be designed and manufactured as a system. All luminaires, wire harnesses, ballast, drivers and other enclosures shall be factory assembled, aimed, wired and tested.
  3. All system components shall be UL Listed for the appropriate application.

## 2.7 SOURCE QUALITY CONTROL

- A. Fixture Aiming:
  1. The fixtures are to be aimed by the Contractor in accordance with the manufacturers aiming charts.

2. The manufacturer is responsible for providing adequate on-site observation during the aiming process. Any labor required for adjusting or relocating the fixtures due to obstructions, or in order to meet the illumination level schedule criteria, shall be the responsibility of the Contractor. Aiming is to be done after the fixtures are installed but before the building is in operation for events.
3. After fixture aiming is complete, the manufacturer, using approved illuminance meter equipment, shall take the following readings to verify that all of the illuminance and uniformity levels have been met.
4. Following readings to verify that all of the illuminance and uniformity levels have been met.
  - a. Vertical (perpendicular to the television camera locations) and horizontal illuminance readings on the (BPPA) at 72 grid points on a 30'-0" by 30'-0" spacing.
  - b. Horizontal readings to be taken in the upper level seating area (ULSA) at the first row, middle of the seating area and last row of the seating area on 30 foot centers on at least one side.
  - c. All readings are to be recorded and verified by the Architect/Engineer for approval.
5. When readings are complete, fixture aiming should be adjusted, if necessary, to meet the design illuminance and uniformity levels. After final adjustments have been made and the design levels met, a slash mark, with a permanent pen of contrasting color, shall be made across the vertical and horizontal rotation adjustment plates.
6. Fixture aiming shall be checked and adjusted if required, by the lighting manufacturer factory Engineer, 3 months after the building is in operation.
7. Fixture illumination level readings shall not be taken until after 100 hours of operation, unless otherwise required by the lamp manufacturer.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify conditions of equipment and installation prior to beginning work.
- B. Verify that equipment is ready for connecting, wiring and energizing.

#### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Complete installations for design of lighting systems for the field shall comply with requirements of the local Building Code and NEC.
- C. Use web fabric slings (not chain or cable) to raise and set support structures. Protect equipment during installation to prevent damage.
- D. Install lamps in each light fixture.
- E. Fasten light fixture to indicated structural supports.
- F. Adjust light fixtures that require field adjustment or aiming.
- G. Baffles and Louvers for Spill Light Correction: Install on lighting fixtures with fasteners provided by the manufacturer. Install and adjust to correct out-of-limit spill-light and glare measurements.
- H. Install remote drivers and other auxiliary devices as required by manufacturer.
  1. Install drivers and devices within maximum remote distances and with wiring sized per manufacturer's recommendations.
  2. Provide label on device indicating panelboard circuit number.
  3. Properly support remote lighting devices, including, but not limited to ballasts, power supplies, and drivers, per Code and manufacturer's recommendations.
  4. Install controls and remote driver housings in cabinets mounted to support structures.
  5. Provide cabinets and enclosures suitable for installation environment as required.

- I. For controllable light fixtures, provide both control and power wiring between light fixture and control device and between light fixtures. Quantity of low voltage and line voltage wiring and wire type shall be per manufacturer's recommendations. At a minimum, provide the following based on control type at either 120V or 277V, unless recommended otherwise by the manufacturer:
  1. 0-10V – two low voltage conductors and two line voltage conductors plus ground
  2. Proprietary digitally addressable – as required per the manufacturer
  3. DMX – two line voltage conductors plus ground and DMX cabling.

### 3.3 FIELD QUALITY CONTROL

- A. Testing: Perform tests, inspections, and analysis according to IESNA RP-6 and IESNA LM-5 where applicable.
- B. Tests and Inspections:
  1. After installing sports lighting system and after electrical circuits have been energized, perform proof-of-performance field measurements and analysis for compliance with requirements.
  2. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA RP-6-01, Appendix B.
    - a. Basketball: Measure at least 60 points on the court. Extend the grid 10 feet (3.0 m) outside the baselines and sidelines.
    - b. Hockey: Measure at least 84 points on the ice. Extend the grid 7 feet (2.25 m) outside the boards.
  3. Make field measurements at established test points in areas of concern for spill light and glare.
  4. Where sports lighting system is providing normal and emergency egress lighting for spectator areas measurements shall be taken and verified. Illumination measurements shall be conducted once under normal power conditions will all sports light fixtures on and again with only emergency sports light fixtures on. Measurements shall be conducted at the following locations:
    - a. Seating areas: Measure points in all seating areas illuminated by the sports lighting fixtures on a 20 foot by 20 foot grid. Measurements shall be taken at 36" above finished floor.
  5. Perform analysis to demonstrate correlation of field measurements with specified illumination quality and quantity values and corresponding computer-generated values that were submitted with engineered design documents. Submit a report of the analysis. For computer-generated values, use manufacturer's lamp lumens that are adjusted to lamp age at time of field testing.
- C. Prior to installation of the support structures, inspect each installed fixture for damage. Replace damaged fixtures and components.
- D. Adjust all light fixture sockets to match the lamp specified and aim all adjustable light fixtures as directed by the Architect.
- E. Upon completion of the installation of light fixtures, and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with the requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- F. Clean light fixtures of dirt and debris upon completion of the installation. Protect installed light fixtures from damage during the remainder of the construction period.

- G. At the time of Substantial Completion, aim all adjustable fixtures, such as flood and spot lights, per the Architect's direction. Provide all necessary equipment to support this effort, such as scaffolds and lifts, as required.
- H. At the time of Final Acceptance of this Project by the Owner, all lamps shall be in working order and all light fixtures shall be fully lamped.
- I. Illumination Observations: Verify normal operation of lighting units after installing light fixtures and energizing circuits with normal power source.
- J. Illumination Tests:
  - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards.
  - 2. Comply with the following IESNA testing guide(s): IESNA LM-5, "Photometric Measurements of Area and Sports Lighting."
- K. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
- L. Sports lighting will be considered defective if it does not pass tests and inspections.
- M. Correction of Illumination Deficiencies: Make corrections to illumination quality or quantity, measured in field quality-control tests, that varies from specified illumination criteria by plus or minus 10 percent. If, in the opinion of the Owner or his appointed Representative, the actual performance levels including footcandles, uniformity ratios, and peak-demand kilowatt consumptions are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer and/or Contractor shall be liable to any or all of the following:
  - 1. Add or replace luminaires, change mounting height, revise aiming, or install louvers, shields, or baffles.
  - 2. If luminaires are added or mounting height is changed, revise aiming and recalculate and modify or replace support structures if indicated. Luminaire mounting heights shall not be adjusted without Engineer's approval.
  - 3. Do not replace luminaires with units of higher or lower wattage without Engineer's approval.
  - 4. Retest as specified above after repairs, adjustments, or replacements are made.
  - 5. Report results in writing.
  - 6. Contractor and/or manufacturer shall pay for additional trips made by Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative at no cost to the owner to re-measure illumination test after corrective measures have been performed.

### 3.4 AD USTING

- A. Two (2) site visits, one for initial adjusting during construction and installation of light fixtures and one for final adjustment and aiming of light fixtures after substantial completion, will be provided by the manufacturer.
- B. Manufacturer shall adjust and aim all adjustable light fixtures as required to achieve the submitted and specified lighting levels. Contractor shall make provisions for supplying all scaffolds, lifts, and other tools and equipment as required.
- C. Where required, adjusting shall be done during hours of darkness. Upon notification by Contractor that all fixtures are correct as per shop drawings and functioning, that specified lamps have been verified, lighting designer or Architect shall coordinate with Contractor as to a mutually agreed upon time to complete adjusting. Failure of Contractor to notify Architect during substantial completion will result in failure to comply with specifications.

**3.5 DEMONSTRATION**

- A. Manufacturer's authorized representative will be responsible to train Owner's maintenance personnel to adjust, operate, and maintain light fixtures. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 26 56 00 - EXTERIOR AREA LIGHTING****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following lighting equipment:
1. Exterior light fixtures with lamps and ballasts.
  2. Exterior LED light fixtures with LED modules and drivers.
  3. Poles and accessories.

**1.2 SUBMITTALS**

- A. General:
1. Only those light fixtures and manufacturers per each fixture type designated and listed in the Light Fixture Schedule or on the Drawings, and approved in accordance with paragraph 1.4-SUBSTITUTIONS of this Section, or both, will be accepted. Where the Light Fixture Schedule indicates an allowance to be made for a specific light fixture, the price is a contractor price and monies shall be allotted for freight, installation, and lamping (if designated). Alternate manufacturers presented at bid shall be disqualified.
  2. Submit all light fixtures, specified for use on this Project, in a single submittal package of portfolios, so that all light fixtures can be reviewed at one time.
- B. Prepare portfolios from manufacturer's standard specification sheets, and include the number indicated on the Light Fixture Schedule to identify each light fixture. Do not combine more than one light fixture type on a single sheet.
1. Fixture or other materials shall not be shipped, stored, or installed into the work without approval of shop drawings.
  2. Modifications to fixtures shall be in accordance with Architect's comments.
- C. Product Data: For each light fixture, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
1. Summary page with the following for each light fixture type
    - a. The number, type and wattage of the light fixture lamps or LEDs (including, but not limited to, assemblies, arrays, bars or modules).
    - b. Light fixture ballast, driver or auxiliary device manufacturer, number and type.
  2. Fixture cut sheets with name of manufacturer and options to be provided marked, including, but not limited to, voltage, lensing, and finish/color.
    - a. Descriptive information providing physical characteristics of light fixture, including, but not limited to, materials, dimensions, effective projected area, fixture efficacy and/or efficiency, and verification of indicated parameters.
    - b. For LED fixtures, include also L70 lifetime and wattage of luminaire including driver/power supply losses.
      - 1) Include MacAdam ellipse step information for luminaires specified with 80 CRI or greater.
  3. Light fixture mounting details, including, but not limited to, non-standard outlet boxes.
  4. Construction of light fixture housing and door (if applicable).
  5. Ballast cut sheet with options marked, providing physical description of ballast including, but not limited to, voltage, lamp, ballast factor, power factor, amperage and wattage.
    - a. For dimming ballasts, also include dimming type technology and dimming range/limits.
  6. Power supply, transformer, and/or driver cut sheet with options marked, providing physical description of auxiliary device including, but not limited to, voltage, power factor, amperage, wattage, and maximum remote distance charts between device and light fixture.
    - a. For dimming LED, also include dimming type technology and dimming range/limits.

7. Lamp cut sheet with options marked, providing physical description of lamps, including, but not limited to, voltage, wattage, efficacy, CCT, CRI, lumens, and life expectancy.
    - a. For LED lamps, include also number of MacAdam ellipse steps and L70 lifetime.
  8. Details of attaching light fixtures and accessories.
  9. Details of installation and construction.
  10. Photometric data, in IESNA format, including LM-79 for LED luminaires, based on laboratory tests of each light fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the light fixture as applied in this Project.
    - a. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
  11. For pole-mounted LED area lighting fixtures, IES-TM-21 LED luminaire lifetime and lumen maintenance projections.
  12. Materials, dimensions, and finishes of poles.
  13. Means of attaching light fixtures to supports, and indication that attachment is suitable for components involved.
  14. Anchor bolts for poles.
- D. Delegated-Design Submittals for Pole-Mounted Area Lighting: Submit the following documents, signed and sealed by a qualified professional engineer:
1. Structural analysis data and calculations used for pole selection and foundations.
    - a. Manufacturer Seismic Qualification Certification: Submit certification that lighting components and their mounting and anchorage provisions are designed to remain in place with out separation of any parts when subject to seismic forces defined in Division 26 Section "Vibration and Seismic and Seismic Controls for Electrical Systems" Include the following:
      - 2) Basis for Certification: Indicate whether withstand certifications are based on actual test of assembled components or calculation.
      - 3) Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
    - b. Manufacturer Wind-Load Strength Certification: Submit certification that selected total support system, including poles and equipment anchorage devices, complies with AASHTO LTS-4 or as required by the local authority having jurisdiction, whichever is more stringent, for location of project.
  2. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
  3. Design calculations for the following:
    - a. Design calculations for determination of poured-in-place concrete foundation size and reinforcement
  4. Shop Drawings:Submittal Schedule
    - a. Within 30 days from Division 26 Contractor award, shop drawings covering all light fixtures within this section shall be forwarded to architect to begin approval process. Any shop drawings submitted after the required time frame will require the contractor to submit only the 1st named manufacturer and associated specification data listed on the fixture schedule as the only approved manufacturer. No substitutions will be allowed after the specified time frame.
    - b. Within 15 days of "approved" and "approved as noted" shop drawings, Contractor shall forward to Architect a guaranteed ship date for each specified fixture.
    - c. Within 15 days after Contractor's receipt of "reject and resubmit" or "not approved" shop drawings, Contractor shall provide Architect with resubmitted shop drawings for only those fixtures deemed unacceptable.
    - d. Contractor is responsible to call to the attention of the Architect any submittals that have not been returned to him in a timely manner that may affect delivery of fixtures or as otherwise affecting Section 1.4.D of this specification.
  5. Show details of non-standard or custom light fixtures. Indicate dimensions, finish color, including, but not limited to, custom color, weights, methods of field assembly, components,

- features, accessories, and modifications. Scaled documents shall be provided for custom fixtures.
6. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
  7. Wiring Diagrams: Power and control wiring.
- E. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 or as noted elsewhere in this specification and that loads imposed by light fixtures and attachments have been included in design. This certification shall be based on design calculations by a professional engineer.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For light fixtures and poles to include in operation and maintenance manuals.
- H. Warranty: Special warranties specified in this Section.

### 1.3 SUBSTITUTIONS

- A. Refer to Division 26 Section "General Electrical Requirements".
- B. Prior to the Bid Date, substitutions will not be considered unless the Architect/Engineer have received written request for approval at least ten calendar days prior to the date for receipt of Bids. Include in each such request the Light Fixture Schedule designation, name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including cut sheets, photometric data, and all other information necessary for an evaluation. Provide interior point-by-point calculations if required by the Engineer. Submit a 100.00 review fee to the Engineer with each such point-by-point calculation for use of electronic base files. The fee will be returned if the substitution is added to the specification.
- C. During the Bid
1. Any proprietary, sole-sourced light fixture listed in the fixture schedule shall be unit priced only. Unit prices shall be clearly identified on the bid form.
  2. Representative agents shall be allowed to offer mini-lot pricing (MLP). MLP shall be defined as:
    - a. Agents can group only specified fixtures they represent, and
    - b. Only represent in the region where the specification originated, and
    - c. Exclude all fixtures outside their represented lines from the MLP, and
    - d. Sole-sourced (proprietary) light fixtures shall not be included in the MLP.
  3. Packaging of light fixtures will not be considered nor approved. Packaging is defined as: distributor(s) providing a single price for a light fixture package made up of specified and non-specified light fixtures. Any submittal package containing non-specified light fixtures or inclusion of lighting control systems will be immediately rejected in its entirety.
- D. After the Bid Date, proposals to substitute light fixtures for those shown on the Drawings or specified herein, will only be considered as a deduct. Submit proposed substitutions separately, in Submittal form, with a list of proposed substitutions together with a deduct price for each substitution. Proposed substitutions will then be reviewed by the Architect/Engineer.
- E. The Architect/Engineer have the final authority as to whether the light fixture is an acceptable replacement to the specified item. The proposed substitution may also be rejected for aesthetic reasons if felt necessary or desirable. In the event the proposed substitutions herein described are rejected, provide the specified item(s).

### 1.4 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature

- C. CFL: Compact Fluorescent
- D. CRI: Color-rendering index.
- E. CU: Coefficient of utilization.
- F. Delegated-Design Submittals: Documents, including, but not limited to, drawings, calculations, and material and product specifications prepared as a responsibility of Contractor to obtain acceptance by Owner and authorities having jurisdiction.
- G. EISA: Energy Independence and Security Act of 2007.
- H. HID: High-intensity discharge.
- I. L70: minimum 70% maintained initial-rated lumens at average rated life for LEDs
- J. LED: Light Emitting Diode
- K. LED Lamp: Replaceable LED light source with an integral driver within envelope of lamp. Lamp/Base types may include MR16/bi-pin, PAR/medium base, etc.
- L. LED Module: Light source that contains LEDs, and may include additional components such as lenses, reflectors, or refractors, however do not include drivers.
- M. LER: Light fixture efficacy rating.
- N. Light fixture: Complete light fixture, including ballast housing if provided.
- O. LLD: Lamp Lumen Depreciation.
- P. LLF: Light Loss Factor.
- Q. Luminaire: Complete lighting fixture, including ballast housing if provided.
- R. Pole: Light fixture support structure, including tower used for large area illumination.
- S. Standard: Same definition as "Pole" above.

### **1.5 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION**

- A. Dead Load: Weight of light fixture and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in latest AASHTO LTS-4.
- B. Live Load: Single load of 500 lbf, distributed as stated in latest AASHTO LTS-4.
- C. Ice Load: As stated in latest AASHTO LTS-4 or as required by the local authority having jurisdiction, whichever is more stringent.
- D. Wind Load: As stated in latest AASHTO LTS-4 or as required by the local authority having jurisdiction, whichever is more stringent.

### **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this project.
- B. Light Fixture Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with IEEE C2, "National Electrical Safety Code."
- E. Comply with NFPA 70.

**1.7 COORDINATION**

- A. Unless otherwise noted, perform all electrical Work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other Divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.
- B. Coordinate layout and installation of light fixtures, poles, foundations, and underground raceway system with other above- and below-grade site construction and utilities. Notify Architect/Engineer of conflicts before proceeding with the Work.

**1.8 WARRANTY**

- A. General Guarantee: For a period of one year after Owner's initial acceptance and establishment of the beginning date of the guarantee period, and at no cost to the Owner, Contractor shall promptly furnish and install replacements for any fixtures or components deemed by the Owner as defective in workmanship under normal operating conditions, excluding lamp replacement as noted in Section 1.12.A.1. Contractor shall repair installed equipment on the job site to Owner's satisfaction. For any time during said guarantee period that fixtures are not fully functional due to defects in material or workmanship, Contractor shall provide or pay for suitable temporary light fixtures, and shall remove said temporary fixtures upon installation of replacement elements. Contractor shall furthermore guarantee replacement fixtures for a period of one year following replacement.
- B. Contractor shall not be held responsible for damage of fixtures or equipment components occurring after the beginning of the guarantee period due to acts of vandalism, acts of war, or acts of God.
- C. LED Warranties: Shall be free from defects in materials and workmanship for the period indicated from date of factory shipment.
  - 1. LED Luminaires, including LED modules, arrays and drivers: Five years.
  - 2. LED Lamps: Three years.

**1.9 DELIVERY STORAGE AND HANDLING**

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on metal poles until right before pole installation.
- D. Handle all poles with web fabric straps.

**1.10 SPARES**

- A. Furnish spare materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
  - 2. Glass and Plastic Lenses, Covers, and Other Optical Parts: 5 for every 100 of each type and rating installed. Furnish at least one of each type.
  - 3. Ballasts and/or Drivers: 2 for every 100 of each type and rating installed. Furnish at least one of each type.
  - 4. Globes and Guards: 2 for every 20 of each type and rating installed. Furnish at least one of each type.
  - 5. Fuses: 10 for every 100 of each type and rating installed.

**PART 2 - PRODUCTS AND MATERIALS****2.1 MANUFACTURERS**

- A. In Light Fixture Schedule, the following requirements apply to product selection:
  - 1. Basis-of-Design Product: The design for each light fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified that meets or exceeds performance characteristics of the named product.

**2.2 LIGHT FIXTURES GENERAL REQUIREMENTS**

- A. Light fixture models scheduled on the Drawings are to show the manufacturer, grade and style of light fixtures required. Regardless of the manufacturer's catalog number suffixes indicated, provide all options and features as described in the Light Fixture Schedule.
- B. Light fixtures shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- C. Comply with IES RP-8 for parameters of lateral light distribution patterns indicated for light fixtures.
- D. Comply with IES BUG ratings where indicated on the Light Fixture Schedule.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- G. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed light fixtures.
- H. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- I. Exposed Hardware Material: Stainless steel for latches, fasteners, and hinges.
- J. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- K. Light Shields: Metal baffles or louvers, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- L. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- M. Gaskets for Lenses and Refractors: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in light fixture doors.
- N. Where located within structural concrete, light fixture housing and any other luminaire components in direct contact with concrete shall be effectively coated and/or covered to prevent chemical reactions with the concrete in accordance with the American Concrete Institute Code.
- O. Factory-Applied Finish for Steel Light Fixtures: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds

- and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    - a. Color: As indicated on the Light Fixture Schedule.
- P. Factory-Applied Finish for Aluminum Light Fixtures: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
  3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
  4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
    - a. Color: As indicated on the Light Fixture Schedule.
- Q. Luminaires supplied with 150W to 500W metal halide lamps and ballasts shall contain a capital E printed in a circled on the ballast label and the fixture packaging per EISA requirements.
- R. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps, LEDs, ballasts and/or drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp, LEDs, ballast and/or driver characteristics:
    - a. "USES ONLY" and include specific lamp or LED type.
    - b. Lamp diameter code (T-4, T-5, T-8), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
    - d. LED type, wattage, beam angle (if applicable) for LED luminaires. Include maximum allowed wattage.
    - e. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
    - f. ANSI ballast type (M98, M57, etc.) for HID luminaires.
    - g. For LED luminaires, includes CCT and CRI.

### 2.3 DRIVERS FOR LED LUMINAIRES

- A. Description: Designed for type and quantity of LED diodes of light fixture. Drivers shall tolerate sustained open circuit and short circuit output conditions without damage. Driver shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Sound Rating: A.
  2. Total Harmonic Distortion Rating: Less than 20 percent. Shall comply with ANSI C82.77.
  3. Transient Voltage Protection: IEEE C62.41, Category A or better.
  4. Power Factor: 0.90 or higher at full load.
  5. Driver shall operate with maximum sustained variations of  $\pm 10\%$  input voltage and frequency with no damage to driver.
  6. Driver output shall be regulated to  $\pm 5\%$  published load range.
  7. LED Current Crest Factor: 1.5 or less.
  8. LED drivers shall not over-drive LEDs at a current or voltage above LED rated values in order to increase LED lumen output.

9. Meets EN61000 for input harmonics.
10. ROHS Compliant.
11. Suitable for use in outdoor light fixtures.
12. Dimming Drivers
  - a. Dimming Range: Visually flicker-free, strobe-free, continuous dimming of source as follows, unless specifically noted otherwise in the Light Fixture Schedule whichever is more stringent:
    - 4) Luminaires: 100 to 10 percent of rated lumens.
    - 5) LED Lamps: 100 to 20 percent of rated lumens.
  - b. 0-10V dimming drivers: Compliant with IEC 60929 standard for 4-wire dimming.
  - c. Compatibility: Certified by the manufacturer for use with specific dimming control system and LED indicated.
  - d. Control: Coordinate to ensure that the dimming driver, power supply, controller, dimming module, and/or wallbox dimmer and connecting wiring are compatible.

## 2.4 LED LAMPS AND LUMINAIRES

- A. Comply with ANSI C78.377 for white light LED color range. Unless noted otherwise in the Light Fixture Schedule, LED color quality characteristics shall be 70 CRI minimum and 4000K CCT. Additionally, color-important light fixtures, as indicated with 80 CRI or better the Light Fixture Schedule shall be 80 CRI minimum and 4000K CCT. All LEDs used for same fixture type throughout the project to originate from same production bin.
- B. Unless indicated otherwise in the Light Fixture Schedule, minimum 70% of maintained initial-rated lumens at the average rated life as follows:
  1. LED outdoor pole mounted area lights: 100,000 hours
  2. LED lamps: 20,000 hours
  3. Other LED luminaires: 50,000 hours
- C. ROHS compliant
- D. Manufacturer of LED chips will be evaluated based on the manufacturer's product literature and data. At a minimum, LED fixtures or lamps will incorporate Bridgelux, Nichia, Cree, Xicato or Osram LEDs; additional manufacturers may be considered however the Architect or Engineer has the authority to reject other manufacturers for technical or aesthetic reasons if felt necessary or desirable.

## 2.5 AUXILIARY DEVICES FOR LOW VOLTAGE AND LED FIXTURES

- A. Provide remote power supplies, drivers and/or transformers for light fixtures as required for a complete and operational system.

## 2.6 POLES AND SUPPORT COMPONENTS GENERAL REQUIREMENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4.
  1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article.
  2. Strength Analysis: For each pole, multiply the actual equivalent projected area of light fixtures and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Light Fixture Attachment Provisions: Comply with light fixture manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
  1. Materials: Shall not cause galvanic action at contact points.



2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M or ASTM A 153/A 153M unless stainless-steel items are indicated.
  3. Anchor-Bolt Template: Plywood or steel.
- D. Concrete Pole Foundations: Cast in place, 3000-psi (28-day minimum compressive strength, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

## 2.7 STEEL POLES

- A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; 1-piece construction up to 40 feet in height with access handhole in pole wall.
1. Shape: As indicated in the Light Fixture Schedule.
  2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- B. Steel Mast Arms: As indicated in the Light Fixture Schedule type, continuously welded to pole attachment plate. Material and finish same as pole.
- C. Brackets for Light Fixtures: Detachable, cantilever, without underbrace.
1. Adapter fitting welded to pole and bracket, then bolted together with galvanized-steel bolts.
  2. Cross Section: Tapered oval, with straight tubular end section to accommodate light fixture.
  3. Match pole material and finish.
- D. Pole-Top Tenons: Fabricated to support light fixture or light fixtures and brackets indicated, and securely fastened to pole top.
- E. Vibration Dampeners: Factory furnish for poles over 20' high.
- F. Steps: Fixed steel, with nonslip treads, positioned for 15-inch vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet above finished grade.
- G. Intermediate Handhole and Cable Support: Weathertight, 3-by-5-inch handhole located at midpoint of pole with cover for access to internal welded attachment lug for electric cable support grip.
- H. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- I. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
- J. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
  2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
  3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    - a. Color: As indicated in the Light Fixture Schedule.

**2.8 ALUMINUM POLES**

- A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.
- B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.
  - 1. Shape: As indicated in the Light Fixture Schedule.
  - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Pole-Top Tenons: Fabricated to support light fixture or light fixtures and brackets indicated, and securely fastened to pole top.
- D. Vibration Dampeners: Factory furnish for poles over 20' high.
- E. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- F. Brackets for Light fixtures: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
  - 1. Tapered oval cross section, with straight tubular end section to accommodate light fixture.
  - 2. Finish: Same as pole.
- G. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- H. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
  - 3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
  - 4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
    - a. Color: As indicated in the Light Fixture Schedule.

**PART 3 - EXECUTION****3.1 INSTALLATION GENERAL**

- A. Install in accordance with manufacturer's instructions.

**3.2 EXAMINATION**

- A. Verify conditions of equipment and installation prior to beginning work.
- B. Verify that equipment is ready for connecting, wiring, and energizing.

**3.3 LIGHT FIXTURE INSTALLATION**

- A. Install lamps in each light fixture.
- B. Fasten light fixture to indicated structural supports.
  - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

- C. Adjust light fixtures that require field adjustment or aiming.
- D. Baffles and Louvers for Spill Light Correction: Install on lighting fixtures with fasteners provided by the manufacturer. Install and adjust to correct out-of-limit spill-light measurements.
- E. Auxiliary devices for low voltage and LED fixtures installation
  1. Install device within maximum remote distances and with wiring sized per manufacturer's recommendations.
  2. In public areas or other areas where remote device visibility is undesirable, install device where concealed from view, well-ventilated and accessible. Provide access panels as required.
  3. Provide label on device indicating fixture type and location/room served along with panelboard circuit number.
  4. Properly support remote lighting devices, including, but not limited to, transformers, power supplies, and drivers, per Code and manufacturer's recommendations.
  5. Provide enclosures suitable for installation environment as required.

### 3.4 DIMMING

- A. For dimmable light fixtures, provide both control and power wiring between light fixture and control device and between light fixtures. Quantity of low voltage and line voltage wiring and wire type shall be per manufacturer's recommendations. At a minimum, provide the following based on control type at either 120V or 277V, unless recommended otherwise by the manufacturer:
  1. 0-10V – two low voltage conductors and two line voltage conductors plus ground
  2. 2-Wire dimming – two line voltage conductors plus ground
  3. 3-Wire dimming – three line voltage conductors (1 for control and two for power) plus ground
  4. DALI – two low voltage conductors and two line voltage conductors plus ground
  5. Proprietary digitally addressable – as required per the manufacturer
  6. DMX – two line voltage conductors plus ground and DMX cabling
- B. Coordinate light fixture and control device dimming types for compatibility.

### 3.5 POLE INSTALLATION

- A. Align pole foundations and poles for optimum directional alignment of light fixtures and their mounting provisions on the pole. Install poles and other structural units level, plumb, and square.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
  1. Fire Hydrants and Storm Drainage Piping: 60 inches.
  2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet .
  3. Trees: 15 .
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
  1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
  2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space. Grout materials, installation, and finishing requirements are specified in Division 05 Section "Metal Fabrications".
  3. Install base covers, unless otherwise indicated.
  4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

- E. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.
  - 1. Install protective pipe bollards on two sides of each embedded pole installed in paved areas. Refer to Division 05 "Metal Fabrications" for pipe bollards.
- F. Raise and set poles using web fabric slings (not chain or cable).

### **3.6 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LIGHT FIXTURES**

- A. Install on concrete base with top 4 inches above finished grade or surface at light fixture location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

### **3.7 CORROSION PREVENTION**

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceways and Boxes for Electrical Systems", including use of coated conduits in concrete foundations.

### **3.8 GROUNDING**

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
  - 1. Install grounding electrode for each pole, unless otherwise indicated.
  - 2. Install grounding conductor pigtail in the base for connecting light fixture to grounding system.
- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
  - 1. Install grounding electrode for each pole.
  - 2. Install grounding conductor and conductor protector.
  - 3. Ground metallic components of pole accessories and foundations.

### **3.9 FIELD QUALITY CONTROL**

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Adjust all light fixture sockets to match the lamp specified and aim all adjustable light fixtures as directed by the Architect.
- C. Upon completion of the installation of light fixtures, and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with the requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- D. Clean light fixtures of dirt and debris upon completion of the installation. Protect installed light fixtures from damage during the remainder of the construction period.
- E. At the time of Substantial Completion, aim all adjustable fixtures, such as flood and spot lights, per the Architect's direction. Provide all necessary equipment to support this effort, such as scaffolds and lifts, as required.
- F. At the time of Final Acceptance of this Project by the Owner, all lamps shall be in working order and all light fixtures shall be fully lamped.

- G. Illumination Observations: Verify normal operation of lighting units after installing light fixtures and energizing circuits with normal power source.
  - 1. Verify operation of photoelectric controls.

### **3.10 CORRECTION OF DEFICIENCIES**

- A. Correction of Illumination Deficiencies: Make corrections to illumination quality or quantity measured in field quality-control tests that vary from specified illumination criteria by plus or minus 10 percent or more; add or replace lighting fixtures, or change mounting height, revise aiming, or install louvers, shields, or baffles. If lighting fixtures are added or mounting height is changed, revise aiming and recalculate and modify or replace support structures, if indicated. Retest as specified above after repairs, adjustments, or replacements are made. Report results in writing.
- B. Correction of Excessive Illumination in Spill-Light-critical Areas: If measurements indicate that specified limits for spill light are exceeded, make corrections to illumination quantity measured in field quality-control tests that reduce levels to within specified maximum values. Replace lighting fixtures, or change mounting heights, revise aiming, or install louvers, shields, or baffles. Obtain Architect's approval to replace luminaires with units of higher or lower wattage. If mounting height is changed, revise aiming and recalculate and modify or replace support structures, if indicated. Retest as specified above after repairs, adjustments, or replacements are made. Report results in writing.
- C. Exterior athletic lighting will be considered defective if it does not pass tests and inspections.

### **3.11 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain light fixtures. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**TABLE OF CONTENTS**  
**DIVISION 27 – COMMUNICATIONS TECHNOLOGY**

270500	COMMOWORK RESULTS FOR COMMUNICATIONS
270526	GROUNDING AND BONDING FOR COMMUNICATIONS
270528	PATHWAYS FOR COMMUNICATIONS
270543	UNDERGROUND PATHWAYS & STRUCTURES FOR COMMUNICATIONS SYSTEMS
270553	IDENTIFICATIONS FOR COMMUNICATIONS
271100	COMMUNICATIONS EQUIPMENT ROOM FITTINGS
271300	COMMUNICATIONS BACKBONE CABLING
271500	COMMUNICATIONS HOIZONTAL CABLING
273124	IP TELEPHONE SYSTEM
273244	EMERGENCY RESPONDER TESTING
273523	EMERGENCY RESPONDER RADIO COVERAGE
276000	NETWORK ELECTRONICS
276200	WIRELESS NETWORK SYSTEMS

**END OF DIVISION 27 TABLE OF CONTENTS**

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 270500****COMMON WORK RESULTS FOR COMMUNICATIONS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 APPLICABLE CRITERIA/REFERENCES**

- A. TIA-568 Generic Telecommunications Cabling for Customer Premises
- B. TIA-569 Commercial Building Standards for Telecommunications Pathways and Spaces
- C. TIA-606 Administration Standard for the Telecommunications Infrastructure
- D. TIA-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- E. TIA-758 Customer Owned Outside Plant Telecommunications Infrastructure Standard
- F. BICSI TDMM BICSI - Telecommunications Distribution Methods Manual
- G. BICSI OSPDRM BICSI – Outside Plant Design Reference Manual
- H. BICSI ITSIMM BICSI – Information Technology Systems Methods Manual
- I. NFPA 70 National Electrical Code
- J. IEEE C2 National Electrical Safety Code

**1.3 SUMMARY**

- A. Section Includes:
  - 1. Definitions
  - 2. Communications equipment coordination and installation.
  - 3. Quality Assurance
  - 4. Delivery, Storage and Handling
  - 5. Warranty
  - 6. Occupational Health and Safety.
- B. Related Sections:
  - 1. Division 01 Section "General Commissioning Requirements"
  - 2. Division 27 Section "Grounding and Bonding for Communications"
  - 3. Division 27 Section "Pathways for Communications"
  - 4. Division 27 Section "Underground Pathways and Structures for Communications"
  - 5. Division 27 Section "Identification for Communications"
  - 6. Division 27 Section "Communications Equipment Room Fittings"

7. Division 27 Section "Communications Backbone Cabling"
8. Division 27 Section "Communications Horizontal Cabling"
9. Division 27 Section "IP Telephone Equipment"
10. Division 27 Section "Network Electronics"
11. Division 27 Section "Wireless Network Systems"

#### 1.4 DEFINITIONS

- A. Indicated: Refers to graphic representations, notes or schedules on the Drawings, or other Paragraphs or Schedules in Specifications, and similar requirements in Contract Documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used, it is to help locate the reference; no limitation on location is intended except as specifically noted.
- B. Directed: Terms such as "directed", "requested", "authorized", "selected", "approved", "required", and "permitted" mean "directed by the Architect", "requested by the Architect", and similar phrases. However, no implied meaning shall be interpreted to extend the Architect's responsibility into the Contractor's area of construction supervision.
- C. Approve: The term "approved", where used in conjunction with the Architect's action on the contractor's applications and requests, is limited to the duties and responsibilities of the Architect as stated in General and Supplementary Conditions. Such approval shall not release the Contractor from responsibility to fulfill Contract requirements unless otherwise provided in the Contract Documents.
- D. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work, whether lawfully imposed by authorities having jurisdiction or not.
- E. Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."
- F. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
- G. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."
- H. Installer: An "Installer" is the Contractor engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged in performing.
- I. Project Site: Is the space available to the Contractor for performance of construction activities, either exclusively or in conjunction with others performing other construction activities as part of the Project. The extent of the Project Site is shown in the Drawings and may or may not be identical with the description of the land upon which the Project is to be built.
- J. Testing Laboratories: A "testing laboratory" is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

**1.5 SUBMITTALS**

- A. Product Data: For sleeve seals.
- B. Material Safety Data Sheets: For all hazardous materials.

**1.6 COORDINATION**

- A. Coordinate arrangement, mounting, and support of communications equipment:
  - 1. To allow maximum headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So, connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are being constructed.
- C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

**1.7 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. The system shall be registered under the most current applicable rulings of the Federal Communications Commission (FCC). Provide the FCC registration number with the equipment submittal. All components and installations should bear an Underwriters' Laboratories (UL) listing.
  - 2. Ordinances and Codes: Perform all work in accordance with applicable Federal, State, and local ordinances and regulations and in accordance with the Rules, Regulations and Accepted Practices of the following Agencies:
    - a. ANSI American National Standards Institute
    - b. ASTM American Society for Testing and Materials
    - c. BICSI Building Industry Consulting Service International
    - d. EIA Electronics Industries Association
    - e. FCC Federal Communications Commission
    - f. ICEA Insulated Cable Engineers Association
    - g. IEEE Institute of Electrical and Electronics Engineers
    - h. ISO International Organization for Standardization
    - i. NEC National Electrical Code
    - j. NEMA National Electrical Manufacturer's Association
    - k. NFPA National Fire Protection Association.
    - l. NECA National Electrical Contractors Association
    - m. TIA Telecommunications Industry Association
    - n. UL Underwriters Laboratories, Inc.

- o. VESA Video Electronics Standards Association
  - 3. Notify the Engineer/Communications Designer before submitting this proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules, or regulations. After entering into Contract, make all changes required to conform to above ordinances, rules, and regulations without additional expense to the Owner.
  - 4. The code or standard establishing the more stringent requirement shall be followed where areas of conflict occur between codes and standards or between codes and standards and specifications.
  - 5. Barrier-Free Regulations: All materials and installations shall comply with the requirements of the Handicapped Barrier-Free Regulations and with the Americans With Disabilities Act (ADA).
  - 6. Comply with federal, state, and local labor regulations and applicable union regulations.
- B. Equipment Manufacturer Qualifications: The equipment shall be built and tested by a manufacturer who has regularly engaged in the production of said equipment for a minimum of five (5) years to assure one source of supply and responsibility.
- C. Equipment Supplier Qualifications: The supplier of the equipment shall maintain permanent service facilities within the area of the installation. The facilities shall include a permanent source of factory-trained service technicians on 24-hour call experienced in servicing this type of equipment and shall provide warranty and routine maintenance service to afford the Owner maximum coverage. He shall also provide a central source of support to warranty immediate answers to Owner's problems resulting from misunderstanding of the operation of the equipment.
- D. Equipment Installer Qualifications: Fully qualified personnel shall perform the installation of the equipment, having had experience on the installation of this type and able to certify that they have had no less than five (5) years of continuous experience in this area and have made installation similar to this and of this size or larger.
- E. Project Management Qualifications: The Contractor Project Manager shall have a minimum of five (5) years of project management experience. Upon request, the contractor will provide a resume for all staff assigned to these positions.
- F. Field Measurements:
- 1. Drawings are not intended to be scaled for roughing-in or to serve as shop drawings. Take all field measurements required for fitting the installation to the building.
- G. Parts listed shall be complete, accurate part/model numbers and equipment furnished shall conform to manufacturer's specifications.
- H. All materials shall be new and shall conform to applicable provisions of Underwriters Laboratories and the American Standards Association.

## 1.8 DELIVERY, STORAGE AND HANDLING

- A. Store Communications equipment, at the vendor's location, as recommended in manufacturer's written instructions and in manufacturer's sealed protective packages until time of installation.
- B. If spare parts are specified, store spare parts at the vendor's location, as recommended in manufacturer's written instructions and in manufacturer's sealed protective packages. Deliver spare parts as part of the project close-out procedure.
- C. Protect Communications equipment from damage and theft.

**1.9 WARRANTY**

- A. Warranty: Refer to Communications sections for specific warranty requirements.

**1.10 OCCUPATIONAL HEALTH AND SAFETY**

- A. Comply with 29 CFR 1910.1200 "Hazard Communication"
  - 1. Ensure that the hazards of all chemicals used, stored, produced, or imported are evaluated, and that information concerning their hazards is transmitted to employees by means of comprehensive hazard communication programs, which shall include:
    - a. Container labeling and other forms of warning.
    - b. Material safety data sheets.
    - c. Employee training.

**PART 2 - PRODUCTS****2.1 SAFETY DATA SHEETS (SDS) FORMERLY (MSDS) MATERIAL SAFETY DATA SHEETS**

- A. Provide and ensure that SDS for all hazardous materials are readily accessible during each work shift to employees when they are in their work area.
- B. Provide copies of all SDS to other trades, contractors, general contractor, construction managers and owners as required.

**2.2 LEED® CERTIFIED COMMUNICATIONS PRODUCTS**

- A. Where practical, provide products that are LEED® certified for certification credits. Examples include material with recycled content, Energy Star® compliant and material produced within 500 miles of the jobsite and CFC Free Communications cables.

**2.3 SLEEVES FOR PATHWAYS AND CABLES**

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, reamed and bushed ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

**2.4 SLEEVE SEALS**

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
1. Manufacturers: Subject to compliance with requirements.
  2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
  3. Pressure Plates: Plastic, Carbon steel or Stainless steel. Include two for each sealing element.
  4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

**2.5 GROUT**

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

**PART 3 - EXECUTION****3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION**

- A. Comply with NECA 1. (Install in a "Neat and Workmanlike Manner" NFPA70 section 110.12)
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange, and install components and equipment to provide maximum headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: To Life Safety systems or piping installed at a required slope.

**3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS**

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting with bushings on both surfaces of walls.
- F. Extend sleeves installed in floors 3 inches (75 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using **cast-iron** pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

### 3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install them in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

**END OF SECTION 270500**

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 270526****GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Grounding conductors.
  - 2. Grounding connectors.
  - 3. Grounding busbars.
  - 4. Grounding labeling.

**1.3 DEFINITIONS**

- A. BCT: Bonding conductor for telecommunications. AKA: TBC (Telecommunications Bonding Conductor)
- B. TGB: Telecommunications grounding busbar. AKA: SBB (Secondary Bonding Busbar)
- C. TMGB: Telecommunications main grounding busbar. AKA: PBB (Primary Bonding Busbar)
- D. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

**1.5 INFORMATIONAL SUBMITTALS**

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following: and routing of their bonding conductors.
- B. Qualification Data: For Installer, installation supervisor, and field inspector.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control reports.

**1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 01 "Operation and Maintenance Data," include the following:
    - a. The result of the ground-resistance test measured at the point of BCT connection.
    - b. Result of the bonding-resistance test at each SBB and its nearest grounding electrode.

**1.7 QUALITY ASSURANCE**

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Installation Supervision: Installation shall be under the direct supervision of ITS Technician Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
  - 2. Field Inspector: Currently registered by BICSI as a designer RCDD to perform the on-site inspection.

**PART 2 - PRODUCTS****2.1 SYSTEM DESCRIPTION**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with TIA-607.

**2.2 CONDUCTORS**

- A. Comply with UL 486A-486B.
- B. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
  - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
  - 2. Cable Tray Equipment Grounding Wire: No. 6 AWG.
- C. Cable Tray Grounding Jumper:
  - 1. Not smaller than No. 6 AWG and not longer than 12 inches (300 mm). If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps.
  - 2. If jumper is a flexible braid, it shall have a 2 Hole Irreversible lug. Attach with grounding screw or connector as specified by cable tray manufacturer.

## 2.3 CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- B. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
  - 1. Electroplated tinned copper, C and H shaped.
- C. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- D. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.
- E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.4 GROUNDING BUSBARS

- A. PBB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, length as indicated on Drawings. The bus bar shall be NRTL listed for use as PBB and shall comply with TIA-607.
  - 1. Predrilling shall be with holes for use with lugs specified in this Section.
  - 2. Mounting Hardware: Stand-off brackets that provide a 4-inch (100-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
  - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- B. SBB Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches (6.3 by 50 mm) in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607.
  - 1. Predrilling shall be with holes for use with lugs specified in this Section.
  - 2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch (50-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
  - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607. Predrilling shall be with holes for use with lugs specified in this Section.
  - 1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
  - 2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch (483- or 584-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
  - 3. Rack-Mounted Vertical Busbar: 72 or 36 inches (1827 or 914 mm) long, with stainless-steel or copper-plated hardware for attachment to the rack.

**2.5 IDENTIFICATION**

- A. Comply with requirements for identification products in DIVISION 27 "Identification for Communications Systems."

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with TIA-607.

**3.3 APPLICATION**

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
  - 1. The bonding conductors between the SBB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
  - 2. The bonding conductors between the TBB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2 AWG minimum.
- C. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Structural Steel: Welded connectors.
- D. Conductor Support:
  - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm).

- E. Grounding and Bonding Conductors:
  - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
  - 2. Install it without splices.
  - 3. Support at not more than 36-inch (900-mm) intervals.
  - 4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.

### 3.4 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the PBB and the ac service equipment ground shall not be smaller than No. 1/0 AWG.

### 3.5 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

### 3.6 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
  - 1. Use crimping tool and the die specific to the connector.
  - 2. Pre-twist the conductor.
  - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the PBB with insulated bonding conductor.
- E. Interconnections: A TBB is the TBC For equalization of potential between multiple spaces and ,rooms containing SBBs to effectively bond them all together at the PBB with connection to the Main Building Ground. The accepted Alternatives for this TBB (Telecommunication Bonding Backbone) is to bond each SBB to Building Steel if present and the nearest electrical panelboard, All such connections SHALL be tested to insure that a low resistance ground is present
- F. Interconnect all SBBs with the PBB with the telecommunications backbone conductor. If more than one PBB is installed, interconnect PBBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot (1 sq. mm/linear meter) of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.

- G. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted or vertically mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the SBB No. 2 AWG bonding conductors.
- H. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each SBB and to the vertical steel of the building frame.
- I. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each SBB to the ground bar of the panelboard.
- J. Shielded Cable: Bond the shield of shielded cable to the SBB in communications rooms and spaces. Comply with TIA-568 and TIA-568 when grounding shielded balanced twisted-pair cables.
- K. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- L. Access Floors: Bond all metal parts of access floors to the TBB.
- M. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.
  - 1. Install the conductors in grid pattern on 4-foot (1200-mm) centers, allowing bonding of one pedestal from each access floor tile.
  - 2. Bond the SBB of the equipment room to the reference grid at two or more locations.
  - 3. Bond all conduits and piping entering the equipment room to the SBB at the perimeter of the room.
- N. Towers and Antennas:
  - 1. Ground Ring: Buried at least 30 inches (760 mm) below grade and at least 24 inches (610 mm) from the base of the tower or mounting.
  - 2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches (460 mm) below grade.
  - 3. Bond the ground ring and antenna grounds to the equipment room TBB or SBB, buried at least 30 inches (760 mm) below grade.
  - 4. Bond metallic fences within 6 feet (1.8 m) of towers and antennas to the ground ring, buried at least 18 inches (460 mm) below grade.
    - a. Roof Ring: Meet requirements for the ground ring except the conductors shall comply with requirements in Section 264113 "Lightning Protection for Structures."
    - b. Bond tower base footings steel, the SBB in the equipment room, and antenna support guys to the roof ring.
    - c. Connect roof ring to the perimeter conductors of the lightning protection system.
  - 5. Waveguides and Coaxial Cable:
    - a. Bond cable shields at the point of entry into the building to the SBB and to the cable entrance plate, using No. 2 AWG bonding conductors.
    - b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

### 3.7 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 grounding requirements.
- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, non-shrink grout.
- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors' level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields per written instructions by manufacturer of splicing and termination kits.

### 3.8 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
  - 1. Label TBB(s) with "fs-TBB," where "fs" is the telecommunications space identifier for the space containing the TBB.
  - 2. Label SBB(s) with "fs-SBB," where "fs" is the telecommunications space identifier for the space containing the SBB.
  - 3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench per manufacturer's written instructions.
  - 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TBB and a SBB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
    - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
  - 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.

- a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TBB and in each SBB. The maximum acceptable ac current level is 1 A.
- D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

**END OF SECTION 270526**



**SECTION 270528****PATHWAYS FOR COMMUNICATIONS SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Ladder cable trays
  - 2. Wire-basket cable trays
  - 3. Metal conduits and fittings.
  - 4. Nonmetallic conduits and fittings.
  - 5. Metal wireways and auxiliary gutters.
  - 6. Nonmetallic wireways and auxiliary gutters.
  - 7. Metallic surface pathways.
  - 8. Nonmetallic surface pathways.
  - 9. Hooks.
  - 10. Boxes, enclosures, and cabinets.

**1.3 DEFINITIONS**

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid conduit.
- C. IMC: Intermediate metal conduit.
- D. RTRC: Reinforced thermosetting resin conduit.

**1.4 ACTION SUBMITTALS**

- A. Product data for the following:
  - 1. Surface pathways
  - 2. Wireways and fittings.
  - 3. Boxes, enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets and custom underground handholes and boxes. Include plans, elevations, sections, and attachment details.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of pathway groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Source quality-control reports.

**PART 2 - PRODUCTS****2.1 GENERAL REQUIREMENTS FOR CABLE TRAYS**

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
  - 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
- C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
  - 1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
  - 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
  - 3. Load and Safety Factors: Applicable to both side rails and rung capacities.

**2.2 LADDER CABLE TRAYS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 2. Chalfant Manufacturing Company.
  - 3. Cooper B-Line, Inc.
  - 4. Mono-Systems, Inc.
  - 5. MP Husky.
- B. Description:
  - 1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
  - 2. Rung Spacing: 9 inches o.c.
  - 3. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
  - 4. Minimum Cable-Bearing Surface for Rungs: 7/8-inch (22-mm) width with radius edges.

5. No portion of the rungs shall protrude below the bottom plane of side rails.
6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
7. Straight Section Lengths: 10 feet (3 m) except where shorter lengths are required to facilitate tray assembly.
8. Width: 12 inches (300 mm) unless otherwise indicated on Drawings.
9. Class Designation: Comply with NEMA VE 1
10. Splicing Assemblies: Bolted type using serrated flange locknuts.
11. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.
12. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

### 2.3 WIRE-BASKET CABLE TRAYS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Chatsworth.
  2. Cablofil/Legrande.
  3. Chalfant Manufacturing Company.
  4. Cooper B-Line, Inc.
  5. NIEDAX Mono-Systems, Inc.
  6. MP Husky.
  7. Snaketray.
  8. Wiremaid Products Division; Vutec Corporation.
- B. Description:
  1. Configuration: Wires are formed into a standard 2-by-4-inch wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.
  2. Materials: High-strength-steel longitudinal wires with no bends.
  3. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.
  4. Sizes:
    - a. Straight sections shall be furnished in standard 118-inch lengths.
    - b. Wire-Basket Depth: 4-inch usable loading depth by 12 and 24 inches wide.
  5. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
  6. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
  7. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.

### 2.4 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
  2. Comply with TIA-569.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated GRC or IMC.
1. Comply with NEMA RN 1.
  2. Coating Thickness: 0.040 inch (1 mm), minimum.
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
  2. Fittings for EMT:
    - a. Material: Steel or die cast.
    - b. Type: Set screw or compression.
  3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
  4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## **2.5 NONMETALLIC CONDUITS AND FITTINGS**

- A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.
- B. General Requirements for Nonmetallic Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by an NRTL (NATIONAL RECOGNIZED TESTING LABORATORY), and marked for intended location and application.
  2. Comply with TIA-569.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Rigid HDPE: Comply with UL 651A.
- E. Continuous HDPE: Comply with UL 651A.
- F. RTRC: Comply with UL 2515A and NEMA TC 14.

- G. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.
- H. Solvents and Adhesives: As recommended by conduit manufacturer.

## **2.6 METAL WIREWAYS AND AUXILIARY GUTTERS**

- A. Description: Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.
- B. General Requirements for Metal Wireways and Auxiliary Gutters:
  - 1. Comply with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized per NFPA 70.
  - 2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by an NRTL (NATIONAL RECOGNIZED TESTING LABORATORY), and marked for intended location and application.
  - 3. Comply with TIA-569.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

## **2.7 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS**

- A. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- B. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- C. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:
  - 1. Listed and labeled as defined in NFPA 70, by an NRTL (NATIONAL RECOGNIZED TESTING LABORATORY), and marked for intended location and application.
  - 2. Comply with TIA-569.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. Solvents and Adhesives: As recommended by conduit manufacturer.

**2.8 SURFACE METAL PATHWAYS**

- A. Description: Galvanized steel with snap-on covers, complying with UL 5.
- B. Finish: Manufacturer's standard enamel finish in color selected by Architect.
- C. Listed and labeled as defined in NFPA 70, by an NRTL (NATIONAL RECOGNIZED TESTING LABORATORY), and marked for intended location and application.
- D. Comply with TIA-569.

**2.9 SURFACE NONMETALLIC PATHWAYS:**

- A. Description: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC.
- B. Finish: Texture and color selected by Architect from manufacturer's standard colors.
- C. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- D. Listed and labeled as defined in NFPA 70, by an NRTL (NATIONAL RECOGNIZED TESTING LABORATORY), and marked for intended location and application.
- E. Comply with TIA-569.

**2.10 HOOKS**

- A. Description: Prefabricated sheet metal cable supports for telecommunications cable.
  - 1. Approved for use in limited applications to support Horizontal cabling. Bundle sizes may not exceed 20 Category 6A.
- B. Listed and labeled as defined in NFPA 70, by an NRTL (NATIONAL RECOGNIZED TESTING LABORATORY), and marked for intended location and application.
- C. Comply with TIA-569.
- D. Galvanized or stainless steel.
- E. J shape.
- F. Accept 3/8" (or 10mm) threaded rod for attachment to building structure or sub-structure.
- G. Holes for easy attachment to wall surfaces, beams, trusses and direct attachment to cable trays and rack systems. Can be tiered in a single column, as well as back-to-back.
- H. White, red, green, yellow, or blue color identifiers for content designation of segregated cables.
- I. Center Hanger Connector Plate

1. Bracket that allows for back-to-back non-continuous open top cable support mounting.
2. Continuous cable division shall be fully maintained within each open top cable support.
3. Fittings shall be manufactured of galvanized steel or stainless steel.

J. Multi-tier Assembly

1. Bracket that allows for top-to-bottom non-continuous open top cable support mounting.
2. Continuous cable division shall be fully maintained within each open top cable support.
3. Fittings shall be manufactured of galvanized steel.

## 2.11 BOXES, ENCLOSURES, AND CABINETS

A. Description: Enclosures for communications.

B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569.
2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL (NATIONAL RECOGNIZED TESTING LABORATORY), and marked for use in wet locations.
3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
4. Device Box Dimensions: 4 inches square by 2-1/4 inches deep (100 mm square by 65 mm deep).
5. Gangable boxes are prohibited.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Nonmetallic Floor Boxes: Nonadjustable, round, or rectangular.

1. Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

I. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures:
  - a. Material: Plastic.
  - b. Finished inside with radio-frequency-resistant paint.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

K. Cabinets:

1. NEMA 250, Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## PART 3 - EXECUTION

### 3.1 RACEWAY INSTALLATION REQUIREMENTS

- A. Minimum conduit size shall be 1" for serving one outlet box. Daisy chaining of outlet boxes is unacceptable. Instead, multiple outlets may be served from an appropriately sized junction box. The conduit feeding the junction box shall be sized as follows:
- a. 1-1/4" for serving two outlet boxes.
  - b. 1-1/2" for serving three outlet boxes.
  - c. Two (2) 1-1/4" for serving floor boxes.
  - d. 1-1/4" for serving up to three outlets in a surface raceway.
- B. Communications ducts and conduits entering the building from the outside shall transition to galvanized rigid steel conduit or intermediate metal conduit at the building wall and shall continue as galvanized rigid steel conduit or intermediate metal conduit until entering the BE room or TR. Maximum conduit length to meet Code shall be 50'. Notify the Project Manager if this length is exceeded.
- C. Riser conduits and sleeves connecting BE rooms and TRs shall be 4". Install conduits and sleeves as close as possible to the walls, at the locations shown. Stub up floor conduits and sleeves 4" AFF. Stub wall conduits and sleeves 4" into the room, and cable trays 6" into the room.
- D. When conduits are needed to bypass a large interference in a cable tray run, the cross-sectional area of the conduits shall equal or exceed the cross-sectional area of the cable tray. These bypass conduits shall have sweeps and bends as noted below and shall be braced well to allow pulling of communication cables.



- E. Conduit bends and offsets shall be made with sweeps or manufactured elbows. Conduits shall not have more than the equivalent of 2 ninety-degree bends between pull points. Pull boxes shall not be used to make directional changes. Provide pull boxes in straight sections of conduit only.
- F. Provide insulated bushings on both ends of conduits.
- G. Provide double gang sheet metal outlet boxes 2-1/8" deep and provide double gang plaster rings.
- H. Bond the entire raceway system together and connect it to the ground system.
- I. Provide nylon pull strings in conduits and sleeves. Label pull strings with room number and wall (N, S, E, or W) of the outlet.

### 3.2 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC.
  - 2. Concealed Conduit, Aboveground: GRC.
  - 3. Underground Conduit: RNC, Type EPC-40-PVC Type EPC-80-PVC, direct buried concrete encased.
  - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or Type 4.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT or RNC.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT or RNC identified for such use.
  - 3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Gymnasiums
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT or innerduct.
  - 5. Damp or Wet Locations: GRC.
  - 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway Plenum-type, communications-cable pathway, EMT.
  - 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser-type, optical-fiber-cable pathway Riser-type, communications-cable pathway, EMT.
  - 8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber-cable pathway Riser-type, optical-fiber-cable pathway Plenum-type, optical-fiber-cable pathway General-use, communications-cable pathway Riser-type, communications-cable pathway Plenum-type, communications-cable pathway, EMT.
  - 9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Pathway Size: 1-inch (25-mm) trade size for copper, aluminum cables, and optical-fiber cables.

- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  - 3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

### 3.3 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
  - 1. NECA 1.
  - 2. NECA/BICSI 568.
  - 3. TIA-569.
  - 4. NECA 101
  - 5. NECA 102.
  - 6. NECA 105.
  - 7. NECA 111.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- C. Comply with requirements in Section 07 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- E. Complete pathway installation before starting conductor installation.
- F. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- G. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.
- H. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- I. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- J. Pathways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.
  2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
  3. Arrange pathways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
  4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  5. Change from nonmetallic conduit and fittings to GRC and fittings before rising above floor.
- K. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for pathways.
  2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- L. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- M. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- O. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits of 2-inch (50-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- R. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.
- S. Surface Pathways:
1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
  2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.
  3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway per manufacturer's written instructions. Tape and glue are not acceptable support methods.
- T. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid, and flexible, as follows:

1. 4-Inch (100-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
  2. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- U. Install pathway-sealing fittings at accessible locations per NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish like that of adjacent plates or surfaces. Install pathway-sealing fittings per NFPA 70.
- V. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where an underground service pathway enters a building or structure.
  3. Where otherwise required by NFPA 70.
- W. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- X. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT that is located where environmental temperature change may exceed 100 deg F (55 deg C), and that has straight-run length that exceeds 100 feet (30 m).
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
    - d. Attics: 135 deg F (75 deg C) temperature change.
  3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected per manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Y. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
  2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
  3. Hook spacing shall allow no more than 6 inches (150 mm) of slack. The lowest point of the cables shall be no less than 6 inches (150 mm) adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power, and telecommunications outlets, and other electrical and communications equipment.
  4. Space hooks no more than 5 feet (1.5 m) o.c.
  5. Provide a hook at each change in direction.
- Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- BB. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- EE. Set metal floor boxes level and flush with finished floor surface.
- FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### **3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

### **3.5 FIRESTOPPING**

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### **3.6 PROTECTION**

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION 270528**

**SECTION 270543****UNDERGROUND PATHWAYS AND STRUCTURES FOR COMMUNICATION SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. ANSI/TIA-758 is the Primary guidance for our Minimum acceptable Installation Specification Criteria and shall always be used unless superseded by the Project Scope of work and/or AHJ guidelines.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Metal conduit and fittings, including GRC and PVC-coated GRC.
  - 2. Rigid nonmetallic duct.
  - 3. Duct accessories, including rigid innerduct and fabric innerduct.
  - 4. Precast concrete handholes.
  - 5. Polymer concrete handholes and boxes with polymer concrete cover.
  - 6. Utility structure accessories.

**1.3 DEFINITIONS**

- A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials, such as concrete.
- B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- C. Duct Bank:
  - 1. Two or more ducts installed in parallel, with or without additional casing materials.
  - 2. Multiple duct banks.
- D. GRC: Galvanized rigid conduit.
- E. IMC: Intermediate metal conduit.
- F. RNC: Rigid nonmetallic conduit.
- G. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include duct-bank materials, including spacers and miscellaneous components.
  - 2. Include duct and conduits and their accessories, including elbows, end bells, bends, fittings, duct spacers and solvent cement.
  - 3. Include accessories for manholes, handholes, and boxes, and other utility structures.
  - 4. Include underground-line warning tape.
  
- B. Shop Drawings:
  - 1. Precast or Factory-Fabricated Underground Utility Structures:
    - a. Include plans, elevations, sections, details, attachments to other work, and accessories.
    - b. Include duct entry provisions, including location and duct size.
    - c. Include reinforcement details.
    - d. Include frame and cover design and manhole chimneys.
    - e. Include grounding details.
    - f. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
    - g. Include joint details.
  
  - 2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
    - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
    - b. Include duct entry provisions, including location and duct size.
    - c. Include cover design.
    - d. Include grounding details.
    - e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Duct and Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
  - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
  - 2. Drawings shall be signed and sealed by a qualified professional engineer.
  
- B. Product Certificates: For concrete and steel used in precast concrete handholes, as required by ASTM C 858.
  
- C. Qualification Data: For professional engineer and testing agency responsible for testing nonconcrete handholes and boxes.
  
- D. Source quality-control reports.
  
- E. Field quality-control reports.



**1.6 MAINTENANCE MATERIALS SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

**1.7 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Qualified per ASTM E 329 for testing indicated.

**1.8 FIELD CONDITIONS**

- A. Interruption of Existing Communications Service: Do not interrupt communications service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary communications service according to requirements indicated:
  - 1. Notify Owner no fewer than two days in advance of proposed interruption of communications service.
  - 2. Do not proceed with interruption of communications service without Owner's written permission.
- B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.
- C. Ground Water: Assume ground-water level is 36 inches (900 mm) below ground surface unless a higher water table is noted on Drawings.

**PART 2 - PRODUCTS****2.1 METAL CONDUITS AND FITTINGS**

- A. GRC: Comply with ANSI C80.1 and UL 6.
- B. PVC-Coated Steel Conduit: PVC-coated GRC.
  - 1. Comply with NEMA RN 1.
  - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- C. General Requirements for Metal Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
  - 2. Comply with TIA-569 and TIA-758.

**2.2 RIGID NONMETALLIC DUCTS**

- A. Underground Plastic Utilities Duct: Type EPC-80-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.

- B. Underground Plastic Utilities Duct: Type DB-120-PVC RNC, complying with NEMA TC 6 & 8 and with ASTM F-512 for direct burial, with matching fittings complying with NEMA TC 9 by same manufacturer as duct.
- C. Underground Plastic Utilities Duct: Type EB-20 PVC RNC, complying with NEMA TC 6 & 8, ASTM F-512, and UL 651, with matching fittings complying with NEMA TC 9 by same manufacturer as duct.
- D. General Requirements for Nonmetallic Ducts and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
  - 2. Comply with TIA-569 and TIA-758.
- E. Solvents and Adhesives: As recommended by duct manufacturer.

### **2.3 FLEXIBLE NONMETALLIC DUCTS**

- A. HDPE Duct: Type EPEC 80-HDPE complying with NEMA TC 7 and UL 651A.
  - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
  - 2. Comply with TIA-569 and TIA-758.

### **2.4 DUCT ACCESSORIES**

- A. Duct Spacers: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
- B. Underground-Line Warning Tape: Underground-line warning tape specified in Section 270553 "Identification for Communications Systems."

### **2.5 PRECAST CONCRETE HANDHOLES AND BOXES**

- A. Description: Monolithically poured, factory-fabricated, reinforced-concrete walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
- B. Comply with ASTM C 858 for design and manufacturing processes.
- C. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
- D. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
- E. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.

1. Cover Hinges: Concealed, with hold-open ratchet assembly.
  2. Cover Handle: Recessed.
- F. Frame and Cover: Weatherproof aluminum frame, with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.
1. Cover Hinges: Concealed, with hold-open ratchet assembly.
  2. Cover Handle: Recessed.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "COMMUNICATIONS."
- I. Configuration: Units shall be designed for flush burial and have integral closed bottom unless otherwise indicated.
- J. Extensions and Slabs: Designed to mate with bottom of enclosure and made of same material as enclosure.
1. Extension shall provide increased depth of 12 inches (300 mm).
  2. Slab: Same dimensions as bottom of enclosure and arranged to provide closure.
- K. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
- L. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct and duct banks, plus an additional 6 inches (150 mm) vertically and horizontally to accommodate alignment variations.
1. Knockout panels shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
  2. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie into concrete envelopes of duct banks.
  3. Knockout panel openings shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
  4. Knockout panels shall be 1-1/2 to 2 inches (38 to 50 mm) thick.
- M. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
1. Type and size shall match fittings to duct or conduit to be terminated.
  2. Fittings shall align with elevations of approaching duct and be located near interior corners of handholes to facilitate racking of cable.
- N. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

**2.6 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER**

- A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
- B. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- C. Color: Gray.
- D. Configuration: Units shall be designed for flush burial and have integral closed bottom unless otherwise indicated.
- E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- F. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- G. Cover Legend: Molded lettering, "COMMUNICATIONS."
- H. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- I. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- J. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

**2.7 UTILITY STRUCTURE ACCESSORIES**

- A. Accessories for Utility Structures: Utility equipment and accessory items used for utility structure access and utility support, listed and labeled for intended use and application.
- B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
  - 1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B, with milled cover-to-frame bearing surfaces; 29-inch (725-mm) diameter.
    - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
    - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
  - 2. Cover Legend: Cast in. Selected to suit system.
- C. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.
- D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- (50-mm-) diameter eye, and 1-by-4-inch (25-by-100-mm) bolt.

1. Working Load Embedded in 6-Inch (150-mm), 4000-psi (27.6-MPa) Concrete: 13,000-lbf (58-kN) minimum tension.
- E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch- (31-mm-) diameter eye, rated 2500-lbf (11-kN) minimum tension.
- F. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- (22-mm-) diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
  1. Ultimate Yield Strength: 40,000-lbf (180-kN) shear and 60,000-lbf (270-kN) tension.
- G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch (13-mm) ID by 2-3/4 inches (69 mm) deep, flared to a minimum of 1-1/4 inches (31 mm) at base.
  1. Tested Ultimate Pullout Strength: 12,000 lbf (53 kN) minimum.
- H. Ground Rod Sleeve: 3-inch (75-mm), PVC duct sleeve in manhole floors 2 inches (50 mm) from the wall adjacent to, but not underneath, the duct entering the structure.
- I. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip, with 1/2-inch (13-mm) bolt, 5300-lbf (24-kN) rated pullout strength, and minimum 6800-lbf (30-kN) rated shear strength.
- J. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic duct, metallic duct, duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- K. Cover Hooks: Light duty, designed for lifts less than 60 lbf (270 N). Two required.

## 2.8 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures per ASTM C 1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
  1. Tests of materials shall be performed by an independent testing agency.
  2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

**PART 3 - EXECUTION****3.1 PREPARATION**

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

**3.2 UNDERGROUND DUCT APPLICATION**

- A. Duct for Communications: Type EPC-80-PVC RNC, in concrete-encased duct bank unless otherwise indicated.
- B. Duct for Communications: Type DB-120-PVC RNC, in direct-buried duct bank unless otherwise indicated.
- C. Duct for Communications: Type EPEC-80-HDPE duct in direct-bored duct bank unless otherwise indicated.
- D. Underground Duct Crossing: Paved Paths, Walks and Driveways: Type EPC-40-PVC RNC, encased in reinforced concrete.
- E. Stub-Ups for Communications: Concrete-encased GRC.

**3.3 UNDERGROUND ENCLOSURE APPLICATION**

- A. Handholes and Boxes for Communications:
  - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
  - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
  - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
  - 4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin or High-density plastic, structurally tested per SCTE 77 with 3000-lbf (13 345-N) vertical loading.
  - 5. Cover design load shall not exceed the design load of the handhole or box.

**3.4 EARTHWORK**

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Replace area immediately after backfilling is completed.
- C. Restore surface features at areas disturbed by excavation and re-establish original grades unless otherwise indicated.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- E. Cut and patch existing pavement in the path of underground duct, duct bank, and utility structures per the "Cutting and Patching" Article in Section 017300 "Execution."

**3.5 DUCT AND DUCT-BANK INSTALLATION**

- A. Where indicated on Drawings, install duct, spacers, and accessories into the duct configuration shown. Duct installation requirements in this Section also apply to duct bank.
- B. Install duct and duct bank per NEMA TCB 2 and TIA-758.
- C. Slope: Pitch duct and duct bank a minimum slope of 1:100 down toward manholes and handholes and away from buildings and equipment. Slope duct and duct bank from a high point in runs between two manholes, to drain in both directions.
- D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1200 mm), both horizontally and vertically, at other locations unless otherwise indicated.
  - 1. Duct and duct banks shall have maximum of two 90-degree bends, or the total of all bends shall be no more 180 degrees between pull points.
- E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings, so those of adjacent ducts do not lie in same plane.
- F. Installation Adjacent to High-Temperature Steam Lines: Where duct or duct banks are installed parallel to underground steam lines, perform calculations showing the duct or duct bank will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct or duct bank crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.
- G. End-Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 6 inches (150 mm) o.c. for 4-inch (100-mm) duct, and vary proportionately for other duct sizes.
  - 1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct slope and without forming a trap in the line.

2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight-line direct-buried duct and duct banks, with calculated expansion of more than 3/4 inch (19 mm).
  3. Grout end bells into structure walls from both sides to provide watertight entrances.
- H. Terminator Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches (150 mm) o.c. for 4-inch (100-mm) duct and vary proportionately for other duct sizes.
1. Begin change from regular spacing to terminator spacing 10 feet (3 m) from the terminator without reducing duct slope and without forming a trap in the line.
  2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight-line duct or duct bank, with calculated expansion of more than 3/4 inch (19 mm).
- I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet (3 m) outside the building wall, without reducing duct slope away from the building or forming a trap in the duct. Use fittings manufactured for RNC duct-to-GRC conduit transition. Install GRC penetrations of building walls as specified in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."
- J. Sealing: Provide temporary closure at terminations of duct that has cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.
- K. Innerduct: Install immediately after mandrelling duct. Size and type as indicated on Drawings.
- L. Pulling Cord: Install 200-lbf- (1000-N-m) test nylon cord in empty duct and innerduct.
- M. Concrete-Encased Duct and Duct Bank:
1. Excavate trench bottom to provide firm and uniform support for duct or duct bank. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
  2. Width: Excavate trench 12 inches (300 mm) wider than duct or duct bank on each side.
  3. Width: Excavate trench 3 inches (75 mm) wider than duct or duct bank on each side.
  4. Depth: Install top of duct and duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
  5. Support duct and duct bank on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
  6. Minimum Space Between Duct: 3 inches (75 mm) between edge of duct and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and communications ducts.
  7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) between tiers. Secure spacers to earth and duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around duct or duct bank.



8. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct run unless otherwise indicated. Extend concrete encasement throughout length of elbow.
9. Elbows: Use manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct run.
  - a. Couple GRC to duct with adapters designed for this purpose and encase coupling with 3 inches (75 mm) of concrete.
  - b. Stub-Ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
    - 1) Stub-ups shall be minimum 4 inches (100 mm) above finished floor and minimum 3 inches (75 mm) from conduit side to edge of slab.
  - c. Stub-Ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches (1500 mm) from edge of wall. Install insulated grounding bushings on terminations at equipment.
    - 1) Stub-ups shall be minimum 4 inches (100 mm) above finished floor and no less than 3 inches (75 mm) from conduit side to edge of wall.
10. Reinforcement: Reinforce concrete-encased duct and duct bank where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
11. Forms: Use trench walls to form side walls of duct and duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
12. Concrete Cover: Install a minimum of 3 inches (75 mm) of concrete cover between edge of duct to exterior envelope wall, 2 inches (50 mm) between ducts, and 4 inches (100 mm) between power and communications duct.
13. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
  - a. Start at one end and finish at the other, allowing for expansion and contraction of duct as its temperature changes during and after the pour. Use expansion fittings installed per manufacturer's written recommendations or use other specific measures to prevent expansion-contraction damage.
  - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing-rod dowels extending a minimum of 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
14. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between ducts and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto duct. Allow concrete to flow to center of bank and rise in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

N. Direct-Buried Duct and Duct Banks:

1. Excavate trench bottom to provide firm and uniform support for duct and duct bank. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for duct less than 6 inches (150 mm) in nominal diameter.
  2. Install duct with a minimum of 3 inches (75 mm) between duct for like services and 6 inches (150 mm) between power and signal duct.
  3. Width: Excavate trench 12 inches (300 mm) wider than duct or duct bank on each side.
  4. Width: Excavate trench 3 inches (75 mm) wider than duct or duct bank on each side.
  5. Depth: Install top of duct or duct bank at least 36 inches (900 mm) below finished grade unless otherwise indicated.
  6. Set elevation of bottom of duct or duct bank below frost line.
  7. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
  8. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) between tiers. Secure spacers to earth and duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around duct or duct bank.
  9. Elbows: Install manufactured duct elbows for stub-ups, at building entrances through floor, and at changes of direction in duct unless otherwise indicated. Encase elbows for stub-ups throughout length of elbow. Extend encasement minimum of 36 inches (900 mm) beyond elbow joints.
  10. Install manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct.
    - a. Couple GRC to duct with adapters designed for this purpose and encase coupling with 3 inches (75 mm) of concrete.
    - b. For equipment mounted on outdoor bases, extend GRC horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
  11. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving duct at end of run free to move with expansion and contraction, as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfills to 4 inches (100 mm) over duct and hand tamp. Firmly tamp backfill around duct to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
    - a. Place minimum of 3 inches (75 mm) of sand as a bed for duct and duct bank. Place sand to a minimum of 6 inches (150 mm) above top level of duct and duct bank.
    - b. Place minimum of 6 inches (150 mm) of engineered fill above concrete encasement of duct bank.
- O. Underground-Line Warning Tape: Bury conducting underground-line warning tape specified in Section 270553 "Identification for Communication Systems" no less than 12 inches (300 mm) below grade. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

**3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES**

- A. Precast Concrete Handhole and Manhole Installation:
1. Comply with ASTM C 891 unless otherwise indicated.
  2. Install units' level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
  3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- B. Elevations:
1. Manhole Roof: Install with rooftop at least 15 inches (380 mm) below finished grade.
  2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.
  3. Install handholes with bottom below frost line, no less than 24 inches below grade.
  4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
  5. Where indicated, cast handhole cover frame integrally with handhole structure.
- C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
- D. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. After duct has been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
- E. Damp proofing: Apply damp proofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Damp proofing materials and installation are specified in Section 071113 "Bituminous Damp proofing." After duct has been connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.
- F. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
- G. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (97 mm) for manholes and 2 inches (50 mm) for handholes, for field-installed anchor bolts installed. Use a minimum of two anchors for each cable stanchion.

**3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE**

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct and duct bank, and seal joint between box and extension as recommended by manufacturer.

- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
- D. Install handholes and boxes with bottom below frost line, a minimum of 24 inches below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- F. Field cut openings for duct per enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring, encircling, and in contact with, enclosure, and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
  - 1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.
  - 2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

### 3.8 GROUNDING

- A. Ground underground duct, duct bank, and utility structures per Section 270526 "Grounding and Bonding for Communications Systems."

### 3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
  - 1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
  - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch- (300-mm-) long mandrel equal to duct size minus 1/4 inch (6 mm). If obstructions are indicated, remove obstructions and retest.
  - 3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 270526 "Grounding and Bonding for Communications Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

**3.10 CLEANING**

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris.
  
- B. Clean internal surfaces of manholes, including sump.
  - 1. Sweep floor, removing dirt and debris.
  - 2. Remove foreign material.

**END OF SECTION 270543**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 270553****IDENTIFICATION FOR COMMUNICATIONS SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor shall label all Spaces and installed equipment such as racks, patch panels, conduit, cable, jacks/modules, terminations, junction/pull boxes and other equipment This Shall be in accordance with ANSI/TIA-606, owners requirements and as shown on the Drawings and/or required in the Specifications.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Color and legend requirements for labels and signs.
  - 2. Labels.
  - 3. Bands and tubes.
  - 4. Underground Warning Tape
  - 5. Signs.
  - 6. Cable ties.
  - 7. Fasteners for labels and signs.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for communications identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule:
  - 1. Outlets: Scaled drawings indicating location and proposed designation.
  - 2. Patch Panels: Enlarged scaled drawings showing rack row, number, and proposed designations.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Comply with NFPA 70 and TIA 606.
- B. Comply with ANSI Z535.4 for safety signs and labels.
- C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

**2.2 COLOR AND LEGEND REQUIREMENTS**

- A. Equipment Identification Labels:
  - 1. Black letters on a white field.

**2.3 LABELS**

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters of raceway or cable they identify, that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, vinyl flexible labels with acrylic pressure-sensitive adhesive.
  - 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating protective shields over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
  - 2. Marker for Labels: Permanent, waterproof black ink marker recommended by tag manufacturer.
  - 3. Marker for Labels: Machine-printed, permanent, waterproof black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
  - 1. Minimum Nominal Size:
    - a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
    - b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.



- c. As required by authorities having jurisdiction.

## 2.4 BANDS AND TUBES

- A. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters of raceway or cable they identify, that stay in place by gripping action.

## 2.5 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground communications utility lines.
  2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  3. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
1. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, and ANSI Z535.4.
  2. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL-FIBER CABLE".
- C. Tag: Type I:
1. Pigmented polyolefin, bright colored, compounded for direct-burial service.
  2. Width: 3 inches (75 mm).
  3. Thickness: 4 mils (0.1 mm).
  4. Weight: 18.5 lb/1000 sq. ft. (9.0 kg/100 sq. m).
  5. Tensile per ASTM D 882: 30 lbf (133.4 N) and 2500 psi (17.2 MPa).
- D. Tag: Type II:
1. Multilayer laminate, consisting of high-density polyethylene scrim coated with pigmented polyolefin; bright colored, compounded for direct-burial service.
  2. Width: 3 inches (75 mm).
  3. Thickness: 12 mils (0.3 mm).
  4. Weight: 36.1 lb/1000 sq. ft. (17.6 kg/100 sq. m).
  5. Tensile per ASTM D 882: 400 lbf (1780 N) and 11,500 psi (79.2 MPa).
- E. Tag: Type ID:
1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, compounded for direct-burial service.
  2. Width: 3 inches (75 mm).
  3. Overall Thickness: 5 mils (0.125 mm).
  4. Foil Core Thickness: 0.35 mil (0.00889 mm).
  5. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
  6. Tensile per ASTM D 882: 70 lbf (311.3 N) and 4600 psi (31.7 MPa).
- F. Tag: Type IID:

1. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, compounded for direct-burial service.
2. Width: 3 inches (75 mm).
3. Overall Thickness: 8 mils (0.2 mm).
4. Foil Core Thickness: 0.35 mil (0.00889 mm).
5. Weight: 34 lb/1000 sq. ft. (16.6 kg/100 sq. m).
6. Tensile per ASTM D 882: 300 lbf (1334 N) and 12,500 psi (86.1 MPa).

## 2.6 SIGNS

### A. Baked-Enamel Signs:

1. Preprinted aluminum signs punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches (180 by 250 mm).

### B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch (1-mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches (250 by 360 mm).

### C. Laminated-Acrylic or Melamine-Plastic Signs:

1. Engraved legend.
2. Thickness:
  - a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
  - b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
  - c. Engraved legend with black letters on white face.
  - d. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.
  - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.7 CABLE TIES

### A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) per ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

### B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 deg F (23 deg C) per ASTM D 638: 12,000 psi (82.7 MPa).
  3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73 deg F (23 deg C) per ASTM D 638: 7000 psi (48.2 MPa).
  3. UL 94 Flame Rating: 94V-0.
  4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
  5. Color: Black.

## 2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying communications identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

### 3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify the identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of communications systems and connected items.
- G. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

- H. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
  - 3. Provide label 6 inches (150 mm) from cable end.
- I. Snap-Around Labels:
  - 1. Secure tight to surface at a location with high visibility and accessibility.
  - 2. Provide label 6 inches (150 mm) from cable end.
- J. Self-Adhesive Wraparound Labels:
  - 1. Secure tight to surface at a location with high visibility and accessibility.
  - 2. Provide label 6 inches (150 mm) from cable end.
- K. Self-Adhesive Labels:
  - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- L. Snap-Around, Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- M. Underground-Line Warning Tape:
  - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
  - 2. Limit use of underground-line warning tape to direct-buried cables.
  - 3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- N. Cable Ties: General purpose, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.

### 3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations with high visibility. Identify by system and circuit designation.
- C. Accessible Fittings for Raceways and Cables within Buildings: Identify covers of each junction and pull box with self-adhesive labels containing wiring system legend.

1. System legends shall be as follows:
  - a. Telecommunications
  - b. Security
  - c. Audio Visual
  
- D. Faceplates: Label individual faceplates with self-adhesive labels. Place label at top of faceplate. Each faceplate shall be labeled with its individual, sequential designation, numbered clockwise when entering room from primary egress, composed of the following, in the order listed:
  1. Wiring closet designation.
  2. Colon.
  3. Faceplate number.
  
- E. Equipment Room Labeling:
  1. Patch Panels: Label individual rows and outlets, starting to left and working down, with self-adhesive labels.
  2. Data Outlets: Label each outlet with a self-adhesive label indicating the following, in the order listed:
    - a. Room number being served.
    - b. Colon.
    - c. Faceplate number.
  
- F. Horizontal Cables: Label each cable with a vinyl-wraparound label indicating the following, in the order listed:
  1. Room number.
  2. Colon.
  3. Faceplate number.
  
- G. Locations of Underground Lines: Underground-line warning tape for copper, coaxial, hybrid copper/fiber, and optical-fiber cable.
  
- H. Instructional Signs: Self-adhesive labels.
  
- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures: Self-adhesive labels.
  1. Apply to exterior of door, cover, or other access.
  
- J. Equipment Identification Labels:
  1. Indoor Equipment: Self-adhesive label.
  2. Outdoor Equipment: Laminated-acrylic or melamine-plastic sign.
  3. Equipment to Be Labeled:
    - a. Communications cabinets.
    - b. Uninterruptible power supplies.
    - c. Computer room air conditioners.
    - d. Fire-alarm and suppression equipment.
    - e. Egress points.
    - f. Power distribution components.

**END OF SECTION 270553**

**SECTION 271100****COMMUNICATIONS EQUIPMENT ROOM FITTINGS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Backboards.
  - 2. Racks.
  - 3. Cabinets.
  - 4. Power strips.
  - 5. UPS.

**1.3 DEFINITIONS**

- A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.
- B. RCDD: Registered communications distribution designer.
- C. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.
- D. TGB: Telecommunications grounding bus bar.
- E. TMGB: Telecommunications main grounding bus bar.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.
  1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of Technician.
  2. Installation Supervision: Installation shall be under direct supervision of Technician, who shall always be present when Work of this Section is performed at Project site.
  3. Field Inspector: Currently registered by BICSI as Technician to perform the on-site inspection.

## PART 2 - PRODUCTS

### 2.1 BACKBOARDS

- A. Backboards: A/C grade, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm) Plywood, fire-retardant treated, comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

### 2.2 RACKS

- A. Manufacturers: Subject to compliance with requirements.
- B. General Frame Requirements:
  1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
  2. Module Dimension: Width compatible with EIA 310 standard, 19-inch (480-mm) panel mounting.
  3. Finish: Manufacturer's standard, baked powder coat.
- C. Four Post Floor-Mounted Racks:
  1. 84" high, modular-type, steel construction.
  2. Integral 6 inch (150 mm) wide vertical cable management with metal hinged covers. Plastic removable covers are prohibited.



3. Baked powder coat finish, black in color.

### 2.3 MODULAR WALL CABINETS

1. Minimum 36" overall high x 23.4" wide x 36" deep.
2. Steel construction.
3. Treated to resist corrosion.
4. Lockable front door and rear pivot frame.
5. Louvered side panels.
6. Cable access provisions top and bottom.
7. Horizontal optical fiber cable management.
8. Grounding lug.
9. Roof-mounted, 250 (118-L/s)-cfm fan.
10. Horizontal power strip.

### 2.4 MODULAR FREESTANDING CABINETS:

1. Cabinet shall have overall dimension of 83-1/2 H x 30 W x 36 D inches.
2. Fully welded construction with static load of 10,000 lbs.
3. 14-gauge steel top and bottom panels.
4. 19 inch (482 mm) wide 11-gauge adjustable rack-rails.
5. 10-32 threaded holes on EIA standard spacing.
6. Removable and lockable steel side panels.
7. Hinged and lockable front Plexiglas and vented rear steel doors.
8. Built-in 4.25 inch (108 mm) front vertical cable management with hinged covers.
9. Adjustable feet for leveling.
10. Cable access and conduit provisions in the roof and base.
11. Grounding bus bar.
12. Four (4) Roof-mounted 4.5 inch (114 mm) fans.
13. Vertical 20Amp Power Strip.
14. Baked-polyester powder coat black finish.
15. Cable access provisions in the roof and base.
16. Baked powder coat finish, black in color.
17. All cabinets keyed alike.

### 2.5 OPTICAL FIBER HORIZONTAL CABLE MANAGEMENT FOR RACKS AND CABINETS

1. Metal, 3.5-inch-high (89 mm) (2RU) front integral wire retaining fingers and hinged front cover. Plastic removable covers are prohibited.
2. Baked-polyester black powder coat finish.
3. Provide one (1) 2RU horizontal cable manager below each optical patch panel.

### 2.6 POWER STRIPS

- A. Power Strips: Equipment rack power strips shall be 125-volt, 20-amp, 3 wire, single circuit type with 10 NEMA 5-20R single receptacle outlets on 6" centers.
  1. Horizontal rack mounting.
  2. Six, 15-A, 120-VAC, NEMA WD 6, Configuration 5-20R receptacles.
  3. LED indicator lights for power and protection status.
  4. LED indicator lights for reverse polarity and open outlet ground.

5. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
6. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
7. Cord connected with 15-foot (4.5-m) line cord.
8. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
9. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.

## 2.7 RACK MOUNT UPS

- A. UPS: Equipment UPS shall be Smart-UPS, 3000VA, 120V with SmartConnect Port.
  1. Horizontal rack mounting.
  2. Output power capacity: 2.7kWatts / 2.88kVA
  3. Rack Height: 2U
  4. Output Connections: (2) NEMA 5-20R (Battery Backup); (6) NEMA 5-15R (Battery Backup)
  5. Nominal Output Voltage: 110V, 120V, 125V
  6. Nominal Input Voltage: 110V, 120V, 125V
  7. Input Connections: NEMA L5-30P
  8. Cord Length: 8.01ft (2.4meters)

## 2.8 GROUNDING

- A. Comply with requirements in Division 27 Section "Grounding and Bonding for Communications Systems." for grounding conductors and connectors.
- B. Telecommunications Main Grounding Bus Bar:
  1. Connectors: Mechanical type, cast silicon bronze, solder less compression-type wire terminals, and long-barrel, two-bolt non-twisting connection to ground bus bar.
  2. Main Telecommunications Ground Bus (MTGB) bar: Copper, minimum 1/4-inch-thick by 4 inches wide (6 mm thick by 100 mm wide) with two vertical 5/16-inch (8-mm) holes spaced 5/8 inches (16 mm) apart.
  3. Telecommunications Ground Bus (TGB) bar: Copper, minimum 1/4-inch-thick by 2 inches wide (6 mm thick by 50 mm wide) with two vertical 5/16-inch (8-mm) holes spaced 5/8 inches (16 mm) apart.
  4. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
  5. Provide a TMGB in the Main Equipment Room and a TGB in each Telecommunications Room.
- C. Comply with TIA-607.
- D. Comply with NECA-BICSI-607.

## 2.9 LABELING

- A. Comply with TIA-606 and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers. Reference sheet T-601 for owner approved labeling standard

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Comply with NECA 1.
- B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Coordinate layout and installation of communications equipment in tracks and in room. Coordinate service entrance configuration with service provider.
  - 1. Meet jointly with systems providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
  - 2. Record agreements reached in meetings and distribute them to other participants.
  - 3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment.
  - 4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.
- F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.
- G. Backboards:
  - 1. Install from 6 inches (150 mm) to 8 feet, 6 inches (2588 mm) above finished floor. If plywood is fire rated, ensure that fire-rating stamp is visible after installation.
  - 2. Paint all sides of backboard with two coats of paint, leaving fire rating stamp visible.
  - 3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569.

**3.2 BE ROOM AND TR REQUIREMENTS**

- A. Provide ceiling-hung lighting with a wall switch at the door.
- B. Provide power to HVAC equipment.
- C. Provide dedicated 120-volt, 20 ampere circuits to duplex receptacles 48" AFF and 10' apart on the plywood backboards. Plywood backboards are by others.
- D. Provide dedicated 120-volt, 30 ampere circuits to NEMA L5-30R receptacles and provide dedicated 120-volt, 20 ampere circuits to power strips on the telecom equipment racks. See Standard Details.
- E. In rooms with DAS, ERRC, and Security equipment plywood backboards, provide two dedicated 120-volt, 20 ampere circuits to quad receptacles on each DAS backboard.

- F. Provide one 120-volt, 20 ampere normal power circuit to a duplex receptacle on the wall near the door.
- G. Coordinate all receptacle locations with Owner.
- H. Provide a copper ground bus bar where shown. Connect it to the unit substation room ground bus bar and to the ground bus bars in the receptacle panels feeding the telecom room receptacles. Ground cables shall be No. 6 AWG green insulated, stranded, copper. The resistance to building ground shall be 1 ohm maximum.

### **3.3 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

### **3.4 FIRESTOPPING**

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569, Annex A, "Firestopping."
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual," "Firestopping Practices" Ch.

**END OF SECTION 271100**

**SECTION 271300****COMMUNICATIONS BACKBONE CABLING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Pathways.
  - 2. 8/125-micrometer, optical fiber cabling.
  - 3. Cable connecting hardware, patch panels, and cross-connects.
  - 4. Cabling identification products.

**1.3 DEFINITIONS**

- A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. LAN: Local area network.
- E. RCDD: Registered Communications Distribution Designer.

**1.4 BACKBONE CABLING DESCRIPTION**

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

**1.5 PERFORMANCE REQUIREMENTS**

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568, when tested according to test procedures of this standard.

**1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  - 3. Cabling administration drawings and printouts.
  - 4. Wiring diagrams to show typical wiring schematics including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.
  - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
- C. Sustainable Design Submittals:

**1.7 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Maintenance Data: For splices and connectors to include in maintenance manuals.

**1.8 CLOSEOUT SUBMITTALS**

- A. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.

**1.9 QUALITY ASSURANCE**

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
  - 2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall always be present when Work of this Section is performed at Project site.
  - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

- B. Testing Agency Qualifications: An NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569.
- F. Grounding: Comply with ANSI-J-STD-607.

#### **1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Test cables upon receipt at Project site.
  - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
  - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

#### **1.11 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### **1.12 COORDINATION**

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

### **PART 2 - PRODUCTS**

#### **2.1 PATHWAYS**

- A. General Requirements: Comply with TIA/EIA-569.
- B. Cable Support: NRTL labeled for support of cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

## 2.2 OPTICAL FIBER CABLE

- A. Singlemode Cable Elements (OS2) shall conform to the following specification:
1. 8.3-micron core diameter, 125-micron cladding diameter (+/- 1 micron)
  2. Mode field diameter of between 8.7 and 9.3 (with +/- 0.5 micron tolerance) at 1310 nm
  3. Attenuation coefficient at 1310 nm of 1.0 db/km or less
  4. Attenuation coefficient at 1550 nm of 1.0 db/km or less
  5. Cladding non-circularity of +/- 1%
  6. Core to cladding concentricity error of or more than 0.8 micron
  7. Maximum dispersion rate of 2.80 ps/nm-km at 1300 nm
  8. Maximum dispersion rate of 17.00 ps/nm-km at 1550 nm
  9. Individual glass elements proof tested at 100 kpsi (100,000 lbs. per square inch)
  10. Number of elements as indicated on the drawings
- B. Backbone Optical Fiber Cable: Cable shall be plenum rated (OFCP) for use as an internal cable in a plenum environment. The cable shall be tight-buffered construction with optical fibers contained within 900-micron color-coded buffers. Interlocking armored cable shall be provided. The cable will be an all-dielectric construction, with a central strength member.
- C. Internal/External Cable: Provide internal/external optical fiber cable. The cable shall be riser rated (OFNR) for use as an internal cable in a non-plenum environment. The cable shall also be recommended by the manufacturer for use as an external cable suitable for installation in an underground duct. Optical fibers shall be contained within loose buffer tubes utilizing water blocking tapes or compounds surrounding these tubes. The cable will be an all-dielectric construction, with a central strength member.
- D. External Cable: Provide external optical fiber cable. The cable shall be recommended by the manufacturer for use as an external cable suitable for installation in an underground duct. Optical fibers shall be contained within loose buffer tubes utilizing water blocking tapes or compounds surrounding these tubes. The cable will be an all-dielectric construction, with a central strength member.

## 2.3 OPTICAL FIBER CABLE HARDWARE

- A. Rack Mounted optical fiber patch panel, conforming to the following specification:
1. Each panel shall be suitable for installation in EIA 19" mounting frame.
  2. Provide strain relief for each cable at the rear of the patch panel.
  3. Allow for labeling of each individual connector.
  4. Allow any individual cable to be terminated or otherwise handled without disturbing other cables.
  5. Each panel shall provide fiber handling for fiber elements, including 36" fiber reserve (service loop) inside the patch panel with or bends sharper than 2" bend radius.
  6. Provide blanking adapter plates to cover all unused spaces as necessary.



## 2.4 OPTICAL FIBER CONNECTORS

- A. Singlemode Optical Fiber Connectors. Provide singlemode duplex LC optical fiber connectors, conforming to the following specification.
1. Small form factor LC connectors
  2. Duplex, handling one pair (two elements) per connector.
  3. Blue in color.
  4. Compatible with both 900 micron buffered strands and 250micron loose tube strands.
  5. Maximum insertion loss, of mated pair, less than 0.5 dB at acceptance.
  6. Minimum return loss of greater than or equal to 40 (50 for LC) dB.
  7. Durability better than 500 matings, with a maximum increase in insertion loss of not more than 0.2 dB.
  8. Meets ANSI/TIA/EIA 568-B and ISO 11801 standards.

## 2.5 PATCH CORDS

- A. Optical Fiber. Provide one optical fiber patch cord per optical fiber pair installed. These shall be sourced from the same manufacturer as the optical fiber connectors provided as a part of this project. Each cord shall meet or exceed the optical fiber performance specifications in this document.
1. 20% of the patch cords shall be 3 feet in length and yellow in color
  2. 60% of the patch cords shall be 7 feet in length and yellow in color
  3. 20% of the patch cords shall be 11 feet in length and yellow in color
- B. The patch cords are to be passed to the client on completion of the project. Each cord is to have a manufacturer's certificate of conformance and shall be in its original, unopened packaging.

## 2.6 GROUNDING

- A. Comply with ANSI-J-STD-607.

## 2.7 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606 and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

## 2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA/EIA-568.
- C. Factory test singlemode optical fiber cables.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

## PART 3 - EXECUTION

**3.1 ENTRANCE FACILITIES**

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

**3.2 WIRING METHODS**

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

**3.3 INSTALLATION OF PATHWAYS**

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569 for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
  - 2. Install cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard when entering room from overhead.
  - 4. Extend conduits 3 inches (76 mm) above finished floor.
  - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

### 3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
  - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
  - 11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. Optical Fiber Cable Installation:
  - 1. Comply with TIA/EIA-568
  - 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- D. Open-Cable Installation:
  - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  - 2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Installation of Cable Routed Exposed under Raised Floors:
  - 1. Install plenum-rated cable only.
  - 2. Install cabling after the flooring system has been installed in raised floor areas.
  - 3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.
- F. Group connecting hardware for cables into separate logical fields.
- G. Separation from EMI Sources:
  - 1. Comply with BICSI TDMM and TIA/EIA-569 recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

### **3.5 FIRESTOPPING**

- A. Comply with TIA/EIA-569, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

### **3.6 GROUNDING**

- A. Install grounding per BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606.
  - 1. Administration Class: 2.
  - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606 for Class 3 level of administration.
- D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- F. Cable and Wire Identification:
  - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
  - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.
  - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606, for the following:
  - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

**3.8 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA/EIA-568.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  - 3. General Instructions.
    - a. The testing is to show beyond reasonable doubt that there are no errors, damaged or incorrectly installed components, that the installation is correctly labeled and that all the installed components meet or exceed the criteria detailed in these specifications and applicable standards. Any test that does not show that a component is satisfactorily installed, as per these specifications, shall be repeated. If a test procedure needs to be modified to satisfactorily test some components, the modification shall be submitted for approval of the Owner's Representative, prior to the tests being conducted.
    - b. Following optical fiber and data cable installation, including labeling and termination at both ends, undertake and record tests to ensure that the cabling system will perform satisfactorily in service. In addition to the tests detailed in this specification, the Installer shall carry out any additional tests that the Installer deems necessary to ensure the satisfactory operation of the telephone and data systems. The costs of these additional tests shall be borne by the Installer.
    - c. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to testing. Any testing performed on incomplete systems shall be redone on completion of the work.
    - d. Provide the Owners' Representative with the opportunity to witness all testing. On reasonable request, the installer shall demonstrate that the test procedure competently identifies the fault conditions being tested for.
    - e. Complete and record all of the tests identified in these specifications.
    - f. Notify the Owners' Representative ten working days before the date of commencement of the cable tests. Provide details in writing, on that advance date, of proposed tests, the test schedule, equipment to be used, its certification and calibration and the names and qualifications of test personnel.
    - g. The Owner and Owners Representative shall be invited, to the first instance of each type of test conducted. In the event of a number of tests being conducted by the Installer prior to this first inspection, the Owner's Representative reserves the right to reject these tests as non-compliant and to require them to be repeated at the Installer's cost.
    - h. Personnel shall be competent in and qualified by experience or training for comprehensive OTDR operation and troubleshooting, for both copper and optical fiber testing.

- i. Include the cost of obtaining, calibrating and maintaining test equipment and the cost of carrying out and recording the tests detailed in this specification, including labor costs, in the bid sum. Or extra costs will be entertained.
- j. Ensure that all test equipment is in calibration before delivery to site and throughout the testing period. The Installer shall be responsible for ensuring that any necessary tests and rework to maintain equipment's calibration status is carried out. Any tests performed on uncalibrated test equipment shall be repeated at the Installer's cost.
- k. The test documentation shall be available for inspection by the Owners' Representative during the installation period and copies shall be passed to the Owners' Representative within five working days of completion of tests on cables in each area. The Installer shall retain a copy to aid preparation of as-built information.
- l. Failures detected during the testing shall be noted on the test results schedule, rectified and re-tested. On the fault being rectified, this shall also be noted. These notes shall not be deleted or obliterated.
- m. Rectification of all damaged cables shall include replacing damaged cables with new cables in complete runs, replacing damaged connectors or remaking poor terminations. In-line cable joints, splices or distribution points will not be acceptable except where specified in this document. All damaged cables shall be removed from site.
- n. If on submittal of the As-Built documentation there are any missing test results or incorrectly named files, the test shall be repeated at the Installer's expense.

D. Optical Fiber Cabling

- 1. Test each Optical Fiber Cable and its associated connectors. Carry out the following tests on every element of every optical fiber cable:
  - a. Length
  - b. End-to-End Attenuation
  - c. Connector Loss
  - d. Splice Loss
  - e. Power Loss
- 2. The tester shall have the following parameters:
  - a. Optical Time Domain Reflectometer (OTDR) shall be used to test every optical fiber cabling
  - b. OTDR shall be used to test optical in both directions and take the average. Provide a launch lead and far end drop off lead.
  - c. Singlemode optical fibers shall be tested at 1310nm and 1550nm
- 3. Test each optical fiber cable element and its associated connectors. Carry out the following test on every element of every optical fiber cable:
  - a. Visually check optical connectors using microscope (minimal magnification x200) to ensure that or physical damage has occurred during the installation process. There are to be or scratches on the core of the fiber or pits on the core or cladding. If any defect cannot be rectified with polishing, the connector is to be replaced.
  - b. Carry out OTDR tests on all elements at 1310 nm for singlemode. These tests shall be carried out from both ends using a near end launch lead and a far end drop lead.
  - c. The number of samples (averages) for each OTDR test shall be such that the noise amplitude is significantly less than the smallest loss of any component under test. This may vary for different cable runs, for shorter runs and fusion splices etc.; it may be necessary to run many samples.
  - d. Record the length and loss of each mated connector pair on the test results schedule for all elements.
  - e. Verify the labeling of the cable and connectors is correct.
  - f. If a element has an excessive attenuation coefficient, a sudden step in attenuation coefficient (greater than 0.2 dB) or back scatter, losses due to micro bending or

- macro bending or has any other fault then the fault on that element shall be rectified.
- g. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted like Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
  - h. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
  - i. End-to-end cabling will be considered defective if it does not pass tests and inspections.
  - j. Prepare test and inspection reports.
  - k. The following table lists the pass/fail criteria for all connectors and fusion splices under test. Any component that does not pass these figures shall be re-worked or replaced.

Element Type	Maximum attenuation across mated connector pair (dB) – outward test	Maximum attenuation across mated connector pair (dB) – return test	Maximum Attenuation across fusion splice – averaged over both directions(dB)	Minimum Return Loss (dB) – outward test	Minimum Return Loss (dB) – return test
<b>MM</b>	<b>0.7</b>	<b>N/A</b>	<b>0.1</b>	<b>N/A</b>	<b>N/A</b>
<b>SM</b>	<b>0.5</b>	<b>0.5</b>	<b>0.1</b>	<b>36dB</b>	<b>36dB</b>

- l. The attenuation of each singlemode connector shall be measured in both directions.
- m. Each fusion splice shall be tested in both directions for singlemode elements. The measurements for each direction shall be averaged for the final attenuation figure for each fusion splice.
- n. The return loss must be measured in both directions for singlemode connectors. The return loss shall be greater or equal to the value shown in the table above.
- o. Any failures shall be recorded (including value of excessively lossy terminations) and the results obtained after rectification of the fault shall be recorded.
- p. Graphical printouts shall be taken of OTDR tests for each element. These printouts shall be stapled or otherwise attached to 11" x 8.5" size sheets. They shall be printed at an appropriate scale, such as 0.5 dB per division for the attenuation axis. Provide diskette copies of the OTDR traces to the owner on completion of the testing. Provide a copy of the emulation software and the appropriate license to the client.





**END OF SECTION 271300**

**SECTION 271500****COMMUNICATIONS HORIZONTAL CABLING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. UTP cabling.
  - 2. Singlemode optical fiber cabling.
  - 3. Multiuser telecommunications outlet assemblies. (MUTOA)
  - 4. Consolidation Points
  - 5. Cable connecting hardware, patch panels, and cross-connects.
  - 6. Telecommunications outlet/connectors.
  - 7. Cabling system identification products.
  - 8. Cable management system.

**1.3 DEFINITIONS**

- A. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- G. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- H. RCDD: Registered Communications Distribution Designer.
- I. UTP: Unshielded twisted pair.

**1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

**1.5 ACTION SUBMITTALS**

- A. Shop Drawings:
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  - 3. Cabling administration drawings and printouts.
  - 4. Wiring diagrams to show typical wiring schematics, including the following:
    - a. Cross-connects.
    - b. Patch panels.
  - 5. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.

**1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

**1.7 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- B. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On compact disk, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.

**1.8 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Patch-Panel Units: One of each type.
2. Connecting Blocks: One of each type.
3. Device Plates: One of each type.
4. Multiuser Telecommunications Outlet Assemblies: One of each type.

## 1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings, Cabling Administration Drawings, and field-testing program development by an RCDD.
  2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall always be present when Work of this Section is performed at Project site.
  3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
1. Test each pair of UTP cable for open and short circuits.
  2. Factory test Singlemode optical fiber cable.

## PART 2 - PRODUCTS

### 2.1 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in testing protocols.
1. TIA/EIA-568 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
  2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
  3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. The work area is approximately 100 sq. ft. (9.3 sq. m) and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

## 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568 when tested per test procedures of this standard.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Grounding: Comply with ANSI/TIA-607.

## 2.3 UTP CABLE

- A. Provide Category 6A UTP cable for Voice and Data use. Provide Cat 6A for wireless Access Points and surveillance cameras. Each cable shall have four pairs of unshielded twisted-pair solid copper conductors. The cable shall be plenum-rated (CMP). Each cable shall meet or exceed the performance specifications in this document when installed as part of the end-to-end cabling system described in this specification.
- B. The high-performance copper cabling system shall meet or exceed the performance specifications for a Category 6A system as detailed in ANSI/TIA 568. This covers all Category 6A components installed as a part of the installation.
- C. Contractor shall coordinate final color requirements with Owner prior to installation.
- D. Description: 100-ohm, four-pair UTP.
  - 1. Comply with ICEA S-90-661 for mechanical properties.
  - 2. Comply with TIA/EIA-568 for performance specifications.
  - 3. Comply with TIA/EIA-568, Category 6A.
  - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - a. Communications Plenum Rated: Type CMP or MPP, complying with NFPA 262.

## 2.4 UTP CABLE HARDWARE

- A. General Requirements for Cable Connecting Hardware: Comply with ANSI/TIA-568, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- B. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
  - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

- C. Provide 8P8C/ RJ-45 Connector type Patch Panels, or equal conforming to the following specification:
  - 1. Suitable for mounting in standard EIA 19" racks.
  - 2. Configured with 48 jacks housed in each 2U (3.5") of usable rack space.
  - 3. Provide strain relief for each cable terminated on the connector at the rear of the patch panel.
  - 4. Allow for labeling of each individual connector.
  - 5. Allow any individual cable to be terminated or otherwise handled without disturbing other cables.
  
- D. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
  - 1. Provide eight-position modular RJ45 TYPE jacks. Each connector shall meet or exceed the channel performance specifications in this document when installed as part of the end-to-end cabling system described in this specification. The pin outs for the jack shall conform to the T568B wiring scheme.
  - 2. Colors of work area connector colors shall be coordinated with Owner prior to installation.

## 2.5 OPTICAL FIBER CABLE

- A. Description: Singlemode, 8/125-micrometer, 2-fiber, nonconductive, tight buffer, optical fiber cable.
  - 1. Comply with ICEA S-83-596 for mechanical properties.
  - 2. Comply with TIA/EIA-568 for performance specifications.
  - 3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    - a. General Purpose, Nonconductive: Type OFN or OFNG.
    - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    - c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
    - d. General Purpose, Conductive: Type OFC or OFCG.
    - e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
    - f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.
  - 4. Conductive cable shall be steel armored type.
  
- B. Jacket:
  - 1. Jacket Color: Yellow for 8/125-micrometer cable.
  - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598
  - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

## 2.6 OPTICAL FIBER CABLE HARDWARE

- A. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
  - 1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

- B. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.
- C. Cable Connecting Hardware:
  - 1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications. Comply with ANSI/TIA-604-10.
  - 2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss is not more than 0.75 dB.
  - 3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

## 2.7 WORK AREA FACEPLATES

- A. Wall-mounted Faceplate. Provide wall-mounted flush modular faceplate to house work area jacks, capable of housing a minimum of four jacks. The faceplate shall fit over a standard NEMA electrical 2-gang outlet box fitted with a single gang plaster ring cover and shall be office white in color.
- B. Blanking Inserts. Provide blanking inserts, matching faceplates, in enough quantities to cover all unused openings in every faceplate.
- C. Stainless Steel Wallphone Faceplate. Provide stainless steel wall-mounted flush modular faceplate to house a single work area jack. The faceplate shall fit over a standard NEMA electrical 2-gang outlet box fitted with a single gang plaster ring cover. The faceplate shall be capable of having a wall-mounted telephone fitted directly over it.
- D. Furniture Faceplate. Provide flush-mounted modular faceplate to house work area jacks. The faceplate shall fit over a modular raceway.
- E. Stainless Steel Faceplate. Provide decorative stainless-steel faceplate covers for locations where decorative wall outlets are required. Provide stainless-steel covers wherever stainless-steel electrical receptacles are provided.
- F. Floorbox Faceplate. Provide an internal blank bracket to house combinations of work area connectors in a flush-mounted floorbox. The bracket shall be provided by the manufacturer of the flush floorbox and shall be designed to fit in the floorbox installed as a part of this project.

## 2.8 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with ANSI/TIA-607.

## 2.9 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606 and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Provide labels for connectors, cables, outlets, termination frames, patch panels, cabinets and racks.



- C. The lettering on each label shall be as large as is practicable. All labels shall be machine-produced. Hand-written labels will not be acceptable.
- D. A standard relative orientation shall be adopted for all labels unless otherwise specified.
- E. Labels shall be robust, durable, shall resist abrasion and shall be UV inhibiting, permanent and indelible. Labels shall be proof to 140 degrees Fahrenheit.
- F. All labels shall be readily visible and shall be fixed so that they remain in a visible position wherever practical.
- G. Labels shall carry the full complement of characters to designate the unique identification for the item that they identify.
- H. Outlet & Jack Labeling
  - 1. Outlet and patch panel labeling shall adhere to the following labeling convention
    - a. IDFX-PPY-ZZ (TR–Patch Panel - Port)  
Example: IDF4-PPC-29 (Closet 4, Patch Panel C, Port 29)
    - b. Closet number can be left off if only one closet per floor.
  - 2. Patch Panel Labeling
    - a. The labeling of cable shall remain the same as this number on the wiring closet end.
    - b. The labeling system shall be as follows:
    - c. IDFX-PPY-ZZ (TR–Patch Panel - Port)

## 2.10 SOURCE QUALITY CONTROL

- A. Factory test UTP cables per ANSI/TIA-568.
- B. Cable will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

### 3.2 WIRING METHODS

- A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters. Conceal pathways and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements in Section 270528 "Pathways for Communications Systems."
- B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.

### 3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with ANSI/TIA-568.
2. Comply with BICSI ITSIMM for "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. MUTOA shall not be used as a cross-connect point.
5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
  - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
  - b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.
6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices". Install lacing bars and distribution spools.
10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
12. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
13. Pulling Cable: Comply with BICSI ITSIMM, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with ANSI/TIA-568.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:

1. Comply with ANSI/TIA-568.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

## Open-Cable Installation:

3. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
4. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
5. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

## E. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.

## F. Group connecting hardware for cables into separate logical fields.

## G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569 for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

**3.4 FIRESTOPPING**

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

**3.5 GROUNDING**

- A. Install grounding per BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI/TIA-607.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground. Increase to 3AWG if over 100Ft.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

**3.6 IDENTIFICATION**

- A. Identify system components, wiring, and cabling complying with ANSI/ TIA -606.
  - 1. Administration Class: 2.
  - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606 for Class 2 level of administration.
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding

conductors. Follow convention of TIA/EIA-606. Furnish electronic record of all drawings, in software and format selected by Owner.

G. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
  - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of devices as shown.
  - b. Label each unit and field within distribution racks and frames.
4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
5. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in ANSI/TIA-606.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
1. Visually inspect UTP materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with ANSI/TIA-568.
  2. Visually confirm Category 6A, marking of outlets, cover plates, outlet/connectors, and patch panels.
  3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
    - a. Test instruments shall meet or exceed applicable requirements in ANSI/TIA-568. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified

in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. UTP Performance Tests:
  - a. Test for each outlet and MUTOA. Perform the following tests per ANSI/TIA-568:
    - 1) Wire map.
    - 2) Length (physical vs. electrical, and length requirements).
    - 3) Insertion loss.
    - 4) Near-end crosstalk (NEXT) loss.
    - 5) Power sum near-end crosstalk (PSNEXT) loss.
    - 6) Equal-level far-end crosstalk (ELFEXT).
    - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
    - 8) Return loss.
    - 9) Propagation delay.
    - 10) Delay skew.
6. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests per TIA/EIA-568.
7. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
  - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
  - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted like Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

**END OF SECTION 271500**

**SECTION 273124**  
**IP TELEPHONE SYSTEM**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 00 and Division 01 Specifications Sections, apply to this Section.

**1.2 SUMMARY**

- A. This section includes a VoIP Telephone solution . The handsets are to include necessary hardware, licenses, etc. Voice mail will be set up and programmed, licenses are to be provided for each phone.
- B. This section includes providing all the equipment specified within this section and installing all physical connections for the system to be fully operational and integrated with other systems specified within the building. Provide installation of the equipment per this specification. Provide all documentation required within this document and onsite technical assistance for, what has been provided, during the owner's implementation and integration to the system. All programming and configuration for the IP voice communication system shall be coordinated with the owner.
- C. Provide all analog connections within the building to each device needed as defined in the construction documents and specifications from the local service provider demarcation.
- D. Manufacturer support for Open System Standards: The manufacturer should be committed to supporting open system industry standards, such as H.323, 802.1p and 802.1q, MGCP, TAPI, JTAPI, etc.
- E. Voice Messaging: Scalable, cost-effective voice messaging solution that supports industry standards, such as AMIS-A, VPIM, LDAP and IMAP.
- F. Provide all additional devices, connections, and programming as needed for intercom devices and auxiliary annunciator as shown on drawings.
- G. The telephone system shall adhere to the following:
1. Keri's Law – requires direct dial 911 without using a code.
  2. Ray Baum's Act – requires the call origination location be identified

**1.3 SCOPE OF WORK**

- A. Provide all new phones and provide limited call availability via local POTS lines in the event of communications failure.
- B. Coordinate installation with Owner.
- C. The VoIP telephone system shall be inter-connected with the Central Sound System to provide paging, time tone and emergency tone activation from any telephone on the system with proper access code.
- D. UTP patch cables to connect telephone system patch panel/cabling in each wiring closet are furnished under the specification Section 27 15 13. This contract shall be responsible for installing and labeling all patch cables between patch panels to activate telephone handsets.

**1.4 SYSTEM DESCRIPTION**

- A. Contractor shall coordinate the installation of central office services. The campus system shall provide a single point of connection to incoming telephone services and the ability to share these incoming lines with each building.
- B. System shall provide analog trunk ports and access to the paging system. Provide hardware and wiring to interface with building paging system. Provide eight (8) interconnection ports in each building.
- C. Provide Power Failure Transfer (PFT) unit for 911 and emergency back-up including one (1) PFT emergency backup phone.
- D. Provide five (5) analog lines within the building. Coordinate exact location with Owner.

**1.5 QUALITY ASSURANCE**

- A. All equipment shall be UL listed.
- B. Compliance with the National Electric Code.
- C. Compliance with FCC rules.
- D. Comply with latest NENA E-911 requirements.
- E. The Contractor shall maintain a fully equipped, factory certified service organization capable of providing full maintenance and service of the installed system within 24 hours. This facility shall be available for inspection by the Engineer.
- F. The Contractor shall employ factory trained service personnel for the service and maintenance of the system.



- G. All materials furnished under this contract shall be new, of highest quality, and shall be of a regularly manufactured line, currently in production at the time of installation.

#### **1.6 CONTRACTOR QUALIFICATIONS**

- A. The handsets shall be furnished, installed and programmed by a contractor who meets all the requirements listed herein. It shall not be acceptable for the system contractor to utilize a subcontractor for any portion of the work, unless the subcontractor has been approved in writing by the Architect/Engineer based upon adherence to the qualifications listed herein.
- B. The Contractor shall maintain a fully equipped, factory certified service organization capable of providing full maintenance and service of the installed system within 24 hours. This facility shall be available for inspection by the Architect/Engineer.
- C. The Contractor shall employ factory trained service personnel for the service and maintenance of the system.
- D. The Contractor shall have had a minimum of one (1) year experience with the specified telephone system. This experience shall include having completed a minimum of two (2) installations in the past 12 months of similar size and scope. The Contractor shall provide references and contact information for the project sites in which the qualifying installations occurred.

#### **1.7 SHOP DRAWINGS**

- A. A complete list of materials with model and part numbers and references to the Part 2 specification paragraph numbers.
- B. Manufacturers Data Sheets of all products and cabling, specific to the project. Data sheets shall show the exact parts, with model numbers and options as required and clearly identified.
- C. Qualifications
  - 1. A statement of contractor's qualifications to verify compliance with other provisions within the specifications, unless the contractor has been pre-approved.
- D. Software data—The data package shall consist of manufacturer's data sheets of all system and application software being provided with sufficient information to verify that all specified features and functions are being addressed.

#### **1.8 PROJECT CONDITIONS**

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted below under the following conditions and then only after arranging temporary utility services according to requirements indicated:

- B. Notify Architect not less than two days in advance of proposed utility interruptions.
- C. Do not proceed with utility interruptions without Architect's written permission.

### **1.9 COORDINATION**

- A. Coordinate Work of this Section with the owner, owner's integrator, owner's ITC-site, CM and Architect.
- B. Meet jointly with representatives of above organizations and Owner's representatives to exchange information and agree on details of equipment arrangements and installation interfaces.
- C. Record agreements reached in meetings and distribute record to other participants.
- D. Adjust arrangements and locations of distribution frames, patch panels, and cross connects in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of all related equipment.
- E. Confirm a schedule time frame that all equipment will be installed, all documentation will be delivered that is needed for the implementation, and service provider requirements and installation time frame.
- F. Coordinate telephone system with requirements of local telephone exchange carrier. The telephone service shall be a 10Mbit fiber connection through the A-site local router then to the router specified within, and analog lines for the router for remote survivability. Connect all analog lines assigned by owner to router. Remaining lines will connect to auxiliary devices as indicated by the owner.
- G. Coordinate with all other trades and provide connection interfaces as applicable.
- H. Coordinate all power and load requirements with UPS requirements so that all UPS equipment is properly sized for submittals.

### **1.10 WORK BY THE LOCAL TELEPHONE COMPANY**

- A. The local telephone company shall provide the main entrance from their telephone grid outside through the building to the telephone room as shown on the Drawings.
- B. This Contractor must coordinate all requirements with the local serving utilities.

### **1.11 CHARGES AND REQUIREMENTS BY THE LOCAL TELEPHONE COMPANY**

- A. The Technology/Telephone System Contractor shall install the telephone enclosure, conduits, cable and trench complete as directed or as required by the local telephone company. Additionally, the contractor shall initiate the calls for the owner as they engage the local Telco to adapt and/or upgrade their telephone service.

**1.12 SYSTEM WARRANTY**

- A. Provide three (3) year warranty of the IP telephones against defects in material and workmanship. If any defects are found within the warranty period, the defective equipment shall be replaced at no extra cost to the Owner for parts or labor.
- B. The telephone vendor shall be responsible to provide service during normal working hours within (8) hours after notification by the Owner for normal service or within (2) hours for emergency service. Emergency service is defined as the loss of 25% or more of outside line capacity, the loss of 25% or more of telephone stations, or the loss of the main console.
- C. If equipment cannot be repaired within 24 hours of service visit. Contractor shall provide "loaner" equipment to the Owner at no charge.

**PART 2 - PRODUCTS****2.1 GENERAL**

- A. This specification is intended to establish a carefully planned minimum level of quality and performance for all components, and will be rigorously enforced by the Owner. Acceptable manufacturers of components described herein are:
  - 1. Ericsson-LG iPECS UCP
  - 2. NEC
  - 3. Mitel

**2.2 IP TELEPHONES**

- A. This specification is intended to establish a carefully planned minimum level of quality and performance for all components and will be rigorously enforced by Owner.
- B. General Requirements
  - 1. The telephone sets shall be multifunction fully digital sets with full duplex speakers.
  - 2. All telephones shall receive Power-Over-Ethernet from powered switches. All telephone sets shall be IEEE 802.3af compliant. Power supplies at the handsets are not acceptable.
  - 3. All telephone sets shall be the latest model available.
  - 4. Provide all required licenses for all telephones.
  - 5. System shall be provided with all equipment to support connections to equipment such as distance learning, video conferencing equipment, digital fax, etc.
  - 6. As a minimum, the system telephone sets shall support the following features:
  - 7. Access Codes (for restricting long distance or local calling)
  - 8. All call, zone call, and room call Voice Page with integration to PA system.

9. Automatic Dialing Buttons
10. Automatic Hold/Park Recall
11. Automatic Location Identifier
12. Automatic Number Identification Support
13. Automatic Off-Hook Line Selection
14. Background Music (while on hold)
15. Call Accounting
16. Call Conferencing
17. Call Forwarding on busy
18. Call Hold.
19. Call Transfer
20. Direct Inward Dialing
21. Do Not Disturb
22. Flash Button
23. Handsfree full duplex speakerphone
24. Hearing Aid Compatible
25. Malicious Call Trace/Hold
26. Message Waiting Light
27. Modular Handset and Line Cord
28. On-Hook Dialing
29. Programmable panic button
30. Repeat Last Number Dialed
31. Ringing Line Preference
32. Saved Number Redial
33. Station Speed Dial (50 Numbers Per Station)
34. User Programmable Feature Buttons
35. Volume Control

### **2.3 ATTENDANT CONSOLE TERMINAL—PROVIDE TWO (2) IN THE MAIN OFFICE AREA**

- A. LIP-9030 Ericsson-LG iPECS with LIP-9048DSS side car.
- B. IP multi-lined keyset
- C. Minimum of 32 Character LCD Display.
- D. Display day, date and time.
- E. Display call durations.
- F. Display caller name and extension/telephone number and incoming caller-ID information.
- G. Hands free, Full-Duplex, Speakerphone.
- H. Pre-programmed E-911 button that automatically puts the phone into a hands-free mode and initiates a 3-way conference call with the Emergency Attendant Console, records

and sends email alerts as well as provide overhead page alerts while contacting the local 911 center.

- I. Shall have a system display panel capable of showing all system extension numbers and their status and capable of extending calls via single touch operation.
- J. Provide a button and LED in attendant console for each telephone in the building. This will show which phones are in use in the system and will allow "one button" connection to all extensions. A separate console must be provided for each building.
- K. Provide any additional licenses required.
- L. Provide each set with a 12' connector cord to interface with the specified voice jacks.
- M. Provide Unit Price

#### 2.4 EXECUTIVE DISPLAY DIGITAL VOICE TERMINAL—(MAIN OFFICE AREAS)

- A. Ericsson-LG iPECS LIP-1020i
- B. Provide executive phone for all administrative areas, conference rooms, small group rooms, and offices.
- C. At least sixteen characters display window.
- D. At least **sixteen** user programmable keys.
- E. Hands free, Full-Duplex, Speakerphone.
- F. Display caller name and extension/telephone number.
- G. Message Waiting Lamp.
- A. Pre-programmed E-911 button that automatically puts the phone into a hands-free mode and initiates a 3-way conference call with the Emergency Attendant Console, records and sends email alerts as well as provide overhead page alerts while contacting the local 911 center.
- B. Provide any additional licenses required.
- C. Provide Unit Price
- D. Provide six (6) additional phones and licenses

**2.5 STANDARD DISPLAY DIGITAL VOICE TERMINAL (SPORTING & KITCHEN OFFICES)**

- A. Ericsson-LG iPECS LIP-9008 (10/100) or LIP-9008G Gigabit
- B. Provide one standard 8 button phone for all classrooms, labs, and other areas not covered above in section 2.3.
- C. At least sixteen characters display window.
- D. At least eight (8) programmable keys.
- E. Hands free, Full-Duplex, Speakerphone.
- F. Display caller name and extension/telephone number.
- G. Message Waiting Lamp.
- H. Pre-programmed E-911 button that automatically puts the phone into a hands-free mode and initiates a 3-way conference call with the Emergency Attendant Console, records and sends email alerts as well as provide overhead page alerts while contacting the local 911 center.
- I. Provide any additional licenses required.
- J. Provide Unit Price
- K. Provide six (6) additional phones and licenses

**2.6 STANDARD DIGITAL WIRELESS PHONE (ALL MEP AND NON-OFFICE AREAS)**

- A. Ericsson-LG iPECS LG Smart Phone with UCS Mobile Client on Android Mobile Device.
- B. Provide voicemail
- C. Provide initiate call
- D. Provide Conference capabilities
- E. Provide Transfer capabilities
- F. Provide Mute capabilities
- G. Provide Forwarding capabilities
- H. 2-Line alphanumeric display
  - 1. Icons
  - 2. Function keys
  - 3. Status indicators
  - 4. Speed dial options

- I. Provide any additional license required.
- J. Provide 6 wireless sets and licenses to be placed where owner determines.
- K. Provide Unit Price

## **2.7 Analog Telephone Adapter**

- A. UCP-SLTM4
- B. 4-port analog telephone adaptor to turn analog phones into IP phones.
- C. Power supply
- D. Provide a minimum of one.

## **2.8 LIGHTNING PROTECTION**

- A. Provide UL listed combination primary/secondary protector between the Telco. DMARC primary protector and the telephone switch CO port connections. Protector shall provide solid state surge protection and PTC self-resetting sneak current protection. Coordinate proper surge voltage rating for incoming lines with telephone company prior to application.

- 2.9 Base bid includes 5% spare Digital telephones and one spare digital Executive telephone. Spare devices shall be turned over to Owner at time of final acceptance.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. FCC registration number and certificate shall be provided.
- B. Install systems in accordance with NEC 760 and other applicable codes. Install system to comply with drawings and final shop drawings in compliance with manufacturer instructions. Provide all required hardware and labor for rack mounting of head-end system components.
- C. Coordinate complete system installation, and Technology Head End Integration with Owner and other Technology Trades.
- D. Coordinate installation and interconnect with local and long-distance Service
- E. Provider (SP). Contractor shall be responsible for all final cross connects and system Data Base loading and verification.

- F. Contractor shall connect to, and interface with the in-house paging system and provide paging from any telephone handset.
- G. Connect system to IP Data Network and program required VLANs and 803.11e support.
- H. Interconnect with existing systems via VoIP trunking.
- I. Integrate system with Owner's Numbering Plan.

### **3.2 NETWORKING LICENSE**

- A. Provide all necessary IP networking licenses as required to provide a complete working solution for all network devices.
- B. Provide a network licenses for spare equipment and all identified attic stock.

### **3.3 GROUNDING**

- A. Ground cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Bond all rack mounted equipment to the Common Grounding Network within the equipment rack or cabinet using an equipment bonding jumper kit. The cabinet/rack grounding busbar shall be bonded to the electronic equipment bonding pad using a minimum #6 AWG insulated copper bonding conductor with a green jacket and yellow horizontal stripe using compression style lugs. Using the manufacture supplied grounding lug when available, attach one end of the binding jumper to the equipment bonding pad. Attach the remaining end to the equipment grounding busbar in the equipment rack/cabinet. If an equipment bonding pad is not available, follow the equipment manufacturer's recommendations for bonding the equipment chassis. Provide bonding conductor length as required to reach the grounding busbar.

### **3.4 SYSTEM PROGRAMMING**

- A. Contractor shall provide the Owner/architect with a complete set of forms for the
- B. entire system and extension feature for final programming.
- C. Final programming of the system shall be co-developed between the Owner/architect and the contractor and must be approved prior to being implemented for system start-up.
- D. Contractor shall supply the "latest" software updates as part of the system
- E. configuration for two (2) years after system acceptance.



**3.5 IMPLEMENTATION**

- A. Provide on-site technical assistance that is capable of all installation criteria within this specification for the scheduled implementation by the owner and the owner's owner representative. Assist with any identification of system components and connections as needed. On-site assistance is to assure there are no issues with the scope of this specification during the implementation.
- B. The implementation will include final system configuration by the owner's representative, and testing with owner of all call routing, user functions from each handset device, remote survivability testing, paging, and all other analog and telephone adapter devices.
- C. The owner's representative will perform the following:
  - 1. Review topologies and bill of materials.
  - 2. Configure the following:
    - a. Network switches
    - b. UCP gateways
    - c. UCP call Manager
    - d. Telephone sets
    - e. Develop dial plan.
    - f. Final testing of all network devices.
    - g. Phone feature deployment.
    - h. End-user Training.

**3.6 FIELD QUALITY CONTROL**

- A. Testing agency to perform the following field quality-control testing:
- B. A factory trained/certified technician shall test connectivity and operation of instruments at the completion of the installation of the telephone equipment and shall provide the Owner and Architect/Engineer a checklist test report showing that the system is fully operational.
- C. Notify the Owner and Construction Manager/Engineer at least 72 hours prior to start of the test.
- D. All deficiencies discovered in cabling, wiring, etc. provided by other trades, shall be reported to the Owner and Architect/Engineer for correction by the trade providing the work.
- E. All deficiencies discovered with equipment provide within this specification shall be replaced, such as equipment dead on arrival or failing during burn in time.

**3.7 IDENTIFICATION/LABELING**

- A. Contractor shall identify all major items of equipment and tag all cables with permanent type markers to denote equipment served. Cables shall be tagged at both ends and at each point where the cable is administered.

- B. The Contractor shall be responsible for generating and programming the labeling for camera information within the recorder software.
- C. All labeling and recording shall be approved by the Owner and the Engineer prior to application.

### **3.8 TELEPHONE SERVICE**

- A. Provide all labor and material required to make all final connections to the telephone service provider(s) Demarcation location and equipment. Coordinate with Owner selected telephone service provider(s).

### **3.9 TRAINING**

- A. Contractor shall provide a minimum of sixty (60) hours of system user training. Sixteen (16) hours of attendant console training and forty hours (40) of system programming and administration training to the Owner. Training shall be provided to all staff and shall be scheduled in advance with the Owner.
- B. Provide all training and utilize specified manuals and record documentation. Training shall be provided to all staff at the project site and coordinated with the Owner.
- C. Training shall utilize the equipment provided at the project site. Coordinate use, time and availability of equipment with the Owner.
- D. Demonstrate adjustment, operation and maintenance of the system including each component and control.
- E. All training shall be recorded and stored in digital content for the Owner's future use. Contractor is responsible for providing required video recording and digital encoding equipment.

### **3.10 PROJECT RECORD DOCUMENTS**

- A. Submit in accordance with Section 27 05 00 for the complete system. Record drawings shall include and indicate all components of the installed systems, including the routing of conduit, raceways and cable.
- B. Drawings shall be coordinated and referenced to the O&M manuals and related wiring diagrams. Floor plan drawings shall be 0.125"-1' AutoCad drawings to provide for clear, legible documents. Provide the Owner a digital copy containing all final AutoCad drawing files of the entire system and the floor plans.
- C. Component Operation Manual including technical data sheets
  - 1. Control Settings
  - 2. Amplifier load

- D. Information for reordering replacement parts
  - 1. Provide a replacement parts list
  - 2. Provide a list of recommended parts, tools, and instruments for testing maintenance purposes.
  
- E. Wiring Diagrams/details
  - 1. System functional block diagrams
  - 2. System schematic diagrams
  - 3. System wiring list
  - 4. Identify terminals to facilitate installation, operating and maintenance
  
- F. System Operating Instructions: Provide a clear and concise description of operation which gives, in detail, the information required to properly operate the equipment and system.
  
- G. Component Service Manual: Include information for testing, repair, troubleshooting, assembly, disassembly, and required/recommended maintenance intervals.

END OF SECTION 273123

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 27 32 44 - EMERGENCY RESPONDER RADIO COVERAGE TESTING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The General Conditions, Special Conditions, Instruction to Bidders and all applicable portions of Division 1 – GENERAL are part of this Section as if written in full herein. Contractor is held to have familiarized himself with these provisions contained herein.

**1.2 DESCRIPTION OF WORK**

- A. Provide radio frequency testing for emergency responder radio coverage throughout the building for all first responder radio frequencies in use by the Authority Having Jurisdiction.

**1.3 QUALITY ASSURANCE**

- A. Codes and Regulations
1. Georgia Fire Code
  2. IFC Section 510
  3. IFC Section 510.5.3 Acceptance Test Procedure
  4. NFPA 1NFPA 72 – Chapter 24
  5. TIA TSB-88.1-D – Wireless Communications Systems Performance in Noise and Interference - Limited Situations Part 1: Recommended Methods for Technology - Independent Performance Modeling
- B. Qualifications
1. A valid FCC issued general radio operators license and certification of in-building system training issued by a nationally recognized organization, school or a certificate issued by the manufacturer of the equipment being installed; or
  2. A professional engineer license or certification (i.e., P.E. or RCDD).
  3. OEM Certification
- C. Definitions
1. AHJ – Authority Having Jurisdiction
  2. RF – Radio Frequency
  3. DAQ – Delivered Audio Quality

**PART 2 – PRODUCTS**

- A. Test Equipment
1. Anritsu Spectrum Analyzer

**PART 3 - EXECUTION**

### 3.1 SUBMITTALS

- A. Contractor shall submit the following:
  - 1. Copies of Contractor certifications as required in section 1.03-B.
  - 2. A list of the frequencies to be tested.
  - 3. Cut sheets of the instruments used for testing. Instruments shall be approved by the Owner or Engineer.
  - 4. Contact information of the AHJ official.

### 3.2 TESTING

- A. Before testing, the Contractor shall verify and/or coordinate the following with the AHJ:
  - 1. All frequencies are used by the first responder radio system.
  - 2. Utilization of repeaters or boosters in the radio system, and if so, where they are located.
  - 3. AHJ representation during the test. If representation is required, any costs involved shall be included in the Bid.
- B. The radio frequencies used by the AHJ shall be tested to ensure two-way coverage on each floor of the building to ensure the following:
  - 1. Measurements in 95 percent of all areas on each floor of the building meet the following signal strengths:
    - a. Minimum signal strength into the building shall be sufficient to provide coverage not less than DAQ 3.4.
    - b. Minimum signal strength out of the building shall be sufficient to provide not less than DAQ 3.4
- C. The following testing procedure shall be followed:
  - 1. RF Signal Strength Test
    - a. The test shall be conducted using a calibrated portable radio of the latest brand and model used by the public agency in question, talking through the agency's radio communication system.
    - b. Contractor shall verify with public agency officials on which frequencies are to be tested.
    - c. If the presence of public agency officials is required to be present for the test, it shall be at no expense to said agency.
    - d. Each floor of the building shall be divided into a minimum of twenty (20) approximately equal test areas.
    - e. A spot located approximately in the center of each test area shall be selected for the test, then the radio will be keyed to verify two-way communications to and from the outside of the building through the public agency's radio communication system. Once the test spot has been selected, that spot shall represent the entire test area and failure in the selected spot shall be considered failure of that test area. Prospecting for a better spot within the test area is not permitted.
    - f. Measurements shall be made with the antenna held in a vertical position

- at three (3) to four (4) feet above the floor to simulate portable radios worn on the belt or turnout coat pocket.
- g. A maximum of one (1) or (5 percent) of nonadjacent test areas shall be allowed to fail the test per floor.
- h. In the event that three or more (or >5 percent) test areas fail the 20-area test, in order to be more statistically accurate, the floor shall be divided into forty (40) equal test areas. In such an event, a maximum of two (2) or (5 percent) nonadjacent areas will be allowed to fail the test per floor. If the system fails the 40-area test, the system shall be altered to meet the 95 percent coverage requirement per floor.
- i. The gain values of all amplifiers shall be measured, and the test measurement results shall be kept on file with the building Owner so that the measurements can be verified during annual tests.
- j. As part of the installation, a spectrum analyzer or other suitable test equipment shall be utilized to ensure spurious oscillations are not being generated by the subject signal boosters.

## 2. Signal Quality Test

- a. For quality purposes, DAQ readings shall be taken at the same time as the above RF signal strength measurements. The DAQ scale is as follows:
  - 1) DAQ 1: Unusable. Speech present but not understandable.
  - 2) DAQ 2: Speech understandable with considerable effort. Requires frequent repetition due to noise or distortion.
  - 3) DAQ 3: Speech understandable with slight effort. Requires occasional repetition due to noise or distortion.
  - 4) DAQ 3.4: Speech understandable without repetition. Some noise or distortion present.
  - 5) DAQ 4: Speech easily understandable; little noise or distortion.
  - 6) DAQ 4.5: Speech easily understandable; rare noise or distortion.
  - 7) DAQ 5: Perfect; no distortion or noise discernible

### 3.3 DOCUMENTATION

- A. Upon completion of the testing, the Contractor shall provide test results for approval by the Owner or Engineer. The test results shall be in the form of building floor plans with each floor overlaid with the test grid used in the testing procedures above. Each grid on the drawings shall show the test results measured for uplink signal, downlink signal and DAQ measurement for that grid square.
- B. Test results shall indicate weather conditions at the time of the testing (i.e., temperature, humidity, fog, rain, snow, etc.).
- C. Small scale drawings (11" x 17" maximum) of these same test results shall also be included in the O&M documentation.

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 273523****EMERGENCY RESPONDER RADIO COVERAGE****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 01 Specification Sections, and other applicable Specification Sections, the Related Sections listed below, apply to this Section.
- B. Related Sections:
  - 1. Section 260513 - Medium, Low & Control Voltage Cables.
  - 2. Section 260526 - Grounding and Bonding for Electrical.
  - 3. Section 270526 - Grounding and Bonding for Communications Systems
  - 4. Section 270528 - Pathways for Communications Systems
  - 5. Section 273524 – Cellular Signal Reinforcement DAS

**1.2 SUMMARY**

- A. Scope of Work:
  - 1. The work under this section includes all final design, material, equipment, supplies, labor, testing, and accessories required to furnish and install a complete Emergency Responder Radio Coverage system (ERRC) as indicated on the drawings and as specified herein. These systems shall be defined as all cables, equipment, products, and etcetera, as indicated on the drawings and mentioned in these specifications.
  - 2. **It is the intent of the Drawings and Specifications, which are presented in a "design-build" format, for the Contractor to design, provide and install a complete, fully operational, and tested system.**
  - 3. All miscellaneous system components including, but not limited to, cables, cable supports, termination equipment, punch blocks, patch panels, patch cords, device outlets, ladder runway, backboards, equipment racks, equipment cabinets, enclosures, terminal cabinets, equipment grounding, and any other related items shall be furnished and installed complete under this section, such that the system shall perform all functions listed herein in compliance with all of the specified requirements.
  - 4. Schedule is paramount to the project's success. With this, the Contractor will have to be a team player, continually working with the team to facilitate expeditious design, procurement, and construction processes.
  - 5. This project will be performed in a phased construction format. Each phase of construction will be completely installed, labeled, and tested, to the greatest extent physically possible, before moving to the next phase.
    - 1. Enables 700Mhz, analog and digital Public Safety 2-way communication support within each building.
- B. Project Description
  - 1. We are seeking out more cost-efficient methods of delivering all services in various campus buildings.

2. This Section includes the requirements for an Emergency Responder Radio System for the purposes of amplifying Emergency Responder radio signals to achieve minimum signal strength in 95% of all areas on each floor of the building.
3. Final acceptance and approval are required from the local Fire Department in writing prior to contract closeout.
4. Outline:
  - a. The Contractor shall develop all ERRC Design Documentation in accordance with this document.
  - b. To support the deployments planned for construction, the Contractor shall provide survey and design services for each indoor building as identified. Services shall include:
    - 1) Pre –Installation: (Design Services)
    - 2) Secure approval and schedule from the Owner to conduct an on-site walk survey per approved plan.
    - 3) Plan and conduct on-site, building-wide, location-specific measurements of existing macro-cell signal and noise levels for wireless service providers (WSPs). Survey can be conducted during normal business hours.
    - 4) Using data collected, prepare an ERRC report that:
      - a) Defines areas in which reinforcement will be required, to meet signal level requirements and that will not cause issues to the Owner or the AHJ.
      - b) Recommended antenna placement, including a signal heat map, to reinforce first responder radios with the exterior of the building. iBwave native files shall include collected and normalized survey data, design files, and the building/signal model. Native iBwave files shall be provided to the Owner.
      - c) Identifies preliminary antenna placement, including a signal heat map, based on a predictive analysis done in iBwave.
  - 5) Submit initial draft of report for the Owner to review, provide written response to Owner review comments, and update report to incorporate Owner comments
  - 6) System Coverage Drawings:
    - a) XXX - TBD
  - 7) Additional Requirements:
    - a) Supplier shall provide all items, instrumentation, materials, equipment, vehicles, and personnel to conduct the survey and inspections.
    - b) Supplier shall comply with all applicable federal, state, and local codes, regulations, and ordinances, including, but not limited to, OSHA regulations.
  - 8) Revit Documentation
    - a) Once the iBwave design is completed, some venues will require conversion of the iBwave to AutoCAD shop level drawings for university review/approval and installation cost estimation efforts. If requested, the Contractor shall be responsible for:
      - b) Converting the iBwave design to Revit.
      - c) Providing detail in Revit of cable routes, mounting details, and related items such that sufficient information is available for the Owner to bid for system installation.

### 1.3 DEFINITIONS

- A. Bi-Directional Amplifier BDA: Device used to amplify band-selective or multi-band RF signals in the uplink, to the base station for enhanced signals and improved coverage.
- B. Emergency Responder Radio Coverage System: A two-way radio communication system installed to assure the effective operation of radio communications systems for fire, emergency medical services or law enforcement agencies within a building or structure. A system used by firefighters, police, and other emergency services personnel.
- C. Delivered Audio Quality Definitions (DAQ): This is a universal standard often cited in system designs and specifications.
  - 1. DAQ 1: Unusable, speech present but unreadable.
  - 2. DAQ 2: Understandable with considerable effort. Frequent repetition due to noise/distortion.
  - 3. DAQ 3: Speech understandable with slight effort. Occasional repetition required due to noise/distortion.
  - 4. DAQ 3.5: Speech understandable with repetition only rarely required. Some noise/distortion
  - 5. DAQ 4: Speech easily understood. Occasional noise/distortion.
  - 6. DAQ 4.5: Speech easily understood. Infrequent noise/distortion.
  - 7. DAQ 5: Speech easily understood. Coupled Bonding Conductor (CBC) – The term "Coupled Bonding Conductor" shall mean a bonding conductor placed, e.g., strapped, on the outside of any technology cable, used to suppress transient noise.
- D. FCC: Federal Communications Commission
- E. OET 65 Standards: FCC's Bulletin 65 provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
- F. Public Safety/First Responder: Public Safety or First Responder agencies which are charged with the responsibility of responding to emergency situations. These include, but are not limited to law enforcement departments, fire departments, and emergency medical companies.

### 1.4 QUALITY ASSURANCE

- A. Codes, regulations, and standards referenced in the Section are:
  - 1. NFPA 1 – The National Fire Code
  - 2. NFPA 70 – The National Electrical Code
  - 3. NFPA 101, Life Safety Code, the California Basic Building Code, and Local Code and Building Authority requirements.
  - 4. NFPA 72-07 National Fire Alarm Code
  - 5. NFPA 1221
  - 6. FCC 47 CFR Private Land Mobile Radio
  - 7. 90.219-2007 Services-Use of Signal Boosters
  - 8. IFC Section 510
  - 9. ICC International Fire Code, Code and Commentary
  - 10. Alabama Fire Code
  - 11. ADA "Americans with Disabilities Act"
  - 12. FCC's OET 65 Standards "Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields".
  - 13. FCC Rules Part 22, Part 90, and Part 101.

- B. Qualifications: Contractor shall have minimum of 3 years' full-time experience executing work of similar scope and complexity.
- C. Certifications:
  1. Contractor shall provide manufacturer certification that their personnel have been trained on components being installed.
  2. Manufacture(s) of active components shall maintain a formal authorized and certified value-added reseller program, which consists of routine quality audits of participating value-added resellers. List of authorized value-added resellers shall be published.
  3. Contractor shall be an authorized and certified value-added reseller for proposed active components.
  4. Contractor shall provide certification that their personnel have been trained in RF design and analysis software
- D. The design shall utilize radio interface modules to filter and combine frequencies and optical modules to convert RF to an optical format (and vice-versa). The optical signal shall then be routed via single-mode fiber to remote modules located throughout each building, usually installed in communication/telco/telecom closets. Where possible, a passive infrastructure solution is preferred in the cable/antenna system.

## 1.5 WARRANTY

- A. Warranty period of service shall include all parts, labor, travel, and trip charges.
- B. Manufacturer Warranty:
  1. Passive devices (splitters, couplers, and antennas): minimum 1-year limited warranty from date of system acceptance.
  2. Cable and Connectors: 20-year limited warranty from date of system acceptance.
  3. Warranty shall include 1 year of customer service from date of acceptance.
- C. Contractor Warranty:
  1. Contractor shall warranty system performance, as approved, for 1 year.
  2. Warranty shall include first annual system test and maintenance.
  3. Response time shall be on-site within 48 hours of notification.
- D. Provide a complete warranty for parts and labor for a minimum of one year from the date of Substantial Completion. Provide add alternate for 5-year warranty.

## PART 2 - PRODUCTS

### 2.1 GENERAL PERFORMANCE REQUIREMENTS

- A. Compatibility: The equipment, including but not limited to repeaters, transmitters, receivers, signal boosters, cabling, fiber distributed antenna system, etc., shall not interfere with the existing communication systems utilized by the Public Safety and First Responder agencies.
- B. Power Supplies: At least two (2) independent and reliable power supplies shall be provided, one primary and one secondary. The primary power source shall be supplied from a dedicated 20 ampere branch circuit and comply with 4.4.1.4 of NFPA 72. The secondary power source shall

be a dedicated battery, capable of operating the in-building radio system for at least 12 hours of 100% system operation. The battery system shall automatically charge in the presence of external power input. The battery system shall be contained in one NEMA 4 or 4X type enclosure. Monitoring the integrity of power supplies shall be in accordance with 4.4.7.3 of NFPA 72.

C. Manufacturers

1. System
  - a. Comba (Basis of Design)
  - b. CommScope/Andrew
  - c. Corning
  - d. Times Microwave
  - e. Tessco
  - f. CCI (Communication Components Inc.)
  - g. Solid Technologies
  - h. Owner approved equal
2. Cable:
  - a. Material Characteristics:
    - 1) Jacket: Halogenated, Fire-Retardant
    - 2) Mechanical Characteristics:
    - 3) Maximum Diameter Over Jacket:  $\leq 0.627$  in
    - 4) Minimum Bending Radius: 5 in
    - 5) One Time Minimum Bending Radius: 2 in
3. Other Characteristics:
  - a. When installed outdoors, cable shall be outdoor installation rated.
  - b. When installed in a plenum, cable shall be plenum rated.
4. RF Amplification, Filtering, and Distribution Equipment Shall have FCC Certification.
5. Shall be wall or rack mounted.
6. Active equipment shall be of modular design and allow for digital filtering.
7. Operating Temperature Range:  $-10^{\circ}\text{F}$  to  $+120^{\circ}\text{F}$ , 85% humidity.
8. Shall include monitoring, diagnostics, and notification for degraded operation or system failure.
9. Power: 120 VAC, 60 Hz.

D. Survivability

1. Physical Protection: All wiring and fiber optics shall be installed in conduit. Refer to electrical specifications "Conduit and Fittings" for type, sizing, and installation standards.
2. Fire Performance: All main risers or trunks of the antenna system shall be installed with resistance to attack from a fire using one of the following methods:
  - a. A 2-hour fire rated cable or cable system.
  - b. Routing the cable through a 2-hour fire rated enclosure(s) or shaft(s).
  - c. A system configured in a looped design, routed through 1-hour fire rated enclosure(s) or shaft(s). The circuit shall be capable of transmitting and receiving a signal during a single open or non-simultaneous single ground fault on a circuit conductor.
  - d. Performance alternative approved by the authority having jurisdiction.

3. Cabinet: The signal booster and all associated RF filters shall be housed in a single, NEMA 4 certified, painted steel weather tight box. The cabinet shall be large enough to dissipate internal heat without venting the inside of the cabinet to the outside atmosphere. Operating temperatures: -22 degrees F to +120 degrees F (-30 degrees C to +50 degrees C) minimum temperature range, including microprocessors. Equipment installed on the roof of structures shall be rated for the expected extreme temperatures associated with rooftop installations.
4. Passive Equipment: Passband shall be 700-900 MHz, IP rating of 2 GHz.
5. Cable: Passband shall be 700-900 MHz Cable shall be rated for fire plenum and riser rating.
6. Constructed of plenum rated components when installed in a plenum.
7. WHITE, ultraviolet light resistant.
8. Capable of operation from -20°F to +140°F at 100% humidity.

## 2.2 SYSTEM COMPONENTS

### A. Signal Strength

1. Downlink: A minimum signal strength of -95 dBm shall be provided throughout the coverage area.
2. Uplink: Minimum signal strength of -95 dBm received at the local Fire Department Radio System from the coverage area.
3. A donor antenna must maintain isolation from the distributed antenna system. The donor antenna signal level shall be a minimum of 15 dB above the distributed antenna system under all operating conditions.

### B. Permissible Systems

1. Buildings and structures shall be equipped with an FCC Certificated Class B Bi-Directional UHF Amplifier(s) as needed.
2. The distributed antenna system may utilize a radiating cable, fixed antennas, or a combination of both.

### C. Supported Frequencies: The radio system shall support frequencies in the 700 and 800 MHz public safety bands as utilized by the local Fire Department.

### D. Reject Filters: Notch filter sections shall be incorporated to minimize adjacent channel cellular and SMR (Nextel) degradation of the signal booster performance. The minimum downlink band adjacent band rejection shall be 35 dB or greater at 865 MHz and 870 MHz.

### E. Band Migration Capability: The signal booster shall include re-tunable or replaceable filters to accommodate rapid and economic passband changes in the event of mandatory FCC changes within the NPSPAC band. The use of non-adjustable and non-replaceable RF input and output filters is prohibited.

### F. Output Level Control: An automatic output leveling circuit shall be included for both passbands with a minimum dynamic range of 60 dB, less any gain reduction setting, to maintain FCC out of band and spurious emission compliance.

### G. Degraded Performance in Emergencies: The system shall be designed to allow degraded performance in adverse conditions, such as abnormally high temperatures resulting from nearby fires, extreme voltage fluctuations or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e., under/over

voltage, over/under current, over/under temperature, etc.) will not be implemented as the standard mode for public safety applications.

- H. Mode of Operation: The system shall be normally powered on and shall continuously provide passing of frequencies within the Public Safety and First Responder bands.
- I. All in-building radio systems shall be compatible with both analog and digital communications simultaneously at the time of installation.

### **2.3 SYSTEM MONITORING**

- A. The distributed antenna system shall include a connection to the fire alarm system to monitor the integrity of the circuit of the signal booster(s) and power supplies and annunciate this malfunction on the fire alarm system shall comply with 4.4.7.1 of NFPA 72.
- B. A sign shall be located at the fire alarm panel with the name and telephone number of the local Fire Department indicating that they shall be notified of any failures that extend past the 2-hour time limit

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Contractor shall design, install, commission, and test system, in accordance with all manufacturer's instructions and recommendations.
- B. Contractor shall supply all personnel and equipment necessary for testing.

### **3.2 SURVEY**

- A. Confirm coordination of equipment locations shown on drawings for space, power, and pathway.
- B. Confirm suitability of provided power and telecommunications grounding system. Note issues to Owner before beginning installation.
- C. Review antenna styles and mounting locations with Owner and A/E for aesthetic concerns and approval.
- D. After complete façade installation and internal framing is complete, conduct RF survey and pre-installation testing to validate coverage areas, proposed antenna locations, and document prevailing signals. Survey a minimum of 20 diverse locations per floor. Walking tests are acceptable. Include survey results.

### **3.3 INSTALLATION**

- A. Obtain approval of all antenna locations with A/E and Owner prior to installation.
- B. Mount equipment securely provided backboard or rack at coordinated locations.
- C. Antennas shall be securely attached, independent of other trades, unless previously approved.

- D. Cables shall be secured using cable colored Velcro cable wraps suitable for the installation environment.
- E. Maintain clearances:
  - 1. Head end enclosure: minimum 12 inches from telecommunications equipment.
  - 2. Antennas, omnidirectional: minimum 36 inches from communications cable, wireless access points and LED lighting fixtures
- F. Install equipment to provide coverage per design requirements and as confirmed in Survey phase.
- G. Cables shall be routed as follows:
  - 1. Coordinated with all ceiling and above ceiling systems.
  - 2. Accessible ceiling: above ceiling, concealed from view.
  - 3. Inaccessible ceiling: above ceiling in conduit
  - 4. Open ceiling: as high as practical, above lighting plane.
  - 5. Mechanical spaces: routed to avoid damage, maintenance space, and environmental extremes.
  - 6. Electrical spaces: do not route cables in electrical rooms.
  - 7. Run parallel and perpendicular to building walls and structure. Do not take direct route.
- H. Antennas may be installed exposed on the underside of ceilings at approved locations. Do not install antennas in wood ceilings.
- I. Ceiling tiles stained or damaged by contractor shall be replaced by contractor at no cost to owner.
- J. Label all devices:
  - 1. Labeling shall be machine-made; no hand labeling is acceptable.
  - 2. Minimum devices label text height is 0.25 inch.
  - 3. Show labels on as-built drawings.
  - 4. "XXXX" in the scheme below is a sequential 4-digit number starting at 0001.
  - 5. Cable: ERRC-C-XXXX.
  - 6. Antenna: ERRC-A-XXXX.
  - 7. Couplers and taps: ERRC-S-XXXX.
  - 8. Active Equipment: ERRC-E-XXXX.

### 3.4 ACCEPTANCE TESTING

- A. Final testing shall not be performed until after the building is fully enclosed (roof, doors, windows, interior walls, and ceilings are in place).
- B. Notify the Owner two (2) weeks in advance of testing.
- C. All licenses, system documentation, and test plans shall be up to date.
- D. Record all equipment settings before test and after adjustments.
- E. Conduct testing for system RF performance
- F. Test, measure, and record the percent of coverage and signal strength and signal quality at all test points per service provider.



- G. A failure of any test parameter shall cause the test area to be considered a fail. A maximum of (2) non-adjacent areas will be allowed to fail the test. If (3) or more areas fail the test, to be more statistically accurate, the floor should be divided into (40) equal areas and the rest should be redone. In such event, a maximum of (4) non-adjacent areas will be allowed to fail the test. After the (40) area test, if the system continues to fail, the Contractor shall have the system altered to meet the minimum coverage requirement.
- H. Conduct testing in coordination with the Owner.
- I. Modify or add equipment, cables, and antennas required to achieve the required performance. This shall be at no additional cost to the Owner.

### **3.5 TRAINING**

- A. Provide written materials for all training sessions.
- B. Provide (1) 4-hour training session for system operation and testing accommodating up to (4) attendees.
- C. Provide (1) 4-hour training session for system maintenance and configuration accommodating up to (4) attendees.

END OF SECTION 273523

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 276000**  
**NETWORK ELECTRONICS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

**1.2 SUMMARY**

- A. This Section includes patch cables, installation and programming including, but not limited, to the following:
  - 1. Network Core Switches
  - 2. Network Edge Switches
  - 3. Network Edge Fiber Switches
  - 4. Extended Range Ethernet device
  - 5. Patch cables
  - 6. Installation of equipment

**1.3 SYSTEM DESCRIPTION**

- A. All network electronics shall be furnished and installed by the Contractor. Programming shall be coordinated in close cooperation with the Owners IT Staff.
- B. The network will consist of stackable switches provisioned as a single logical unit.
- C. The equipment under this contract shall be provided and configured with all net hardware and programming to permit seamless integration into the high-speed data network.
- D. A new VoIP telephone system will be integrated into the data network.
- E. A new IP security system will be integrated into the data network.
- F. Audio Visual networks will be integrated into the data network.
- G. Public address networks will be integrated into the data network.
- H. Lighting control, building automation, and snow melt systems will be integrated into the data network.
- I. The Owner has organized their network utilizing a private IP scheme.
- J. Furnish and Install all patch cables in a professional manner. Utilize existing wire management where applicable. Where wire management is not available, route patches neatly in such a way

to protect the patch cables from damage. Utilize Velcro tie wraps as needed. Plastic tie wraps are not acceptable and will be rejected.

#### 1.4 WARRANTY

- A. Warranty: All patch cords and optical fiber jumpers shall be warranted to be free from defects in material and workmanship upon installation.

#### 1.5 SPARE PARTS

- A. None

### PART 2 - PRODUCT

#### 2.1 APPROVED MANUFACTURERS

- A. Subject to compliance with requirements, provide network electronics, associated modules and optics as manufactured by one of the following:
  - 1. Aruba (Basis of Design)
  - 2. Cisco
  - 3. Extreme
  - 4. Juniper

#### 2.2 NETWORK ELECTRONICS

- A. General:
  - 1. The network electronics shall be new, of modern design, and the current standard production of the manufacturer. All equipment within the same product line shall be the same manufacturer revision.
  - 2. The following sections specifically list the acceptable equipment types and items for this project.
- B. Uplink Interface
  - 1. Provide the following Uplink interface modules:
    - a. 50GBE Long Range SMF
    - b. 100GBE Long Range SMF
- C. Network Ethernet Switches:
  - 1. Provide the following Switch types
    - a. Chassis Core Fiber Ethernet with 1G/10G/25GbE/50GbE/100GbE uplinks
    - b. 24-port Edge Fiber Ethernet 10/100/1000Base-T switches with Fiber Uplinks
    - c. 48-port Edge Ethernet 10/100/1000Base-T switches
    - d. 24-port Edge Fiber MultiGig Ethernet 1G/2.5G/5G/10G Base-T switches

## D. Network Ethernet Switches

1. Provide the following switch types and accessories as part of the base bid:

Line#	Part Number	Description	Quantity
<b>Core</b>			
1.0	R0X26C	HPE Aruba Networking CX 6405 v2 Switch	1
1.1	HR7H9E	Aruba 5Y FC NBD Exch 6405 SVC [for R0X26C]	1
1.2	R0X35A	HPE Aruba Networking CX 6400 1800W Power Supply with C16 Inlet Accessory	4
1.3	R0X35A B2E	INCLUDED: NEMA 6-20 220V NA Power Cord	4
1.4	R0X31A	HPE Aruba Networking CX 6400 Management Module	1
1.5	R0X45C	HPE Aruba Networking CX 6400 12-port 40/100GbE QSFP28 v2 Extended Tables Module	1
1.5.1	S3N89A	HPE Aruba Networking 100G LR QSFP28 LC 10km SMF Transceiver	2
1.6	R0X44C	HPE Aruba Networking CX 6400 48-port 1G/10G/25GbE SFP28 v2 Extended Tables Module	1
1.6.1	S0V65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	16
		Core Subtotal	
<b>Headend 01.23.03</b>			
2.0	R9W88A	HPE Aruba Networking CX 8100 24x10GBase-T 4x10G SFP+ 4x40/100G QSFP28 FB 3Fan 2AC PSU Switch Bundle	1
2.1	R9W88A ABA	INCLUDED: Power Cord - U.S. localization	1
2.2	H83S2E	Aruba 5Y FC NBD Exch 8100 24SFP+ FB SVC [for R9W88A]	1
2.3	S3N89A	HPE Aruba Networking 100G LR QSFP28 LC 10km SMF Transceiver	2
		Headend 01.23.03 Subtotal	
<b>IDF 01.06.03</b>			
3.0	R0M46A	HPE Aruba Networking 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable	4
4.0	R0M47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
5.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
5.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
5.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
5.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
6.0	JL661A	HPE Aruba Networking CX 6300M 48-port 1GbE Class4 PoE and 4-port SFP56 Switch	3
6.1	HR5B7E	Aruba 5Y FC NBD Exch 6300M 48 PoE SVC [for JL661A]	3
6.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	3
6.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	3
7.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
7.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1

7.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
7.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
7.4	S0V65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
		IDF 01.06.03 Subtotal	
IDF 01.12.09			
8.0	ROM46A	HPE Aruba Networking 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable	4
9.0	ROM47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
10.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
10.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
10.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
10.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
11.0	JL661A	HPE Aruba Networking CX 6300M 48-port 1GbE Class4 PoE and 4-port SFP56 Switch	3
11.1	HR5B7E	Aruba 5Y FC NBD Exch 6300M 48 PoE SVC [for JL661A]	3
11.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	3
11.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	3
12.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
12.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1
12.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
12.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
12.4	S0V65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
		IDF 01.12.09 Subtotal	
IDF 01.27.11			
13.0	ROM46A	HPE Aruba Networking 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable	2
14.0	ROM47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
15.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
15.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
15.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
15.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
16.0	JL661A	HPE Aruba Networking CX 6300M 48-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
16.1	HR5B7E	Aruba 5Y FC NBD Exch 6300M 48 PoE SVC [for JL661A]	1
16.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
16.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
17.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
17.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1

17.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
17.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
17.4	SOV65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
		IDF 01.27.11 Subtotal	
IDF 01.29.09			
18.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
18.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
18.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
18.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
19.0	ROM46A	HPE Aruba Networking 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable	4
20.0	JL661A	HPE Aruba Networking CX 6300M 48-port 1GbE Class4 PoE and 4-port SFP56 Switch	3
20.1	HR5B7E	Aruba 5Y FC NBD Exch 6300M 48 PoE SVC [for JL661A]	3
20.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	3
20.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	3
21.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
21.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1
21.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
21.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
21.4	SOV65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
22.0	ROM47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
		IDF 01.29.09 Subtotal	
IDF 02.06.03			
23.0	ROM46A	HPE Aruba Networking 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable	2
24.0	ROM47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
25.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
25.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
25.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
25.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
26.0	JL661A	HPE Aruba Networking CX 6300M 48-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
26.1	HR5B7E	Aruba 5Y FC NBD Exch 6300M 48 PoE SVC [for JL661A]	1
26.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
26.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
27.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
27.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1

27.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
27.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
27.4	S0V65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
		IDF 02.06.03 Subtotal	
IDF 02.11.03			
28.0	ROM46A	HPE Aruba Networking 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable	2
29.0	ROM47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
30.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
30.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
30.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
30.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
31.0	JL661A	HPE Aruba Networking CX 6300M 48-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
31.1	HR5B7E	Aruba 5Y FC NBD Exch 6300M 48 PoE SVC [for JL661A]	1
31.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
31.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
32.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
32.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1
32.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
32.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
32.4	S0V65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
		IDF 02.11.03 Subtotal	
IDF 02.21.02			
33.0	ROM46A	HPE Aruba Networking 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable	2
34.0	ROM47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
35.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
35.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
35.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
35.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
36.0	JL661A	HPE Aruba Networking CX 6300M 48-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
36.1	HR5B7E	Aruba 5Y FC NBD Exch 6300M 48 PoE SVC [for JL661A]	1
36.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
36.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
37.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
37.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1



37.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
37.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
37.4	S0V65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
		IDF 02.21.02 Subtotal	
IDF 02.27.03			
38.0	ROM46A	HPE Aruba Networking 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable	2
39.0	ROM47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
40.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
40.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
40.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
40.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
41.0	JL661A	HPE Aruba Networking CX 6300M 48-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
41.1	HR5B7E	Aruba 5Y FC NBD Exch 6300M 48 PoE SVC [for JL661A]	1
41.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
41.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
42.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
42.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1
42.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
42.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
42.4	S0V65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
		IDF 02.27.03 Subtotal	
IDF 03.06.02			
43.0	ROM46A	HPE Aruba Networking 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable	2
44.0	ROM47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
45.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
45.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
45.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
45.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
46.0	JL661A	HPE Aruba Networking CX 6300M 48-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
46.1	HR5B7E	Aruba 5Y FC NBD Exch 6300M 48 PoE SVC [for JL661A]	1
46.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
46.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
47.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
47.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1

47.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
47.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
47.4	S0V65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
		IDF 03.06.02 Subtotal	
IDF 03.12.01			
48.0	ROM46A	HPE Aruba Networking 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable	2
49.0	ROM47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
50.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
50.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
50.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
50.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
51.0	JL661A	HPE Aruba Networking CX 6300M 48-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
51.1	HR5B7E	Aruba 5Y FC NBD Exch 6300M 48 PoE SVC [for JL661A]	1
51.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
51.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
52.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
52.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1
52.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
52.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
52.4	S0V65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
		IDF 03.12.01 Subtotal	
IDF 03.21.05			
53.0	ROM46A	HPE Aruba Networking 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable	3
54.0	ROM47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
55.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
55.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
55.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
55.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
56.0	JL661A	HPE Aruba Networking CX 6300M 48-port 1GbE Class4 PoE and 4-port SFP56 Switch	2
56.1	HR5B7E	Aruba 5Y FC NBD Exch 6300M 48 PoE SVC [for JL661A]	2
56.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
56.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
57.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
57.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1

57.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
57.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
57.4	SOV65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
		IDF 03.21.05 Subtotal	
IDF 03.27.01			
58.0	ROM46A	HPE Aruba Networking 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable	2
59.0	ROM47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
60.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
60.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
60.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
60.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
61.0	JL661A	HPE Aruba Networking CX 6300M 48-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
61.1	HR5B7E	Aruba 5Y FC NBD Exch 6300M 48 PoE SVC [for JL661A]	1
61.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
61.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
62.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
62.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1
62.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
62.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
62.4	SOV65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
		IDF 03.27.01 Subtotal	
IDF CAT A			
63.0	ROM47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
64.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
64.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
64.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
64.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
64.4	SOV65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
65.0	JL487A	HPE Aruba Networking 25G SFP28 to SFP28 0.65m Direct Attach Cable	2
66.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
66.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1
66.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
66.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
66.4	SOV65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	2
		IDF CAT A Subtotal	
IDF CAT B			

67.0	R0M47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
68.0	JL487A	HPE Aruba Networking 25G SFP28 to SFP28 0.65m Direct Attach Cable	2
69.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
69.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
69.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
69.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
69.4	S0V65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
70.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
70.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1
70.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
70.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
70.4	S0V65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	2
		IDF CAT B Subtotal	
IDF CAT C			
71.0	R0M47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
72.0	JL487A	HPE Aruba Networking 25G SFP28 to SFP28 0.65m Direct Attach Cable	2
73.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
73.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
73.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
73.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
73.4	S0V65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
74.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
74.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1
74.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
74.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
74.4	S0V65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	2
		IDF CAT C Subtotal	
IDF CAT D			
75.0	R0M47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
76.0	JL487A	HPE Aruba Networking 25G SFP28 to SFP28 0.65m Direct Attach Cable	2
77.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
77.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
77.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
77.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
77.4	S0V65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
78.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1

78.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1
78.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
78.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
78.4	SOV65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	2
		IDF CAT D Subtotal	
MDF 01.21.09			
79.0	R0M46A	HPE Aruba Networking 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable	2
80.0	R0M47A	HPE Aruba Networking 50G SFP56 to SFP56 3m Direct Attach Copper Cable	1
81.0	R8S89A	HPE Aruba Networking CX 6300M 24p HPE Smart Rate 1/2.5/5/10G Class6 PoE 2p 50G 2p 25G Switch	1
81.1	H63F0E	Aruba 5Y FC NBD Exch 6300M 24SR PoE SVC [for R8S89A]	1
81.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	2
81.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	2
82.0	JL661A	HPE Aruba Networking CX 6300M 48-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
82.1	HR5B7E	Aruba 5Y FC NBD Exch 6300M 48 PoE SVC [for JL661A]	1
82.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
82.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
83.0	JL662A	HPE Aruba Networking CX 6300M 24-port 1GbE Class4 PoE and 4-port SFP56 Switch	1
83.1	HL6T2E	Aruba 5Y FC NBD Exch 6300M 24 PoE SVC [for JL662A]	1
83.2	JL086A	HPE Aruba Networking X372 54VDC 680W 100-240VAC Power Supply	1
83.3	JL086A ABA	INCLUDED: Power Cord - U.S. localization	1
83.4	SOV65A	HPE Aruba Networking 50G LR 10km SMF Transceiver	1
		MDF 01.21.09 Subtotal	
Optional Central Cloud Mgt			
84.0	Q9Y80AAE	HPE Aruba Networking Central Switch Class-3 Foundation 5-year Subscription E-STU	54
84.1	R8L82AAE	HPE Aruba Networking Central Switch Class-4 Foundation 5-year Subscription E-STU	1
84.2	R3K05AAE	HPE Aruba Networking Central Switch Class-5 Foundation 5-year Subscription E-STU	2
		Optional Central Cloud Mgt Subtotal	
Video 03.21.01			
85.0	R9W88A	HPE Aruba Networking CX 8100 24x10GBase-T 4x10G SFP+ 4x40/100G QSFP28 FB 3Fan 2AC PSU Switch Bundle	1
85.1	R9W88A ABA	INCLUDED: Power Cord - U.S. localization	1
85.2	H83S2E	Aruba 5Y FC NBD Exch 8100 24SFP+ FB SVC [for R9W88A]	1
85.3	S3N89A	HPE Aruba Networking 100G LR QSFP28 LC 10km SMF Transceiver	2
		Video 03.21.01 Subtotal	

**2.3 EXTENDED RANGE ETHERNET DEVICES**

- A. Provide quantity of extended range Ethernet devices located on the drawings as indicated. These shall be sourced from the same manufacturer as the connectors provided as a part of this project. Each device shall meet or exceed the performance specifications in this document when installed as part of the end-to-end cabling system described in this specification.
1. Industrial unmanaged 100W Gigabit PoE Extender
  2. Multiple port configurations:
  3. Auto-negotiate PoE power level requested by attached device
  4. DIN-rail mountable
  5. Industrial (-40 to +75°C) operating temperature range

**2.4 28AWG 6-INCH COPPER PATCH CABLES**

- A. Provide quantity of high-performance copper patch cords to match 100% of work area connectors installed. These shall be sourced from the same manufacturer as the connectors provided as a part of this project. Each cord shall meet or exceed the performance specifications in this document when installed as part of the end-to-end cabling system described in this specification.
- B. The patch cords are to be passed to the client on completion of the project. Each cord is to have a manufacturer's certificate of conformance and shall be in its original, unopened packaging.
- C. Category 6A compliant per EIA/TIA 568.
- D. Each patch cable shall be bootless and labeled sequentially with the patch panel port number.
- E. Patch cables shall be bootless, and color coded as follows:
1. Telecommunications Closet Patch Cables:
    - a. Red – Critical
    - b. Orange – Wi-Fi
    - c. Yellow – Temporary show connections
    - d. Purple – Digital signage
    - e. Pink – Security cameras
    - f. Grey – Other VLANs
- F. The Contractor shall install the cable to provide neat and organized patches to equipment. The Contractor is required to review site conditions to ensure the proper cable lengths are installed.

**2.5 OPTICAL FIBER JUMPERS**

- A. Duplex optical fiber jumper cable, OS2 1m long with a 3.0mm Duplex LC optical fiber connectors on each end.
- B. Each optical fiber jumper cable shall be a duplex Kevlar reinforced cable with a PVC or Teflon jacket.

**2.6 LABELING**

- A. All cable designations and color-coding shall be in full compliance with ANSI/TIA- 606.
- B. Clearly label all cables, including patch cables at both ends with permanently applied mechanically printed labels. Handwritten labels will not be acceptable. Use standardized colors and alphanumeric codes. All patch cables shall be numbered sequentially with port numbers on both ends of the cable. Technology Designer/Engineer will approve labeling system and method.

## PART 3 - EXECUTION

**3.1 INSTALLATION-GENERAL**

- A. Install switches.
- B. Furnish and install new category 6A patch cables and optical fiber jumpers.
- C. Support the final installation to ensure defect free installation.

**3.2 PROJECT RECORD DOCUMENTS**

- A. Provide 3 sets of documentation. All documentation shall be provided electronically or on a CD/DVD and in print delivered in a tabbed 3-ring binder as directed by and agreed upon with the client.
- B. All drawings and documentation and the information contained therein become the sole property of the Owner.

**END OF SECTION 276000**

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 276200****WIRELESS NETWORK SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

**1.2 SUMMARY**

- A. This Section includes wireless network equipment, software, associated peripherals, installation, and training including, but not limited, to the following:
  - 1. Installation of wireless network access points.
  - 2. Record drawings and documented configuration.

**1.3 SYSTEM DESCRIPTION**

- A. All wireless access points and external antenna shall be purchased, programmed, and furnished by the Contractor in close cooperation with the Owner.
- B. All wireless access point mounts and mounting hardware shall be furnished and installed by the Contractor.
- C. This Contractor shall be responsible to furnish and install vinyl covers intended to mask/hide various access points.
- D. This Contractor shall be responsible for all wireless access point physical installation including mounting hardware, specialty mounts, cabling, and any miscellaneous hardware.

**1.4 WARRANTY/SERVICE**

- A. Warranty: All products shall be warranted to be free from defects in material and workmanship upon installation.

**1.5 SPARE PARTS**

- A. Provide one (1) spare mount of each type.

## PART 2 - PRODUCT

**2.1 WIRELESS ACCESS POINTS**

- A. Wireless access points located within high foot traffic, low supervisory locations shall utilize integrated antennas.
- B. Wireless access points located within low foot traffic, high supervisory locations shall utilize integrated or external antennas.
- C. Wireless access points shall meet the following minimum specifications:
1. Minimum tri radios 5GHz; 2.4GHz and 5GHz; 2.4GHz/5GHz/Sensor
  2. Variable power transmit settings.
  3. Automatic power and channel selection.
  4. Wall or ceiling mountable.
  5. Auto sensing 10/100/1000BASE-T Ethernet uplink.
  6. High Density versions with multi-gig Ethernet uplink.
  7. Power, link, and activity status LEDs.
  8. 802.11ax certified and compliant.
  9. Subject to compliance with requirements, provide wireless access points as manufactured by one of the following:
    - a. Aruba (Basis of Design)
    - b. Cisco
    - c. Extreme
    - d. Or Equal
  10. Wireless access point final quantities will be determined based upon building surveys. AP types to be included with base bid shall be as follows:

Line#	Part Number	Description
1.0	R7J28A	HPE Aruba Networking AP-635 (US) Tri-radio 2x2 802.11ax Wi-Fi 6E Internal Antennas Campus AP (Standard Density Areas)
2.0	R7J39A	Aruba AP-655 Tri-radio 4x4:4 802.11ax Wi-Fi 6E Internal Antennas Campus AP (High Density Areas)
3.0	R4H18A	Aruba AP-575 (US) AP (Outdoor Area)
4.0	R3J18A	HPE Aruba Networking AP-MNT-D Campus AP mount bracket kit (individual) type D: solid surface
5.0	S0J40A	HPE Aruba Networking AP-MNT-MP10-U Campus AP 10-pack Universal Mount Bracket Kit
6.0	Q9Y59AAE	HPE Aruba Networking Central AP Foundation 3-year Subscription E-STU

**2.2 WIRELESS ACCESS POINT MOUNTS**

- A. Wireless access points shall be located within high foot traffic, low supervisory locations shall utilize integrated antennas.

- B. Wireless access points located within low foot traffic, high supervisory locations shall utilize integrated or external antennas.
- C. Wireless access points shall be either wall or ceiling mountable.

### 2.3 VINYL WRAPS

- A. Vinyl wraps shall be provided where indicated on the drawings. The Contractor is responsible for coordinating final wireless access point locations, providing any necessary photographs to the vinyl wrap supplier, and shipping to and receiving from the vinyl wrap supplier all wireless access points and external antenna.
- B. Vinyl wraps shall be supplied by Acceltex Solutions <https://www.acceltex.com/skins/>.
- C. Isaac Juarez Regional Sales Manager AccelTex Solutions | 12000 Crownpoint Drive, Suite 165 San Antonio, Texas 78233 USA Main: 1.888.406.8906 Mobile: 1.210.556.9007 (Preferred)

### 2.4 LABELING

- A. The Contractor shall provide and apply a mechanically produced identification label on each piece of equipment provided under this bid. The label shall follow the following Owner standards:
  - 1. Wireless access points:
    - a. Consult with the Owner to develop a labeling scheme.
    - b. This label shall be programmed into each device.

## PART 3 - EXECUTION

### 3.1 INSTALLATION-GENERAL

- A. Unpack and assemble equipment.
- B. Furnish and install vinyl wraps where necessary.
- C. Install, configure, program, and test the systems.
- D. Support the final installation to ensure defect free installation.

### 3.2 INSTALLATION-WIRELESS ACCESS POINTS

- 1. All ceiling pad penetrations shall be dressed out using a grommet or escutcheon ring to provide a neat and professional finish.
- 2. All access points shall be installed utilizing PoE switch ports.
- 3. All wireless access points shall be securely mounted utilizing manufacturer provided mounts suitable for the application (i.e., ceiling grid mounts, wall mounts, etc.)

### 3.3 TESTING

- A. Testing shall be performed by the Contractor. The following shall be tested and documented:
  - 1. Device density throughput requirements
  - 2. Device roaming while maintaining authentication and security parameters
- B. The methodology and the tools used to perform tests shall be documented and delivered to the Owner.
- C. This Contractor shall use Owner owned equipment for testing where possible to best simulate the results the Owner will experience.
- D. All test results shall be documented and delivered to the Owner.
- E. The following performance specifications shall be tested and documented through post-installation surveys and management tools:
  - 1. Signal strength: -75dBm
  - 2. Signal to noise ratio: 20dB
  - 3. Building RF visualization
  - 4. Rogue access point detection, location, and containment
  - 5. Device location awareness
  - 6. NAC identification, validation, policy enforcement, quarantine, and remediation

### 3.4 PROJECT RECORD DOCUMENTS

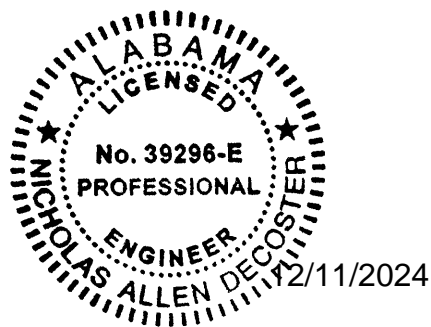
- A. This Contractor must provide record drawings including, but not limited to:
  - 1. WAP labeling
  - 2. Mounting hardware
  - 3. Final record drawings

**END OF SECTION 276200**

**SECTION 27 00 01 - DIVISION 27 - COMMUNICATIONS - AUDIO-VIDEO**

- 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO**
- 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO-VIDEO**
- 27 41 00 - AUDIO VIDEO SYSTEMS**
- 27 41 16 - AUDIO VIDEO SYSTEMS EQUIPMENT**
- 27 41 22 - LARGE FORMAT DISPLAY SYSTEMS**
- 27 41 51 - BROADCAST SYSTEMS PRE-WIRE**

**END OF DIVISION 27 TABLE OF CONTENTS**



**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO****PART 1 GENERAL****1.1 RELATED SECTIONS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and to the following sections:
  - 1. 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO-VIDEO
  - 2. 27 41 00 - AUDIO VIDEO SYSTEMS
  - 3. 27 41 16 - AUDIO VIDEO SYSTEMS EQUIPMENT
  - 4. 27 41 22 - LARGE FORMAT DISPLAY SYSTEMS
  - 5. 27 41 33 - TELEVISION DISTRIBUTION SYSTEM
  - 6. 27 41 51 - BROADCAST SYSTEMS PRE-WIRE

**1.2 SECTION INCLUDES**

- A. This Division requires providing complete functioning systems, and each element thereof, as specified, indicated, or reasonably inferred, on the Drawings and in these Specifications, including every article, device, or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, supplies, tools, equipment, transportation and utilities.
- B. Division 27 of these Specifications, and Drawings numbered with prefixes TA and TB, generally describe these systems, but the scope of the Communications Work includes all such Work indicated in all of the Contract Documents, including, but not limited to: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing, Electrical and Telecommunications Drawings and Specifications; and Addenda.
- C. Drawings are graphic representations of the Work upon which the Contract is based. They show the materials and their relationship to one another, including sizes, shapes, locations, and connections. They also convey the scope of Work, indicating the intended general arrangement of the equipment, fixtures, outlets and cabling without showing all of the exact details as to elevations, offsets, and other installation requirements. Use the Drawings as a guide when laying out the Work and to verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory and properly operating system.
- D. Specifications define the qualitative requirements for products, materials, and workmanship upon which the Contract is based.

**1.3 ABBREVIATIONS AND ACRONYMS**

- A. ADA - Americans with Disabilities Act
- B. AFF - Above Finished Floor
- C. AHJ - Authority Having Jurisdiction
- D. ANSI - American National Standards Institute
- E. ASTM - American Society for Testing and Materials

- F. BICSI - Building Industry Consulting Service International
- G. ETL - Electrical Testing Laboratories, Inc.
- H. FCC - Federal Communications Commission
- I. FM - Factory Mutual
- J. IEEE - Institute of Electrical and Electronic Engineers
- K. LED - Light Emitting Diode
- L. NEC - National Electrical Code
- M. NESC - National Electrical Safety Code
- N. NEMA - National Electrical Manufacturers Association
- O. NFPA - National Fire Protection Association
- P. NRTL - Nationally Recognized Testing Laboratory
- Q. OEM - Original Equipment Manufacturer
- R. OFCI - Owner Furnished Contractor Installed
- S. OSHA - Occupational Safety and Health Administration
- T. OSP - Outside Plant
- U. RCDD - Registered Communications Distribution Designer
- V. TIA - Telecommunications Industries Association
- W. UL - Underwriters Laboratories
- X. UON - Unless Otherwise Noted

#### 1.4 DEFINITIONS

- A. Whenever used in specifications or drawings, the following terms shall have the indicated meanings:
  - 1. AHJ - The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
  - 2. Approved Equivalents or Equal - For specific products, materials, equipment, or systems for which this Division specifically identifies the Contractor shall use as the basis for their bid. Where the term approved equivalent or equal is listed the Contractor may submit documentation for review by the Design Consultant for approval. The Design Consultant's acceptance or rejection is final.
  - 3. As Directed - means as directed by the Contract Administrator, or their representative.
  - 4. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified.
  - 5. Communications Room - means the location of a floor-serving facility for housing telecommunication equipment, cable terminations, and cross-connect wiring, as well as those for audio video systems and potentially other low-voltage systems such as security and fire alarm (electronic safety and security). This room is recognized in TIA-569 as the transition point between the telecommunications horizontal (station) pathway facilities and the backbone (riser) pathway facilities.



6. Concealed - means embedded in masonry or other construction, installed behind wall furring or within drywall partitions, or installed within hung ceilings.
7. Conditionally Approved – the manufacturer has been found reputable by the design professional, but the design professional has not verified that the product offering by manufacturer meets to all specification requirements. Contractor shall adhere to submittal review process for final approval on products.
8. Contract Administrator: Where referenced in this Division, “Contract AdministratorContract Administrator” is the primary liaison between the Owner and the Contractor. Specifically, for this project this is "the Architect".
9. Design Consultant - Where referenced in this Division, “Design Consultant” is the Design Professional for the Work under this Division, and is a consultant to, and an authorized representative of, the Contract Administrator, as defined in the Section 00 72 00 - General Conditions and/or Section 00 73 00 - Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Design Professional, in addition to involvement by, and obligations to, the “Contract Administrator”.
10. Furnish - “To supply and deliver to the project site, ready for unloading, unpacking, assembling, installing, and similar operations.”
11. Furnished by Owner (or Owner-Furnished) or Furnished by Others: “An item furnished by the Owner or under other Divisions or Contracts, and installed under the requirements of this Division, complete, and ready for the intended use, including all items and services incidental to the Work necessary for proper installation and operation. Include the installation under the warranty required by this Division.
12. Install - “To perform all operations at the project site, including, but not limited to, and as required: unloading, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, testing, commissioning, starting up and similar operations, complete, and ready for the intended use.”
13. NRTL - Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other NRTL’s that are acceptable to the AHJ, and standards that meet the specified criteria.
14. Provide - “To furnish and install complete, and ready for the intended use.” When ‘furnish’, ‘install’, ‘perform’, or ‘provide’ is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
15. Submit - means submit to Contract Administrator for review.
16. Substitution - means a product meeting all requirements and specifications and having been approved by the Design Consultant to replace another product specifically identified herein.
17. Wet Location - means a pathway that does not protect cables from moisture levels that are beyond the intended operating range of “inside” premises cable.
  - a. For example: Slab-on-grade construction where pathways are installed underground or in concrete slabs that are in direct contact with soil (e.g., sand and gravel) is considered a “wet location.”
  - b. Also refer to the BICSI TDMM for definitions of wet locations
18. Value Engineering: A systematic method to improve the “value” of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value

can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.

19. ( ) – Where appearing in product part or model numbers; shall represent wild card character to be filled in by the Contractor to meet required specifications.
- B. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Design Consultant as equivalent to the item or manufacturer specified".
- C. The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.
- D. The following definitions apply to excavation operations:
  1. Additional Excavation: Where excavation has reached indicated sub-grade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
  2. Sub-base: as used in this Section refers to the compacted soil layer used in pavement systems between the sub-grade and the pavement base course material.
  3. Sub-grade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
  4. Unauthorized excavation consists of removal of materials beyond indicated sub-grade elevations or dimensions without specific direction from the Contract Administrator.

## 1.5 REFERENCE STANDARDS

- A. Execute all Work in accordance with, and comply at a minimum with, National Fire Protection Association (NFPA) codes, state and local building codes, and all other applicable codes and ordinances in force, governing the particular class of Work involved, for performance, workmanship, equipment, and materials. Additionally, comply with rules and regulations of public utilities and municipal departments affected by connection of services. Where conflicts between various codes, ordinances, rules, and regulations exist, comply with the most stringent. Wherever requirements of these Specifications, Drawings, or both, exceed those of the above items, the requirements of these Specifications, Drawings, or both, shall govern. Code compliance, at a minimum, is mandatory. Construe nothing in these Construction Documents as permitting work not in compliance, at a minimum, with these codes. Bring all conflicts observed between codes, ordinances, rules, regulations and these documents to the Contract Administrator's and Design Consultant's attention in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specifications Addenda required to resolve the conflict.
- B. If the conflict is not reported timely, prior to the opening of bids, resolve the conflict and provide the installation in accordance with the governing codes and to the satisfaction of the Contract Administrator and Design Consultant, without additional compensation. Contractor will be held responsible for any violation of the law.
- C. Project shall be executed in accordance with the sustainable building standard rating as indicated in Division 27 section, Sustainable Design Requirements.
- D. Obtain timely inspections by the constituted authorities having jurisdiction; and, upon final completion of the Work, obtain and deliver to the Owner executed final certificates of acceptance from these authorities having jurisdiction.

- E. All material, manufacturing methods, handling, dimensions, methods of installation and test procedures shall conform to industry standards, acts, and codes, including, but not limited to the following, except where these Drawings and Specifications exceed them.
- F. The references to the following codes, references and standards represent the most current and up-to-date revisions or printing as of the issue of this document including all sections, parts and their addenda. The Contractor is responsible for following the latest revision or printing (UON):
  - 1. TIA-569 - "Commercial Building Standard for Telecommunications Pathways and Spaces"
  - 2. NFPA 70 - National Electrical Code (NEC)
  - 3. IEEE C2 - National Electrical Safety Code (NESC)
  - 4. ADA Standards - Americans with Disabilities Act (ADA) of 1990, as amended.

#### **1.6 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate with other Divisions for Communications work to be included but not listed in Division 27 or indicated on Communications Drawings.
- B. Visit the site and ascertain the conditions to be encountered in installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make do provisions for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, and incorrect or faulty installation of any of the Work under this Division or for additional compensation for any Work covered by this Division.
- C. Refer to Communications Drawings and Divisions of the other trades and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. Follow these drawings as closely as the actual construction and the work of other trades will permit. Provide all offsets, fittings, and accessories, required to clear equipment, beams and other structural members which may be required but not shown on the Drawings.
- D. Provide materials with trim that will fit properly the types of ceiling, wall, or floor finishes installed.
- E. Maintain a project manager on the jobsite always to coordinate this Work with other trades so that various components of the Communications systems are installed at the proper time, fits the available space, allows proper service access to all equipment, and meets all required codes and standards.
- F. Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
- G. Carry on the Work in such a manner that the Work of the other trades will not be handicapped, hindered, or delayed at any time.
- H. Work of this Division shall progress according to the "Construction Schedule" as described in Division 01 and as approved by the Contract Administrator. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule to ensure successful achievement of all schedule dates.
- I. Examine and compare the Contract Drawings and Specifications with the Drawings and specifications of other trades and report any discrepancies between them to the Contract Administrator and obtain written instructions for changes necessary in the work. Install and coordinate the work in cooperation with other related trades. Before installation, make proper

provisions to avoid interferences.

- J. Before commencing work, examine adjoining work on which this work is in any way affected and report conditions, which prevent performance of the work. Become thoroughly familiar with actual existing conditions to which connections shall be made or which shall be changed or altered.
- K. In cases of doubt as to the work intended, or in the event of need for explanation, request supplementary instructions from the Contract Administrator.
- L. Measurements and Layouts: The Drawings are schematic in nature but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the Work. Figured dimensions take precedence to scaled dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. Correct, at no additional costs to the Owner, errors that could have been avoided by proper checking and inspection.

### 1.7 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to the requirements of individual Sections. Additionally, prepare coordination drawings as required scope of installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one trade.
  - 1. Information shall be project specific and drawn accurately to a scale large enough to resolve conflicts. Do not base coordination drawings on standard dimensional data.
  - 2. Prepare floorplans, sections, elevations, and details as needed to adequately describe relationship of various systems and components.
  - 3. Clearly indicate functional and spatial relationships of components of all systems specified in the Contract Documents, including but not limited to: architectural, structural, civil, mechanical, electrical, fire protection, and specialty systems.
  - 4. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
  - 5. Show location and size of access doors required for access to concealed equipment, fittings, controls, terminations, and cabling.
  - 6. Indicate required installation sequence to minimize conflicts between entities.
  - 7. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Contract Administrator indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
  - 8. The details of the coordination are the responsibility of the Contractor and, where indicated on the Drawings, minor adjustments in raceway routing, device placement, device type, or equipment arrangement are not to be considered changes to the Contract.
- B. Equipment Room Coordination Drawings: In accordance with the submittal procedures outlined within these Specifications, provide dimensioned layouts of communications equipment locations within communications (telecom and AV) rooms, electrical rooms/closets, mechanical rooms, generator rooms, and fire pump rooms with equipment drawn to scale and identified therein.
  - 1. Clearly identify all required working clearances and access provisions required for installation and maintenance.

2. Equipment layouts should be arranged accounting for considerations for required door openings and the clearances required by the equipment manufacturer.
  3. Indicate path to allow the future removal of each large piece of equipment (including but not limited to communications racks and cabinets) without removal of nonrelated equipment or architectural elements.
  4. Include work provided by others routed through the equipment rooms.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
  2. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.
    - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Contract Administrator.
  3. Where the Engineer's digital data files are provided to the Contractor for use in preparing coordination digital data files, the Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings or Specifications.
  4. Submit coordination drawings in accordance with the submittal procedures outlined within these Specifications.
- D. Refer to Coordination requirements in specific sections for additional information.

## 1.8 SUBMITTALS

- A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.
- B. Refer to Division 01 for acceptance of electronic submittals. If not specified by Division 01, provide electronic submittals. If Division 01 requires paper submittals, provide the quantity of submittals required, but no fewer than seven (7) sets.
- C. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Contract Administrator and Design Consultant that the submittals have been posted. If electronic submittal procedures are not defined in Division 01, Contractor shall include the website, username and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Contract Administrator's and Design Consultant's designated representatives. Contractor shall allow for the Design Consultant Review Time as specified. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.
- D. Design Consultant Review Time: Transmit submittals as early as required to support the project schedule. Allow two weeks for Design Consultant review time or time specified in the Engineer's Agreement with the Client, plus to/from mailing time via the Contract Administrator, plus a duplication of this time for resubmittal if required. Transmit submittals as soon as possible after Notice to Proceed and before Mechanical construction starts.
- E. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Design Professional. They shall not be copies of the work product of the Design

Professional. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.

- F. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division as noted in each individual Section. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.
- G. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.
- H. Unless noted otherwise within each individual section, submittals shall be provided for approval in four distinct stages:
  - 1. Pre-bid
    - a. Required no less than two weeks prior to the due date for the submission of bids, such as:
      - 1) Product substitutions, approved alternate or equivalent requests to be reviewed for approval (Prior to Bid)
      - 2) Alternate personnel credentials to be reviewed for approval.
      - 3) And as required by individual sections in this Division.
  - 2. Bid
    - a. Required at the time of the submission of bids, such as:
      - 1) Bid Response Forms
      - 2) Unit Pricing (if required by sections in this Division)
      - 3) Personnel Qualifications
      - 4) Contractor Qualifications (Previous project references)
      - 5) Voluntary Bid Alternates
      - 6) And as required by individual sections in this Division
  - 3. Pre-construction
    - a. Required after the award of the project to the winning bidder and prior to starting construction.
    - b. Submit the following items no longer than four weeks after receiving the notice to proceed:
      - 1) Division of Labor amongst sub-Contractors. Include:
        - a) Company Name
        - b) Address
        - c) Name of project manager for this project, including:
          - (1) E-mail
          - (2) Telephone number
      - 2) Construction schedule showing important milestone dates and activities. Schedule shall be coordinated with overall project construction schedule.
      - 3) Updated Personnel and Contractor Qualifications where different from those submitted during Bid.
      - 4) A typed list, indexed by Specification section, of products specifically identified by part number (no wild card characters) within each specification section in this Division. Products are to be listed in the same order as in the specification. List is to include length of manufacturer warranty for each product.



- 5) Manufacturers' cut sheets:
    - a) Cut sheets are to be in the same order as in the specification sections.
    - b) At a minimum all cut sheets shall contain the following:
      - (1) Cross-reference to the specification section and/or drawings for which the product is to be reviewed for compliance and acceptance.
      - (2) Every product cut-sheet submitted for review shall contain the manufacturers' name and logo somewhere on the page.
      - (3) All parts, pieces, and equipment submitted for review shall be clearly identified by stamp, markup, or highlight in such a manner that the product(s) being submitted are clearly identifiable and distinguished from all other materials, parts, or equipment that may be on the submittal.
      - (4) For cut sheets with accessories, additional parts, or derivations of the product being submitted, all shall be clearly identified for the reviewer and acceptance.
      - (5) Sufficient detail for reviewer to identify all required information, such as size, weight, color, NRTL listings, approval or certification information, and other necessary identifying information to confirm product meets specifications.
  - 6) Samples – refer to individual sections for specific sample requirements.
    - a) Samples requested shall be physical examples that represent materials, equipment or workmanship and establish standards by which the work will be judged. Contractor or Manufacturer shall cover all associated fabrication and shipping costs.
  - c. Submit the following items sufficiently prior to installation of each respective portion of work:
    - 1) Shop Drawings
      - a) Shall be furnished per the requirements of each Division 27 specification Section.
4. Project Completion
- a. Required after the substantial completion but prior to final approval for completion, such as:
    - 1) Record Drawings
    - 2) Operation and Maintenance Data
    - 3) Project test reports
    - 4) Cable Databases (as applicable)
    - 5) Warranty Certificate(s)
    - 6) Lead Installer / Project manager letter with signature stating the project has been installed in accordance with referenced industry standards and contract documents.
    - 7) And as required by individual sections in this Division
  - I. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.
  - J. Refer to individual Sections for additional submittal requirements.
-

- K. No part of the work shall be started in the shop or in the field until the shop drawings and /or samples for that portion of the work have been submitted and accepted.
- L. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- M. Submittals shall contain the following information:
  - 1. The project name.
  - 2. The applicable specification section and paragraph.
  - 3. Equipment identification acronym as used on the drawings.
  - 4. The submittal date.
  - 5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
  - 6. Submittals not so identified will be returned to the Contractor without action.
- N. The checking and subsequent acceptance by the Design Consultant and/or Contract Administrator of submittals shall not relieve responsibility from the Contractor for (1) deviations from Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Design Consultant and Contract Administrator prior to implementing any deviation.
- O. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.
- P. Video Recordings: Record training and demonstrations in .AVI format, unless noted otherwise in Division 01 specifications or where approved by the Owner.

### 1.9 SUBSTITUTIONS

- A. Refer to Bid documents, General and Supplementary Conditions and Division 01 Specification Sections for limitations and restrictions on substitutions in addition to requirements specified in this section.
- B. For products, materials, equipment, or systems for which this Division specifically identifies, the Contractor shall use it as the basis for their bid. However, if the Contractor feels a substitute is appropriate for consideration they may submit, as required in these documents prior to bid, for approval by the Design Consultant.
- C. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance, and quality to be met by the proposed substitution.
- D. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.
- E. Request for Substitution:
  - 1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
  - 2. The burden of proof of the merit of the proposed substitution is upon the proposer.



3. Unless stated otherwise in writing to the Design Consultant by the Contractor, Contractor warrants to the Design Consultant, Contract Administrator, and Owner the following:
  - a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
  - b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
  - c. Proposed substitution has received necessary approvals of the Authorities Having Jurisdiction.
  - d. Same warranty will be furnished for proposed substitution as for specified Work.
  - e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
  - f. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.
- F. Substitution Consideration:
  1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
  2. No substitutions will be considered prior to receipt of bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of bids.
  3. If the proposed substitution is approved prior to receipt of bids, such approval will be stated in an addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
  4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

#### **1.10 ELECTRONIC DRAWING FILES**

- A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of 200 for a drawing set up to 12 sheets and 15 per sheet for each additional sheet.
- B. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form.
- C. Contact the Contract Administrator for written authorization.
- D. The following must be received before electronic drawing files will be sent:
  1. Contract Administrator's written authorization
  2. Engineer's release agreement form
  3. Payment

#### **1.11 QUALITY ASSURANCE**

- A. Execute all work under this Division in a thorough and professional manner by competent and experienced workmen duly trained to perform the work specified.

- B. Install all work in strict conformance with all manufacturers' requirements and recommendations, unless these Documents exceed those requirements. Install all equipment and materials in a neat and professional manner, aligned, leveled, and adjusted for satisfactory operation, in accordance with NECA guidelines.
- C. Unless indicated otherwise on the Drawings, provide all material and equipment new, of the best quality and design, free from defects and imperfections and with markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Provide all material and equipment of the same type from the same manufacturer whenever practicable.
- D. Unless specified otherwise, manufactured items of the same types specified within this Division shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this Project.

#### **1.12 OPERATION AND MAINTENANCE MANUALS**

- A. Refer to Division 01 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.
- B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.
- C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.
- D. Prior to Substantial Completion of the project, furnish to the Contract Administrator, for Engineer's review, and for the Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.
- E. Each manual shall contain equipment data, approved submittals, shop drawings, diagrams, capacities, spare part numbers, manufacturer service and maintenance data, warranties and guarantees.
- F. Refer to Division 01 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Contract Administrator and Design Consultant that the manuals have been posted. If electronic manual procedures are not defined in Division 01, Contractor shall include the website, username and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Contract Administrator's and Design Consultant's designated representatives.

#### **1.13 SPARE PARTS**

- A. Provide to the Owner the spare parts specified in the individual sections of this Division.

#### **1.14 RECORD DRAWINGS**

- A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

- B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.
- C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Contract Administrator.

#### **1.15 DELIVERY STORAGE AND HANDLING**

- A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.
- B. Deliver equipment and material to the job site in their original containers with labels intact, fully identified with manufacturer's name, make, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.
- C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and always, take every precaution to properly protect equipment and material from damage, including the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which becomes rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Contract Administrator.
- D. Be responsible for the safe storage of tools, material, and equipment.

#### **1.16 WARRANTIES**

- A. Refer to Division 01 and General Conditions for Warranties in addition to requirements specified herein.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- C. Warrant each system and each element thereof against all defects due to faulty workmanship, design, or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in these Construction Documents or manufacturer's standard warranty exceeds 12 months. Remedy all defects, occurring within the warranty period(s), as stated in the General Conditions and Division 01.
- D. The above warranties shall include labor and material. Make repairs or replacements without any additional costs to the Owner.
- E. Perform the remedial work promptly, upon written notice from the Contract Administrator or Owner.
- F. At the time of Substantial Completion, deliver to the Owner all warranties, in writing and properly executed, including term limits for warranties extending beyond the one-year period,

each warranty instrument being addressed to the Owner and stating the commencement date and term.

### 1.17 TEMPORARY FACILITIES

- A. Refer to Division 01 and General Conditions for Temporary Facilities requirements.
- B. Temporary Utilities: The types of services required include, but are not limited to, electricity, telephone, and internet. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.

### 1.18 FIELD CONDITIONS

- A. Conditions Affecting Work in Existing Buildings: The following project conditions apply:
  - 1. The Drawings describe the general nature of remodeling to the existing building; however, visit the Site prior to submitting bid to determine the nature and extent of work involved.
  - 2. Schedule Work in the existing building with the Owner.
  - 3. Perform certain demolition work prior to the remodeling. Perform the demolition that involves Communications systems, equipment, raceways, equipment supports or foundations and materials.
  - 4. Remove articles that are not required for the new Work. Unless otherwise indicated, remove each item removed during this demolition from the premises and dispose in accordance with applicable federal, state, and local regulations.
  - 5. Relocate and reconnect Communications facilities that shall be relocated to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where communications equipment or materials are removed, cap unused raceways below the floor line or behind the wall line to facilitate restoration of finish.
  - 6. Obtain permission from the Contract Administrator for channeling of floors or walls not specifically noted on the Drawings.
  - 7. Protect adjacent materials indicated to remain. For Work specific to this Division, install, and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
  - 8. Locate, identify, and protect communications services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services shall be interrupted, provide temporary services for affected areas.
- B. Conditions Affecting Excavations: The following project conditions apply:
  - 1. Maintain and protect existing building services that transit the area affected by selective demolition.
  - 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
- C. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.

- D. Use of explosives is not permitted.
- E. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits specified by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

## **PART 2 PRODUCTS**

### **2.1 NOT USED**

## **PART 3 EXECUTION**

### **3.1 INSTALLATION GENERAL**

- A. Install in accordance with manufacturer's instructions.

### **3.2 EXISTING CONDITIONS**

- A. Existing conditions indicated on the Drawings are taken from the best information available from the Owner, existing record drawings, and from limited, in-situ, visual site observations; and, they are not to be construed as "AS BUILT" conditions. The information is shown to help establish the extent of the new Work.
- B. Verify existing conditions at the project site and perform the Work as required to meet the existing conditions and the intent of the Work indicated.

### **3.3 EXISTING UTILITIES**

- A. Existing utility services not specifically indicated to be removed or altered shall remain as they presently exist.
- B. Where existing services interfere with demolition or construction, alter, or reroute such existing equipment to facilitate demolition or construction after obtaining written permission from the Contract Administrator. Notify in writing giving two weeks advance notice or planned alteration prior to altering any existing condition is required.
- C. Schedule and coordinate with the utility service provider, Owner, and Contract Administrator connections to, relocation of, or discontinuation of services from existing utility service providers. Include premium time required for such work in the Bid.
- D. Preserve continuity of service of existing facilities (related to damage or alteration due to new construction). Unauthorized alteration to existing equipment shall be corrected without additional cost to the Owner.
- E. Repair existing utilities damaged due to construction operations to the satisfaction of the Owner or utility provider without additional cost.
- F. Do not leave utilities disconnected at the end of a workday or over a weekend unless authorized by representatives of the Owner or Contract Administrator.
- G. Make repairs and restoration of utilities before workmen leave the project at the end of the workday in which the interruption takes place.
- H. Include in Bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

### **3.4 EXAMINATION OF SITE**

- A. Prior to the submitting of bids, visit the project site and become familiar with all conditions affecting the proposed installation and make provisions as to the cost thereof.

- B. The Contract Documents do not make representations regarding the character or extent of the sub-soils, water levels, existing structural, mechanical, electrical, communications, and electronic safety and security installations, above or below ground, or other sub-surface conditions which may be encountered during the work. Evaluate existing conditions, which may affect methods or cost of performing the work, based on examination of the site or other information. Failure to examine the Drawings or other information does not relieve the Contractor of responsibility for satisfactory completion of the work.

### 3.5 PERMITS AND FEES

- A. Secure and Pay all required fees and obtain all required permits related to the Communications Infrastructure installation.
- B. Pay royalties or fees in connection with the use of patented devices and systems.

### 3.6 SELECTIVE DEMOLITION

- A. Refer to Division 01, Division 02, and General Conditions for Selective Demolition requirements.
- B. General: Demolish, remove, demount, and disconnect abandoned communications materials and equipment indicated to be removed and not indicated to be salvaged or saved.
- C. Materials and Equipment to Be Salvaged:
  - 1. Communications Infrastructure equipment to be removed that is in good working order shall be carefully removed and offered to the Owner. Items rejected by the Owner shall be removed from the project site and legally and properly disposed of.
  - 2. Remove, demount, and disconnect existing communications materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.
- D. Remove existing conduit and wire back to the Communications Equipment room unless a specific extent of removal is indicated on the Drawings.
- E. Communications Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
  - 1. Inactive and obsolete raceways, fittings, supports and specialties, equipment, wiring, controls, fixtures, and insulation:
    - a. Raceways and outlets embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Cut embedded raceways to below finished surfaces, seal, and refinish surfaces as specified or as indicated on the Architectural Finish Drawings. Remove materials above accessible ceilings. Cap raceways allowed to remain.
    - b. Perform cutting and patching required for demolition in accordance with Division 01, General Conditions and "Cutting and Patching" portion of this Section in Division 27.

### 3.7 ACCESS TO EQUIPMENT

- A. Locate all pull boxes, junction boxes and controls to provide easy access for operation, service inspection and maintenance. Provide an access door where equipment or devices are located above inaccessible ceilings. Refer to 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO-VIDEO.
- B. Maintain all code required clearances and clearances required by manufacturers.

**3.8 PENETRATIONS**

- A. Unless otherwise noted as being provided under other divisions, provide sleeves, box frames, or both, for openings in floors, walls, partitions, and ceilings for all electrical work that passes through construction. Refer to 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO-VIDEO.
- B. Provide sleeves, box frames, or both, for all conduit, cable, and cable trays that pass-through masonry, concrete or block walls.
- C. The cutting of new and/or existing construction will not be permitted except by written approval of the Contract Administrator.

**3.9 EXCAVATION AND BACKFILLING**

- A. Refer to Division 01, Division 02 and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.
- B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this division. Excavation shall be in conformance with applicable Divisions and sections of the Specifications.
- C. Restore roads, alleys, streets, and sidewalks damaged during this work to the satisfaction of Authorities Having Jurisdiction.
- D. Do not excavate trenches close to walks or columns without prior consultation with the Contract Administrator.
- E. Erect barricades around excavations, for safety, and place an adequate number of amber lights on or near the work and keep those burning from dusk to dawn. Be responsible for all damage that any parties may sustain in consequence of neglecting the necessary precautions in prosecuting the work.
- F. Slope sides of excavations to comply with local, state, and federal codes and ordinances. Shore and brace as required for stability of excavation.
- G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state, and federal codes and authorities. Maintain shoring and bracing in excavations regardless of period excavations will be open.
  - 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inch below finished grade elevation.
- H. Install sediment and erosion control measures in accordance with local codes and ordinances.
- I. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
  - 1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
  - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.
- J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.



1. Locate and retain soil materials away from edge of excavations. Do not store within dripline of trees indicated to remain.
  2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- K. Excavation for Underground Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 ft; plus, a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
1. Excavate, by hand, areas within dripline of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
  2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.
- L. Trenching: Excavate trenches for communications installations as follows:
1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of raceway and cables.
  2. Excavate trenches to depth indicated or required for raceway and cables to establish slope, away from buildings and indicated elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
  3. Limit the length of open trench to that in which raceway and cables can be installed, tested, and the trench backfilled within the same day.
  4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceway and cables. Provide a minimum of six inches of stone or gravel cushion between rock bearing surface and raceway and cables.
  5. Excavate trenches for raceway, cables, and equipment with bottoms of trench to accurate elevations for support of raceway and cables on undisturbed soil.
- M. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.
- N. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
  2. Under building slabs, use drainage fill materials.
  3. Under raceway and cables, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
  4. For raceway and cables less than 30 inch below surface of roadways, provide 4 inch thick concrete base slab support. After installation and testing of raceway and cables, provide a 4 inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
  5. Other areas use excavated or borrowed materials.
- O. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
  2. Removal of concrete formwork.
  3. Removal of shoring and bracing, and backfilling of voids.



4. Removal of trash and debris.
- P. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inch in loose depth for material compacted by heavy equipment, and not more than 4 inch in loose depth for material compacted by hand-operated tampers.
  1. For vertical and diagonal raceway installations, thoroughly support raceways from permanent structures or undisturbed earth at no less than 10 ft intervals, while placing backfill materials, so that raceways are not deflected, crushed, broken, or otherwise damaged by the backfill placement.
- Q. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- R. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.
- S. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below:
  1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D1557 and not less than the following percentages of relative density, determined in accordance with ASTM D4253, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
    - a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inch of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    - b. Areas Under Walkways: Compact top 6 inch of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    - c. Other Areas: Compact top 6 inch of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
  2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or after, compaction operations.
- T. Subsidence: Where subsidence occurs at mechanical installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

### 3.10 CUTTING AND PATCHING

- A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.

- B. Obtain permission from the Contract Administrator prior to cutting. Do not cut or disturb structural members without prior approval from the Contract Administrator and Structural Engineer.
- C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Contract Administrator and Structural Engineer prior to performing any work. Obtain approval from Contract Administrator and Structural Engineer for all core drills and penetrations at least four days prior to performing work.
- D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.
- E. Patch around openings to match adjacent construction, including fire ratings, if applicable.
- F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Contract Administrator.

### **3.11 PAINTING**

- A. Refer to Division 09 Section "Painting" for painting requirements.
- B. Paint exposed ferrous surfaces, including, but not limited to, hangers, equipment stands and supports using materials and methods as specified under individual sections and Division 09 of the Specifications; colors shall be as selected by the Contract Administrator.
- C. Re-finish all field-threaded ends of galvanized conduits and field-cut ends of galvanized supports with a cold-galvanizing compound approved for use on conductive surfaces. Follow closely manufacturer's instructions for pre-cleaning surfaces and application.
- D. Factory finishes and shop priming, and special finishes are specified in the individual equipment Specification sections.
- E. Where factory finishes are provided and no additional field painting is specified, touch up or refinish, as required by, and to the acceptance of, the Contract Administrator, marred or damaged surfaces so as to leave a smooth, uniform finish. If, in the opinion of the Contract Administrator, the finish is too badly damaged to be properly re-finished, replace the damaged equipment or materials at no additional costs to the Owner.

### **3.12 CLEANING**

- A. Remove dirt and refuse, resulting from the performance of the Work, from the premises as required to prevent accumulation. Cooperate in always maintaining reasonably clean premises.
- B. Immediately prior to final inspection, make a final cleanup of dirt and refuse resulting from Work and assist in making the premises vacuum clean. Clean all material and equipment installed under this Division.
- C. Remove dirt, dust, plaster, stains, and foreign matter from all surfaces.
- D. Touch up and restore damaged finishes to their original condition.
- E. All communications equipment shall be thoroughly vacuumed and wiped clean prior to startup and at the completion of the project. Equipment shall be opened for observation as required.

### **3.13 ADJUSTING ALIGNING AND TESTING**

- A. Adjust, align, and test all equipment furnished and/or installed under this Division.
- B. Check and test protective devices for specified and required application and adjust as required.

- C. Verify that completed wiring system is free from short circuits, unintentional grounds, low insulation impedances, and unintentional open circuits.
- D. Notify the Contract Administrator immediately of all operational failures caused by defective material, labor, or both.
- E. Refer to individual Sections for additional and specific requirements.

### **3.14 START-UP OF SYSTEMS**

- A. Prior to start-up of each system, check all components and devices to confirm compliance with manufacturers' recommended installation procedures.
- B. Demonstrate that all equipment and systems perform properly as designed per Drawings and Specifications.
- C. Refer to individual Sections for additional and specific requirements.

### **3.15 SUBSTANTIAL COMPLETION REVIEW**

- A. Prior to requesting a site observation for "CERTIFICATION OF SUBSTANTIAL COMPLETION", complete the following items:
  - 1. Submit results of systems tests and adjustments per each individual section.
  - 2. Submit complete Operation and Maintenance Data.
  - 3. Submit complete Record Drawings.
  - 4. Perform all required training of Owner's personnel.
  - 5. Turn over all spares and extra materials to the Owner, along with a complete inventory of spares and extra materials being turned over.
  - 6. Perform start-up tests of all systems.
  - 7. Remove all temporary facilities from the site.
  - 8. Comply with all requirements for Substantial Completion in the Division 01 and General Conditions.
- B. Request in writing a review for Substantial Completion and scheduling of final acceptance. Provide a minimum of 8 business days' notice.
- C. State in the written request that the Contractor has complied with the requirements for Substantial Completion.
- D. Upon receipt of a request for review, the Contract Administrator will either proceed with the review or advise the Contractor of unfilled requirements.
- E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above-mentioned items, then provide reimbursement to the Contract Administrator and Design Consultant for time and expenses incurred for the visit.
- F. Upon completion of the review, the Contract Administrator and Design Consultant will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.
- G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.
- H. Prior to requesting a final review, submit a copy of the final list of items to be completed or corrected. State in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

### **3.16 EARLY OCCUPANCY**

- A. Failure to meet the Substantial Completion date can result in the Owner needing to take early occupancy. Complete the systems which are necessary to allow partial early occupancy of the building by original Substantial Completion date.
  - 1. Refer to individual sections for additional requirements.
- B. Verify and comply with requirements for temporary occupancy with the local Building and Fire Departments.

**END OF SECTION**

**SUBSTITUTION REQUEST FORM**

To Project Engineer: \_\_\_\_\_ Request # (GC Determined): \_\_\_\_\_

Project Name: \_\_\_\_\_

Project No/Phase: \_\_\_\_\_ Date: \_\_\_\_\_

Specification Title: \_\_\_\_\_

Section Number: \_\_\_\_\_ Page: \_\_\_\_\_ Article/Paragraph: \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_

Manufacturer: \_\_\_\_\_ Model No.: \_\_\_\_\_

Address: \_\_\_\_\_ Phone: \_\_\_\_\_

History:  New product  1-4 years old  5-10 years old  More than 10 years old

Differences between proposed substitution and specified Work: \_\_\_\_\_

Point-by-point comparative data attached – REQUIRED BY ENGINEER  
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached:  Drawings  Product Data  Samples  
 Tests  Reports  Other: \_\_\_\_\_

Reason for not providing specified item: \_\_\_\_\_

Similar Installation:  
Project: \_\_\_\_\_ Architect: \_\_\_\_\_  
Address: \_\_\_\_\_ Owner: \_\_\_\_\_  
Date Installed: \_\_\_\_\_

Proposed substitution affects other parts of Work:  No  Yes; explain: \_\_\_\_\_

**Substitution Certification Statement:**

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

- A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
- B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
- C. Proposed substitution does not affect dimensions and functional clearances.
- D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
- E. Same warranty will be furnished for proposed substitution as for specified Work.
- F. Same maintenance service and source of replacement parts, as applicable, is available.
- G. Proposed substitution will not adversely affect other trades or delay construction schedule.
- H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor	Date	Company
-----------------------	------	---------

**Manufacturer's Certification of Equal Quality:**

I \_\_\_\_\_ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative	Date	Company
-------------------------------	------	---------

**Engineer Review and Recommendation Section**

Recommend Acceptance     Yes     No

Additional Comments:     Attached     None

**Acceptance Section:**

Contractor Acceptance Signature	Date	Company
Owner Acceptance Signature	Date	Company
Architect Acceptance Signature	Date	Company
Engineer Acceptance Signature	Date	Company



**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO-VIDEO****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Grounding and bonding for communications systems
- B. Pathways for communications systems
  - 1. Hangers and Supports
    - a. Cable hook supports (J-hooks)
    - b. Cable supports (saddle or loop)
  - 2. Conduits and Backboxes
    - a. Conduit
    - b. Pull boxes
    - c. Floor boxes and poke throughs
  - 3. Underground ducts and raceways
  - 4. Sleeves and sleeve seals
    - a. Sleeves in unrated barriers
    - b. Sleeves in acoustical barriers
  - 5. Access panels
- C. Fire Stop Systems
- D. Identification for communications system

**1.2 RELATED REQUIREMENTS**

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- C. Section 26 05 36 - CABLE TRAYS FOR ELECTRICAL SYSTEMS.
- D. Section 26 05 39 - UNDERFLOOR RACEWAYS FOR ELECTRICAL SYSTEMS.
- E. Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO.
- F. Section 27 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS
- G. Section 27 05 48 - SEISMIC CONTROLS FOR COMMUNICATIONS SYSTEMS
- H. Section 27 10 00 - STRUCTURED CABLING
- I. Section 27 41 00 - AUDIO VIDEO SYSTEMS
- J. Section 27 41 16 - AUDIO VIDEO SYSTEMS EQUIPMENT

**1.3 DEFINITIONS**

- A. AV: Audio Video
- B. Cable Tray or Cable Tray System: A unit or assembly of units or sections and associated fittings forming a structural system used to securely fasten or support cables and raceways.
- C. Common Work: Work specified in this section.

- D. Conduit Body: A separate portion of a conduit or tubing system that provides access through a removeable cover(s) to the interior of the system at a junction of two or more sections of the system or at a terminal point of the system. Boxes such as FS and FD or larger cast or sheet metal boxes are not classified as conduit bodies.
- E. Conveniently Accessible: Capable of being reached from the floor or via the use of an 8 ft step ladder without crawling or climbing over or under obstacles such as piping, duct work, motors, transformers, pumps, etc.
- F. Firestop System Assembly: Firestopping products tested and rated by a Nationally Recognized Testing Laboratory (NRTL), such as UL, to provide the required flame (F), fire and temperature (T), air and smoke (L), and water (W) containment for a given partition/penetration.
- G. Floor Box Assembly (Floor Box): An on-grade solution or above grade (with a native fire classification or in combination with an approved Firestopping System) solution for in-floor terminations. The Assembly consists of pour pan (as applicable), Firestopping System (as applicable), floor box (compartment), plate mounting brackets, line voltage divider plates, termination plates, termination connectors, electrical receptacle(s), gang plates (termination cover plates), and access door / cover / lid.
- H. Ground or Grounding: A conducting connection, whether intentional or accidental, between an electrical circuit (e.g. telecommunications) or equipment and the earth, or to some conducting body that serves in place of earth.
- I. IMC: Intermediate Metal Conduit
- J. Plenum: A compartment or chamber to which one or more air ducts are connected and forms part of the air distribution system.
- K. Plenum-rated: A product listed by a NRTL as being suitable for installation into a plenum space.
- L. Point of Entrance (Building Entrance): The point within a building where the Outside Plant (OSP) communications cabling emerges from an external wall, a concrete floor slab, or IMC/RMC. If Communications Point of Entrance isn't identified on the drawings, assume the Main Communications (MDF) also acts as the Point of Entrance.
- M. Poke Through Assembly (Poke-Thru): An above grade solution with a native fire classification for in-floor terminations. The Assembly consists of pre-pour sleeve (as applicable), Firestopping System, fire resistant conduit stub, poke thru (compartment), plate mounting brackets, line voltage divider plates, termination plates, termination connectors, electrical receptacle(s), gang plates (termination cover plates, as applicable), and access door / cover / lid.
- N. Quality Control Specialist: as it pertains to Work within this Section, quality control specialist is Project AVIXA CTS-I.
- O. RMC: Rigid Metal Conduit
- P. Surface Metal Raceway: A metallic raceway intended to be mounted to the surface of a structure, with associated couplings, connectors, boxes, and fittings for the installation of electrical conductors.
- Q. Surface Nonmetallic Raceway: A nonmetallic raceway intended to be mounted to the surface of a structure, with associated couplings, connectors, boxes, and fittings for the installation of electrical conductors.

R. UL: Underwriters Laboratory

#### 1.4 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASHRAE Handbook - ASHRAE Handbook Online; Online Edition.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- F. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- G. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- I. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- J. FM 4991 - Approval Standard of Firestop Contractors; 2013.
- K. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- L. NEMA VE 1 - Metal Cable Tray Systems; 2017.
- M. NEMA VE 2 - Cable Tray Installation Guidelines; 2018.
- N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).
- P. TIA-607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises; 2019d, with Addendum (2021).
- Q. UL (DIR) - Online Certifications Directory; Current Edition.
- R. UL (FRD) - Fire Resistance Directory; Current Edition.
- S. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.
- T. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
- U. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Adjust location of pathways for communications systems to accommodate the work to prevent interferences, both anticipated and encountered. Determine the route and location of each conduit prior to fabrication:
  - 1. Right-of-Way: Lines which pitch shall have the right-of-way over those which do not pitch. For example: condensate, steam, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
  - 2. Provide offsets, transitions and changes in direction of conduit as required to maintain proper headroom and pitch on sloping lines.
  - 3. So connecting raceways, cables, and wireways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed.

## 1.6 SUBMITTALS

- A. Refer to 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO for submittal procedures.
- B. Pre-construction submittal
  - 1. Manufacturers' cut sheets or catalog cut sheets
    - a. Size - including physical and loading dimensions
    - b. Maximum span length
    - c. Weight supported
    - d. Type
    - e. Fittings to be used
    - f. Method of attachment to structure
    - g. Firestop system assembly information for each system to be installed:
      - 1) Firestop manufacturer
      - 2) UL system number
      - 3) F, T, L and W Ratings
      - 4) The complete description of the firestop system; To include what specific construction the system is intended to pass through such as a wall or floor assembly, the penetrating items allowed to pass through the opening in the wall or floor assembly, and the materials designed to prevent the spread of fire through the openings.
  - 2. Shop drawings
    - a. Submit for review scaled layout drawings showing the size/routing of all pathways and the size/information/locations of all boxes, pull boxes, firestops, and access panels.
      - 1) Each pathway shall be identified by type and size on the drawings.
        - a) Example #1: 4" EMT
        - b) Example #2: 4" x 12" Cable Tray
      - 2) Each grounding conductor shall be identified by size (and insulation)

- a) Example: #3/0 insulated ground
  - 3) Each firestop system shall be identified by manufacturer and product, as well as UL system number for each location.
    - a) Example #1: EZ-Path Series 22, UL System W-L-3255
    - b) Example #2: Specseal Power Shield, UL QCSN/CLIV.R14288
  - 4) Each pull box and access panel shall be identified by size and height above finished floor.
    - a) Pull box Example: Pull box 8" x 24" x 40" approximately 12' AFF.
  - b. Unless otherwise required by these specifications, it is permissible to show pathways systems (conduit, cable tray, auxiliary supports, etc.) on the same shop drawing along with the cabling and system work to be installed through those pathways. Individual pathways shall be separate shop drawings. Shared pathways such as cable tray shall be shown on both shop drawings. Refer to individual sections for specific requirements.
- 1) 27 41 00 - AUDIO VIDEO SYSTEMS

C. Project Completion

1. As-Built Drawings:

- a. The quality control specialist shall review the installation and as-built drawings for the common work results required for their scope of work and shall stamp the final as-built drawings with CTS-I stamp before submission. By stamping the as built drawings, the quality control specialist indicates that the common work results have been installed per the contract documents and associated codes, standards, and guidelines, and changes to the drawings have been incorporated into the as-built drawings.

2. Pictures of each firestop system

**1.7 QUALITY ASSURANCE**

- A. Submittals and shop drawings for common work results specified in this section shall, if not created by, be reviewed by the Quality Control Specialist.

- 1. The Quality Control Specialist shall stamp relevant submittals for their associated Division 27 sections, which indicates at a minimum, the proposed work has been reviewed by them and found to be in compliance in regard to:
  - a. Applicable codes and industry standards and guidelines referenced in Division 27.
  - b. Full coordination with other trades and to be installed per the construction documents.
  - c. Installed per manufacturer's direction.

- B. The Quality Control Specialist shall make weekly inspections during construction to ensure all work installed per this section is correct.

- 1. Identified deficiencies encountered prior to and during installation shall be corrected by the installing Contractor under the direction of the Quality Control Specialist and/or the Design Consultant.

C. Firestopping systems

- 1. Firestopping material and systems shall be tested and listed by UL. Firestopping products shall bear UL classification marking.
- 2. Installation technicians shall be by qualified and trained personnel. Acceptable installer qualifications are as follows:

- a. FM Research, approved in accordance with FM 4991.
- b. Individuals who are trained and certified by the firestopping manufacturer. For Specified Technologies, installers shall have FIT Level 1 certification.
- D. Copies of documents at project site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- E. Products: Listed, classified, and labeled as suitable for the purpose intended.
- F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

### 1.8 DELIVERY STORAGE AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep stored products clean and dry.

### 1.9 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a 2 year period after date of substantial completion.

### 1.10 NOISE CRITICAL SPACES

- A. Many areas of the building, referred to as "noise-critical spaces", require special attention (special acoustical provisions and restrictions). The table below designates a partial list of noise-critical spaces. See ASHRAE Handbook: HVAC Applications, "49. Noise and Vibration Control" for full list.

<u>Space</u>	<u>RC Level</u>
Teleconference Rooms	25
Meeting/Banquet Rooms	30
Conference Rooms	30

## PART 2 PRODUCTS

### 2.1 GROUNDING AND BONDING FOR COMMUNICATIONS

- A. Refer to Drawings and following Division 27 Sections for grounding and bonding requirements.
  - 1. 27 41 00 - AUDIO VIDEO SYSTEMS

### 2.2 PATHWAYS FOR COMMUNICATIONS SYSTEMS

- A. Hangers and Supports
  - 1. Cable hook supports (J-hooks)
    - a. Basis of design
      - 1) Above ceiling: Eaton Corporation PLC; B-Line series BCH21, BCH32, BCH64
      - 2) Below raised floor: Eaton Corporation PLC; B-Line series BCH21, BCH32, BCH64 with appropriate underfloor support bracket
    - b. Other acceptable manufacturers
      - 1) Hilti, Inc
      - 2) MonoSystems
      - 3) nVent Electric PLC; Caddy

- 4) Panduit Corporation
- 5) Snake Tray
- 6) Substitution: See Section 01 60 00 - Product Requirements.
- c. Description
  - 1) Non-continuous cable supports shall be designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 2) Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
  - 3) Have a flat bottom and sufficient width to comply with the minimum bend radius of all cabling as required by the referenced standards and manufacturers recommendations.
  - 4) Be open for easy lay-in and removal of cabling.
  - 5) Be designed so the mounting hardware is recessed to prevent cable damage.
  - 6) Cable hooks for non-corrosive areas shall be pre-galvanized steel, ASTM A653/A653M. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish, ASTM B633, SC3
  - 7) Cable hooks for corrosive areas shall be stainless steel, AISI Type 304
  - 8) Be factory assembled for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc. to meet job conditions.
  - 9) Be factory assembled multi-tiered cable hooks, shall be used where required to provide separate cabling compartments, or where additional capacity is needed.
2. Cable supports (saddle or loop)
  - a. Basis of design
    - 1) Above ceiling: nVent CADDY CAT 425, 425A6
  - b. Other acceptable manufacturers
    - 1) Arlington Fittings
    - 2) nVent Electric PLC; Caddy
    - 3) Substitution: See Section 01 60 00 - Product Requirements
  - c. Description
    - 1) Non-continuous cable supports shall be designed to prevent degradation of cable performance and pinch points that could damage cable.
    - 2) Suitable for air handling spaces (plenum)
    - 3) Adjustable strap allows for multiple support sizes to reduce inventory.
- B. Conduit and Backboxes
  1. Conduit
    - a. Manufacturers
      - 1) Refer to Section 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS for list of Manufacturers.
    - b. Description
      - 1) Refer to Section 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS for product and material information. Sizes, methods, and more stringent requirements shall be adhered to when specified in this Division.
      - 2) Conduits provided as connection to incoming services, utilities, including private services to other buildings or outside connection points shall be rigid metal or

intermediate metal conduit at the point it enters the building, emerges from an exterior wall or ground floor slab to the final termination/transition point.

- 3) If services enter a room or space such as a mechanical room, electrical room or other intermediate room due to convenience or proximity to the exterior and adequate space has not been provided within 50 ft for the equipment needed for transitioning these and future cables/services to an appropriately rated indoor cable then those conduits shall be continued uninterrupted (except for necessary pull boxes) to the final connection point or location where the transition point has been designated. Generally, this connection point will be a designated Entrance Room for Communications or the Main Telecommunication space. If space has not been identified the Contractor shall request information prior to bid.
- 4) Provide conduit as indicated on the drawings or required by this specification. Minimum conduit size for structured cabling shall be 1 inch. Provide a polypropylene or monofilament plastic line with not less than 200 lb tensile strength in each empty conduit. Permanently mark or tag each conduit or pull box, identifying it as communications (Telecom), AV, TV, Broadcast, Intercom, etc.), at intervals of not more than 75 ft. Each conduit stubbed into the ceiling space from an outlet box shall be permanently marked or tagged; refer to labeling requirements in Part 3 Execution.
- 5) Route an empty conduit from each outlet box into the ceiling space above and terminate with a nylon bushing. In rooms with a non-accessible ceiling, route conduits to the nearest accessible corridor ceiling or communications space.
- 6) Typical conduit size for number of telecommunications cables. Size per TIA-569.

Number of Telecommunications Cables	Conduit Size
Up to 4	1 inch
Up to 8	1-1/4 inch

2. Pull Boxes
  - a. Basis of design: nVent Electric PLC; Hoffman Screw-Cover, Type 1
  - b. Other acceptable manufacturers:
    - 1) NEMA Enclosures
    - 2) Madison Electric, Smart L
    - 3) Wiegmann
    - 4) Or Approved Substitution (submitted and accepted in the pre-bid submittal)
  - c. Description
    - 1) NEMA 250 Type 1
    - 2) Interior use only
    - 3) Refer to Part 3 Execution for sizing requirements.
    - 4) Flat, removable covers fastened with plated steel screws
    - 5) Shall be keyed
3. Floor Boxes and Poke Throughs
  - a. Refer to floor box and poke through schedule on Audio Video, Electrical, and Telecommunications drawings.



- b. Include provisions for mounting communications faceplate and connectors in accordance with the requirements of the structured cabling manufacturer.  
Telecommunications outlet termination plate and termination connectors shall be provided per 27 10 00 - STRUCTURED CABLING. Coordinate all other assembly components to ensure compatibility.
  - c. Audio Video custom termination plates and connectors shall be provided per Section 27 41 00 - AUDIO VIDEO SYSTEMS and/or 27 41 16 - AUDIO VIDEO SYSTEMS EQUIPMENT. Coordinate assembly components to ensure compatibility.
- C. Underground Ducts and Raceways
- 1. General
    - a. Refer to Section 26 05 39 - UNDERFLOOR RACEWAYS FOR ELECTRICAL SYSTEMS and Section 27 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS for additional requirements. Where a conflict exists between Division 26 and Division 27 the more stringent requirements shall apply.
  - 2. Handholes - for exterior, in-grade applications
    - a. Basis of Design: Hubbell Incorporated; Quazite PG
    - b. Other Acceptable Manufacturers
      - 1) Armorcast Products Company
      - 2) CRH PLC; Oldcastle Infrastructure
      - 3) MacLean Highline
      - 4) NewBasis
      - 5) Substitution: See Section 01 60 00 - Product Requirements
    - c. Description
      - 1) Size: 11 inch x 18 inch x 12 inch
      - 2) Design Load: 22,500 lb, tier 22
      - 3) For use with one or two conduits, 2 inch diameter and smaller are installed.
      - 4) Construction: Polymer Concrete with straight side with open bottom
- D. Sleeves and Sleeve Seals
- 1. Sleeves in unrated barriers
    - a. Manufacturers
      - 1) Refer to Section 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS for list of Manufacturers.
    - b. Description
      - 1) Nylon bushings at cable entry and exit, UL listed for plenum (UL 2043)
      - 2) Conduit waterfall at areas where cables exiting sleeve will be damaged from pinch point or over bending. Panduit Corporation CWF400 or equal.
  - 2. Sleeves in acoustical barriers
    - a. Basis of Design: Specified Technologies, Incorporated 33NEZ
    - b. Other Acceptable Manufacturers
      - 1) 3M
      - 2) Hilti Corporation
      - 3) Or Approved Substitution (submitted and accepted in the "pre-bid" phase)
    - c. Description
      - 1) For use in place of conduit sleeves through walls of noise critical spaces.
-

- 2) Plenum Rated (to UL 2043)
  - 3) Sound Transmission Classification (STC) as tested per ASTM E90 shall be greater than 60.
- E. Access Panels
1. Manufacturers
    - a. Activar/J.L Industries
    - b. Acudor Products
    - c. Alfab/Barco
    - d. Elmdor Products
    - e. Karp Associates, Inc.
    - f. Milcor
    - g. Nystrom Building Products
    - h. Williams Brothers
    - i. Wind-lock
    - j. Substitution: See Section 01 60 00 - Product Requirements
  2. Description
    - a. Where pull boxes are required above inaccessible ceiling spaces, or for other required conditions, provide an appropriately sized access panel.
    - b. Steel access doors and frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation.
      - 1) Joints and seams: continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
      - 2) Frames: 16-gauge steel, with a 1 inch wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling:
      - 3) For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch wide exposed perimeter flange and adjustable metal masonry anchors.
      - 4) For gypsum wallboard or plaster: perforated flanges with wallboard bead.
      - 5) For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
      - 6) Flush panel doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
      - 7) Fire-rated units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
    - c. Locking devices: Where indicated, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.
    - d. Indicate proposed size and locations on pre-construction shop drawings. No access panels shall be installed without Architect and Design Consultant approval.

### 2.3 FIRE STOP SYSTEMS

- A. Basis of design
1. Barrier penetration: Specified Technologies Incorporated EZ-Path
  2. Back boxes in fire-rated wall: Specified Technologies Incorporated SpecSeal Power Shield

3. Other applications: Specified Technologies Inc. - submit UL System documentation for each floor/wall type and product cutsheets for all STI materials to be utilized.
- B. Other acceptable manufacturers
1. 3M
  2. Hilti
  3. Substitution: See Section 01 60 00 - Product Requirements
- C. Description
1. General
    - a. Refer to Section 07 84 00 - Firestopping for additional requirements. Where a conflict exists between Division 07 and Division 27 the more stringent requirements shall apply.
    - b. Communications ladder rack and cable tray shall not continue through a fire-rated wall. Stop the tray, install multiple fire-rated pathway devices, and continue tray on the other side. Ensure grounding of the tray is continuous through the wall.
  2. Barrier penetration - for sleeves through a single penetration (wall or floor)
    - a. Minimum performance requirements: Shall meet testing requirements of ASTM E814 or UL 1479; Shall be installed in accordance with the NRTL. Provide fire stop systems appropriate for the specific application and in accordance with manufacturer's instructions.
    - b. Shall meet or exceed the ratings of the wall or floor that it penetrates.
    - c. Shall be a prefabricated and zero-maintenance solution which requires no action to activate the fire and smoke protective characteristics of the device.
    - d. Allows the installation and removal of cables without the need to remove or add materials.
    - e. Used to seal penetrations of cables through fire rated partitions.
  3. Back boxes in fire-rated walls
    - a. Used to seal backboxes in fire rated partitions.
    - b. Minimum performance requirements: Shall meet UL testing requirements of UL 263 and classified as Wall Opening Protective Material (QCSN or CLIV); Shall be installed in accordance with the NRTL. Shall meet or exceed the ratings of the wall or floor that it is located in.
    - c. Provide fire stop systems appropriate for the specific application and in accordance with manufacturer's instructions.
  4. Other applications
    - a. For fire-rated penetrations where the conduit pathway extends beyond a single fire-rated partition/floor, and other required firestopping applications not previously addressed in this specification.
    - b. Shall be UL listed for the specific application; Shall meet or exceed the ratings of the wall or floor that it penetrates.
- D. Identification
1. Label Printers
    - a. Manufacturer
      - 1) Aptiv PLC; HellermannTyton
      - 2) Brady Corporation
-

- 3) Brother International Corporation
  - 4) Epson Labelworks PX
  - 5) Newell Company; DYNMO
  - 6) Panduit Corporation
  - 7) Substitution: See Section 01 60 00 - Product Requirements
- b. Description
- 1) Refer to additional requirements in Part 3.
  - 2) Refer to individual sections for additional identification requirements for work.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Pathways for communications
1. General
    - a. Refer to Division 26 for additional installation requirements.
      - 1) Where a conflict exists between Division 26 and Division 27, the more stringent requirements shall apply.
    - b. Refer to Section 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS for pathway requirements in telecommunications spaces.
    - c. Supports shall be manufactured to support the required cable weight and volume. Field fabricated supports will not be accepted.
    - d. Install a pull cord in each pathway (empty or not) for installation of new wires or cables. Use polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at each end of pull cord.
    - e. Unless otherwise noted, pathway routing shown on the drawings is illustrative only and meant to indicate the general configuration of the work. Install pathways so that adequate clearances and offsets between pathways and other trades are provided. Coordinate all pathways with other trades prior to installation.
    - f. Pathways shall include empty space for a minimum of 25% growth beyond initial installation of cabling.
    - g. Cables shall be rigidly supported by cable pathways as indicated on the drawings. Cables shall be physically supported at intervals not to exceed 5 ft.
    - h. Store and keep products dry in original container in a climate-controlled environment until installation is to occur.
    - i. Install communications pathways:
      - 1) So that cables are pulled in accordance with referenced standards and guidelines.
      - 2) So that cables are pulled without damage to conductors, shield, armor, or jacket.
      - 3) So that cables are not forced or exceed minimum bend radius by manufacturer or referenced standards and guidelines.
      - 4) So that the maximum pulling tension is not exceeded.
      - 5) To meet the requirements of the structure and the requirements of other work on the project.
      - 6) To clear openings, depressions, ducts, pipes, reinforcing steel, etc.

- 7) Within or passing through the concrete structure in such a manner so as not to adversely affect the integrity of the structure. Become familiar with the Architectural and the Structural Drawings and their requirements affecting the raceway installation. If necessary, consult with the Architect.
  - 8) Parallel or perpendicular to building lines or column lines.
  - 9) When concealed, with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- j. Cables shall remain unattached to pathways or other cables and shall simply lay at rest on the supports provided by its pathway (including cable trays, wire basket, j-hooks, conduit, etc.). Zip ties, Velcro straps, electrical tape or other methods shall not be used to attach cables to cable supports, UON.
- 1) Except when supported by ladder racking within each telecommunications room, UON.
- k. Provide sufficient communications pathways so that cables are not forced to attach, be supported, or use other pathways not specifically designed and provided for communications cable purposes. Deviation from this will not be accepted.
- 1) At no point shall cables come in contact with, be supported by, or attach to other trades equipment or supports. UON
- l. Provide appropriately sized sleeves where cables are required to pass through non-rated full-height partitions. Where allowed, sleeves shall extend a minimum of 3 inch beyond the partition surface on both sides and shall be rigidly supported to support the weight of cables. Sleeves shall be sized no more than 50% of the cross-sectional area is utilized by the cabling to be installed. The minimum inside diameter of each sleeve shall be nominal 2 inch.
- m. Suspended cables shall be installed with at least 3 inch of clear vertical space above the ceiling tiles and support channels (T-bars).
- n. Waterproofing
- 1) Avoid, if possible, the penetration of waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, make penetration prior to the waterproofing and furnish any sleeves or pitch-pockets required. Advise the architect and obtain written permission before penetrating waterproof membrane, even where such penetration is shown on the drawings.
  - 2) Restore waterproofing integrity of walls or surfaces after they have been penetrated without additional cost to the Owner.
- o. Cutting and Patching
- 1) Where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for the proper installation, support or anchorage of conduit or other equipment, layout the work carefully in advance. Repair damage to the building, piping, equipment or defaced finished plaster, woodwork, metalwork, etc. using skilled tradespeople of the trades required at no additional cost to the Owner.
    - a) Do not cut, channel, chase or drill masonry, tile, etc., unless permission from the architect is obtained. If permission is granted, perform this work in a manner acceptable to the Architect.

- b) Patch around openings to match adjacent construction.
  - c) Where conduit or equipment is mounted on a painted finished surface, or a surface to be painted, paint to match the surface. Cold galvanize bare metal whenever support channels are cut.
  - d) Provide slots, chases, openings and recesses through floors, walls, ceilings, and roofs as required. Where these openings are not provided, provide cutting and patching to accommodate penetrations at no additional cost to the Owner.
  - e) After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Architect.
- p. Mounting Heights
- 1) Mounting heights for equipment and devices requiring operational access shall conform to ADA Standards.
    - a) Unobstructed forward reach - Wall mounted devices requiring operational access shall be mounted a minimum of 15 inch above finished floor to bottom of device and a maximum of 48 inch above finished floor to top of device.
    - b) Obstructed forward reach with less than 20 inch counter - Wall mounted devices requiring operational access shall be mounted a minimum of 34 inch above finished floor to bottom of device and a maximum of 48 inch above finished floor to top of device.
    - c) Obstructed forward reach with 20 inch to 25 inch counter - Wall mounted devices requiring operational access shall be mounted a maximum of 44 inch above finished floor to top of device.
    - d) Unobstructed side reach - Wall mounted devices requiring operational access shall be mounted a minimum of 15 inch above finished floor to bottom of device and a maximum of 48 inch above finished floor to top of device.
    - e) Obstructed side reach with less than 10 inch counter - Wall mounted devices requiring operational access shall be mounted a maximum of 48 inch above finished floor to top of device.
    - f) Obstructed side reach with 10 inch to 24 inch counter - Wall mounted devices requiring operational access shall be mounted a maximum of 46 inch above finished floor to top of device.
  - 2) Mounting heights shall be from floor to center of device, unless otherwise noted. Verify locations and mounting heights with the architect before installation.
  - 3) Typical mounting heights shall match nearest adjacent electrical outlet mounting height UON or as directed by the architect.
- q. Painting
- 1) Refer to Division 09 for painting requirements.
  - 2) Paint exposed ferrous surfaces, including, but not limited to, hangers, equipment stands and supports using materials and methods as specified under Division 09; colors shall be as selected by the architect.
  - 3) Re-finish field-threaded ends of galvanized conduits and field-cut ends of galvanized supports with a cold-galvanizing compound approved for use on conductive surfaces. Follow closely manufacturer's instructions for pre-cleaning

- surfaces and application.
- 4) Factory finishes and shop priming and special finishes are specified in the individual equipment Specification sections.
  - 5) Where factory finishes are provided and no additional field painting is specified, touch-up or refinish, as required by, and to the acceptance of, the architect and design consultant, marred or damaged surfaces to leave a smooth, uniform finish. If, in the opinion of the architect or design consultant, the finish is too badly damaged to be properly re-finished, replace the damaged equipment or materials at no additional costs to the Owner.
  - 6) Provide touch-up paint as required by specification Sections in this Division.
- r. Fastenings
- 1) Fasten equipment to building structure in accordance with the best industry practice.
    - a) Where weight applied to the attachment points is 100 lb or less, conform to the following as a minimum:
      - (1) Wood: Wood screws.
      - (2) Concrete and solid masonry: Bolts and expansion shields.
      - (3) Hollow construction: Toggle bolts.
      - (4) Solid metal: Machine screws in tapped holes or with welded studs.
      - (5) Steel decking or sub-floor: Fastenings as specified below for applied weights in excess of 100 lb.
    - b) Where weight applied to building attachment points exceeds 100 lb, but is 300 lb or less, conform to the following as a minimum:
      - (1) At concrete slabs provide 24 inch x 24 inch x 1/2 inch steel fishplates on top with through bolts. Fishplate assemblies shall be chased in and grouted flush with the top of slab screed line, where no fill is to be applied.
      - (2) At steel decking or sub-floor for fastenings, provide through bolts or threaded rods. The tops of bolts or rods shall be set at least 1 inch below the top fill screed line and grouted in. Suitable washers shall be used under bolt heads or nuts. In cases where the decking or sub-floor manufacturer produces specialty hangers to work with his decking or sub-floor such hangers shall be provided.
    - c) Where weight applied to building attachment points exceeds 300 lb, coordinate with and obtain the approval of architect and conform to the following as a minimum:
      - (1) Provide suitable auxiliary channel or angle iron bridging between building structural steel elements to establish fastening points. Bridging members shall be suitably welded or clamped to building steel. Provide threaded rods or bolts to attach to bridging members.
    - d) For items, which are shown as being ceiling mounted at locations where fastening to the building construction element above is not possible, provide suitable auxiliary channel or angle iron bridging tying to the building structural elements.
    - e) Wall mounted equipment may be directly secured to wall by means of steel bolts. Groups or arrays of equipment may be mounted on adequately sized



- steel angles, channels, or bars. Prefabricated steel channels as manufactured by Kindorf or Unistrut are acceptable.
- s. For large quantities of cables (greater than 50) that converge upon a common run such as at a rack, in corridors, and other areas, provide cable trays or other special supports manufactured to support the required cable weight and volume.
  - t. Areas identified as noise critical spaces shall have penetrations sealed to minimize sound transmission between adjacent spaces. Install acoustical pathway(s) through walls of noise critical spaces.
2. Access to pathways and associated equipment
- a. Locate cable trays, open hanger cable supports, j-hooks, pull boxes, junction boxes and fire stopping systems to provide easy access for operation, service inspection and maintenance.
  - b. Provide an access panel where equipment or devices are located above inaccessible ceilings. Where access doors are necessary but not shown on the plans, coordination type and location with architect and design consultant through an RFI.
    - 1) Pathways requiring access such as open hanger cable supports, j-hooks, and cable trays shall have an access door or other means of direct access at a minimum of 10 ft intervals.
    - 2) Cables or cable pathways requiring access such as open hanger cable supports, j-hooks, and cable trays may not change directions above an inaccessible ceiling unless complete access to the change of direction in pathway or cable route is within arm's reach 3 ft from adjacent accessible point.
  - c. Maintain code required clearances and clearances required by manufacturers.
3. Cable distribution
- a. Provide pathways for telecommunications (structured cabling system) to allow cabling to be installed in the following manner:
    - 1) For typical new walls:
      - a) Conduit from outlet location to accessible ceiling then j-hooks to main run of cable tray.
    - 2) For existing walls:
      - a) For stud walls (ring and string): Mud ring for faceplate, cabling run in hollow cavity of the wall and then j-hooks are utilized back to the nearest cable tray or serving Telecommunications Room/Space
      - b) For masonry or inaccessible walls - Surface-mounted raceway to accessible ceiling space.
    - 3) For phone and data lines to all elevator equipment rooms and fire alarm panels:
      - a) Homerun method: Conduit from outlet location all the way back to the telecommunications room/space.
    - 4) See drawings for clarification.
  - b. Provide pathways for audio video systems to allow cabling to be installed in the following manner:
    - 1) For typical new walls:
      - a) Homerun method: Conduit from outlet/box location to the AV rack identified on the drawings.
    - 2) For existing walls:



- a) For stud walls (ring and string): Mud ring for faceplate, cabling run in hollow cavity of the wall and then j-hooks are utilized back to the nearest cable tray or serving Telecommunications Room/Space
  - b) For masonry or inaccessible walls - Surface-mounted raceway.
  - 3) See drawings for clarification.
4. Conduits
- a. Conduit shall be of the appropriate type required by code and Division 26.
  - b. Adequate access shall be available where cables enter conduits.
  - c. Bond and ground metallic conduits and boxes in accordance with national or local requirements and with TIA-607.
  - d. Install conduits in the most direct route possible, running parallel to building lines.
  - e. Ream conduit ends and fit ends with an insulated bushing to eliminate sharp edges that can damage cables during installation or service.
  - f. Conduits which enter telecommunications rooms shall extend 3 inch AFF or through the wall.
  - g. Conduits which enter Entrance Facilities shall extend 4 inch AFF or below the finished ceiling (if exists).
  - h. Flexible conduits shall be limited to where specifically allowed by these contract documents.
    - 1) Flexible conduit sections shall be less than 20 ft in length.
  - i. No continuous section of a conduit may exceed 100 ft without a pull box.
  - j. No more than (2) 90° bends, or equivalent will be allowed between pull boxes.
    - 1) Each offset shall be considered a 90° bend.
      - a) A pull box is required wherever a reverse bend is installed.
  - k. The minimum bend radius for conduits is
    - 1) (6) times the inside diameter for 2 inch conduits or less.
    - 2) (10) times the inside diameter for conduits greater than 2 inch.
  - l. Single conduit run may not serve more than (1) outlet location unless expressly indicated on the drawings.
  - m. Where building entrance conduits (for service provider and Owner's WAN cabling) do not enter the building directly into the Communications Entrance Room/Facility, extend those entrance conduits via RMC or IMC into the Communications Entrance Room/Facility.
    - 1) Coordinate with Contractor for 27 13 00 - COMMUNICATIONS BACKBONE CABLING and 27 15 00 - COMMUNICATIONS HORIZONTAL CABLING for potential other pathways where IMC/RMC are required.
  - n. Conduits shall contain no electrical condulets (also known as LBs).
    - 1) Exception: Pre-approved (by the design consultant) condulets manufactured specifically for the purpose of maintaining the minimum bend radius for communications cables. Identify condulet locations on the shop drawings.
  - o. Underground conduit requirements
    - 1) For audio video system cabling serving pole-mounted loudspeakers, broadcast boxes, etc.
    - 2) Requirements
      - a) Refer to applicable details on drawings for illustrative requirements.

- b) Wherever practical, slab-on-grade floor boxes shall have conduit extended underground or in-slab from box to serving communications room or equipment cabinet.
  - (1) Only one horizontal bend is allowed, 90 degrees or less.
  - (2) Indicate proposed routing and stub-up locations on shop drawings.
- c) Route underground conduit so there is no more than (3) 90 degree bends, including stub-up bend at communications room/equipment cabinet.
  - (1) For underground conduit serving outlets/boxes outside the footprint of the building that require more than (3) 90 degree bends, provide appropriately-sized handhole(s). Coordinate location with Architect and Owner, indicate proposed location(s) on shop drawings, and include product information in pre-construction submittals. In general, handholes are not to be in roadways, parking lots, sidewalks, or location subject to vehicular traffic.
- 3) Approved conduit types:
  - a) When routed in slab-on-grade:
    - (1) Horizontal conduit shall be RMC or Schedule 40 PVC, including horizontal bends. If PVC is installed, also install tracer wire.
    - (2) Vertical bends shall be RMC.
  - b) When routed below slab-on-grade or outside the footprint of the building:
    - (1) Horizontal conduit shall be RMC or Schedule 40 PVC a minimum of 12 inch below grade. If PVC is installed, also install tracer wire.
    - (2) All vertical and horizontal bends shall be RMC.
- p. Install approved expansion/deflection fittings where raceways pass through or over building expansion joints.
- q. Route raceway through roof openings for piping and ductwork or through roof seals approved by the architect, the roofing Contractor, or both. Obtain approval for roof penetrations and seal types from the Architect, Owner, roofing Contractor, or all three as required to maintain new or existing roofing warranties.
- 5. Pull Boxes
  - a. Pull boxes shall be placed in conveniently accessible locations.
  - b. Coordinate the location and installation of pull boxes to ensure adequate access is provided.
  - c. Pull boxes above an accessible ceiling shall:
    - 1) Be aligned directly over the ceiling grid to allow access.
    - 2) Be installed with a minimum of 3 inch clearance to ceiling grid and tiles
  - d. No directional changes shall be allowed in pull boxes. Conduit shall continue in the same direction as it enters and then change direction via an appropriately sized bend in the conduit.
  - e. Size pull boxes according to the following chart (all sizes are minimums):

Conduit Trade Size	Width	Length	Depth	Width Increase for Additional Conduit (of same size)

3/4" or smaller	4"	4"	2-1/8"	Not applicable
1"	4"	16"	3"	2"
1-1/4"	6"	20"	3"	3"
1-1/2"	8"	28"	4"	4"
2"	8"	36"	4"	5"
2-1/2"	10"	42"	5"	6"
3"	12"	48"	5"	6"
4"	16"	60"	8"	6"

6. Back boxes
  - a. No back boxes shall be located back-to-back in a wall cavity.
    - 1) Where possible offset to next stud cavity, with a minimum of 6 inch 6 inch separation.
  - b. Outlet boxes shall be within 3 ft of nearest electrical outlet.
  - c. Outlet boxes located in fire-rated walls are to have the appropriate firestopping for backboxes. These locations are to be identified on shop drawings.
  - d. Where cabling enters a backbox directly (not via conduit), provide black rubber grommet on knockout.
7. Cable Tray
  - a. Cable trays shall be installed in accordance with the applicable electrical code and standards.
  - b. The inside of the cable support system shall be free of burrs, sharp edges or projections that can damage cable insulation. Abrasive supports (e.g., threaded rod) installed within the cable fill area shall have portion within the tray rigidly protected with a smooth, non-scratching covering so cable can be pulled without physical damage, such as appropriately rated (plenum) plastic tubing.
  - c. Cables shall remain unattached to its pathway and shall simply lay at rest on the supports provided by its pathway. Zip ties, Velcro straps, electrical tape or other methods shall not be used to attach cables to cable supports, UON.
  - d. Installation of cables shall not exceed the fill requirements stated above.
  - e. Cable trays shall not extend through fire-rated walls and walls for noise critical spaces.
  - f. Cable trays shall not extend over 6 ft length (or greater) of inaccessible ceilings. Stop cable trays just before the inaccessible ceiling and provide overhead conduits of quantity and size bridging the two sections of cable tray so that conduit cable capacity (square inches per fill ratio) is equal to that of the cable tray.
    - 1) The cable fill ratio for cable tray shall be 50%.
    - 2) The cable fill ratio for conduits shall be 40%.
      - a) Example: a 4" x 12" cable tray has 48 square inches of total capacity, and 24 square inches of cable capacity. Per the NEC, a 4" trade size EMT conduit has a 40% cable capacity of 4.62 inches. 24 divided by 4.62, rounding up to the next whole number equals (6) 4" conduits shall be provided for a 4" x 12" cable tray.
  - g. Cable trays and cable runways shall not be used as walkways or ladders.

- h. A minimum of 12 inch access headroom shall be provided and maintained above a cable tray system or cable runway.
  - i. Care shall be taken to ensure other building components (e.g., air conditioning ducts, pipes, conduits) do not restrict access.
  - j. Flexible cable trays shall be supported according to manufacturer's instruction via one of the following:
    - 1) Trapeze/Unistrut under the cable connected to the cable tray and to (2) 3/8 inch (or greater) rods to structure above.
      - a) Center-hung, single-rod supports are not allowed.
    - 2) Shelf or L-brackets attached to wood or metal studs.
  - k. Test cable tray systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with maximum grounding resistance.
- C. Firestopping
- 1. General
    - a. Refer to Division 07 for additional installation requirements.
      - 1) Where a conflict exists between Division 07 and Division 27, the more stringent requirements shall apply.
    - b. Provide fire-resistant materials of a type and composition necessary to restore fire ratings to wall, floor or ceiling penetrations, including membrane penetrations. Materials shall be classified or listed as a complete system by UL (FRD) (or an approved NRTL by the design consultant and AHJ) and meet NFPA 70 and local codes. The use of partial systems or components of systems is not allowed unless specifically identified in the documents.
    - c. All penetrations through fire rated floors and walls shall be sealed to prevent the passage of smoke, flame, toxic gas or water through the penetration before, during or after a fire. The fire rating (F and T) of the penetration seal shall be at least that of the floor or wall into which it is installed, so the original fire rating of the floor or wall is maintained as required by referenced building codes.
      - 1) Assume floors are fire-rated, unless otherwise noted.
      - 2) Also install fire stops at other locations indicated in the Specifications or Drawings.
    - d. Provide a label on both sides of fire rated assembly at all fire stop locations indicating:
      - 1) Firestop Manufacturer
      - 2) Installer and company
      - 3) Date installed
      - 4) UL system number with relevant ratings indicated.
    - e. Include labels in each telecom room in which one or more fire rated walls is installed. Provide a 2 inch block letter stencil label on the inside of the telecom room to indicate rating for each barrier.
    - f. Provide systems as identified on the drawings and specified herein. At locations where the cabling routing encounters a fire-rated barrier provide an adequately sized firestop device for the quantities and types for cables to be installed plus 25% growth.
  - 2. Penetration Sealant - Conduits
    - a. Provide listed system to seal around openings between wall, floor or partition around conduits in accordance with system listing and manufacturer's instructions.

3. Penetration Sealant - Voids, Cavities, and Openings
    - a. Install firestop materials in the framed openings through fire rated partitions per the Architect's drawings and in accordance with the NRTL listed system instructions.
    - b. Firestop voids, cavities, and openings left by the removal of cabling, conduits, conduit sleeves, cable trays or other equipment related to the communications systems not to be reused.
    - c. Install the firestop system in accordance with the manufacturer's instructions and local codes.
  4. Fire-Rated Pathway Device
    - a. Provide fire-rated pathway device anywhere cables are required to pass through fire-rated walls, floors or partitions.
    - b. Devices shall be installed in locations where required by the Contract Drawings, arranged individually or appropriately ganged.
    - c. Install the devices in strict accordance with the approved shop drawings and the equipment manufacturer's recommendations.
    - d. Apply the factory supplied gasketing material (where required) prior to the installation of the wall plates.
    - e. Secure wall plates (where required) to devices per the equipment manufacturer's recommendations.
- D. Identification for communications systems
1. Labeling Installation
    - a. Remove dust, dirt, oil, etc. prior to install which impede the adhesion of labels to mounting surface.
    - b. For adhesive labels, provide adhesive appropriate for mounting surface.
  2. Labels are to be installed on:
    - a. Firestopping systems. For wall and floor penetrations, label on both sides. Take picture of each firestop system assembly (with label visible) to include with Project Completion Submittal.
    - b. Pathways (e.g., conduit, innerduct, etc.) installed under this work.
    - c. Label conduit and innerduct with "TELECOM" or "AV" according to the intended system/use of the installed (or future) cabling. Conduit labels shall utilize text readable from a standing position on the finished floor. Conduit sleeves which pass through a single wall or floor need not be labeled.
    - d. For wall stub-up locations, label overhead only.
    - e. For conduits greater than 10 ft, label both ends of conduit with far end location and Room/Number.
      - 1) Example - "AV to AV Rack R01".
    - f. For conduits that stub directly up or into a Communications Room, label both ends of conduit.
      - 1) Example: under slab conduit from Telecom Room 1A to the Floor Box in Conference Room 101A shall be labeled as follows:
        - a) Conduit stub-up location in Telecom Room 1A - "Telecom to Conf. Rm 101A Floor box"
        - b) Bottom of floor box, immediately adjacent to serving Telecom conduit - "Telecom to Telecom Room 1A"

- g. Pull boxes and junction boxes for Communications shall be labeled such as "TELECOM PULL BOX", "AV JUNCTION BOX", "TV", etc. on the cover, such that the text is of sufficient size to be readable from a standing position on the finished floor.
- h. Conduits entering and exiting pull boxes and junction boxes shall be labeled with their destination/room number - ie "To AV Box Q:212:01 in Control Rm 212".
- i. For pathways above accessible ceiling, paint the cover of pull boxes/junction boxes blue and stripe all conduits every 5 ft with that color.
- j. Wherever raceways for future use are terminated outside of the building, stake the location with a 2 ft long, 1 inch x 1 inch clear heart redwood stake.
- k. In general, the label is to be provided and installed by whomever installed the item that is being labeled.
- l. Refer to individual Division 27 sections and to the drawings for additional information on labeling requirements.

### **3.2 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.

### **3.3 SYSTEM STARTUP**

- A. Provide manufacturer's field representative to perform systems startup.
- B. Prepare in accordance with manufacturers' instructions and recommendations.
- C. Adjust for proper operation within manufacturer's published tolerances.

### **3.4 CLEANING**

- A. See Section 01 74 19 - Construction Waste Management and Disposal 01 74 19 - Construction Waste Management and Disposal, for additional requirements.

### **3.5 COMMISSIONING**

- A. See Section 001 91 13 - General Commissioning Requirements, for commissioning requirements.
- B. Test electrical grounding for compliance with requirements of authorities having jurisdiction.

### **3.6 CLOSEOUT ACTIVITIES**

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Demonstrate proper operation of equipment to Owner's designated representative.
- D. Demonstration: Demonstrate operation of system to Owner's personnel.
  - 1. Use operation and maintenance data as reference during demonstration.
  - 2. Conduct walking tour of project.
  - 3. Briefly describe function, operation, and maintenance of each component.

### **3.7 MAINTENANCE**

- A. See 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

### **END OF SECTION**

**SECTION 27 41 00 - AUDIO VIDEO SYSTEMS****PART 1 GENERAL REQUIREMENTS****1.1 SECTION INCLUDES**

- A. Contractor Qualifications
- B. System Description
- C. Temporary Technical System
- D. Computer System
- E. Ethernet Switches & Accessories
- F. Data Patch Panels & Accessories
- G. A/V Control System - General Programming Requirements
- H. Cable - Bulk
- I. Cables - Factory Terminated - Installed
- J. Connectors
- K. Equipment Rack
- L. Equipment Rack Accessories
- M. AC Power
- N. This parent section pertains to subsections 27 41 01 through 27 41 99. Requirements found in this section shall apply to all subsections unless otherwise noted.
  - 1. Exception: Section 27 41 33 - TELEVISION DISTRIBUTION SYSTEM stands alone.

**1.2 RELATED REQUIREMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO
- C. Section 27 00 13 - SUSTAINABLE DESIGN REQUIREMENTS
- D. Section 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO-VIDEO
- E. Section 27 41 16 - AUDIO VIDEO SYSTEMS EQUIPMENT
- F. Section 27 41 33 - TELEVISION DISTRIBUTION SYSTEM
- G. All category and fiber optic cabling and terminations shall adhere to Section 27 10 00 - STRUCTURED CABLING.

**1.3 DEFINITIONS**

- A. Structured Cabling System: the physical infrastructure installed to support information technology/transport for voice and data applications, commonly referred to as a Telecommunications System. This includes, but is not limited to: Category cabling, terminations/blocks, modules, faceplates, etc., and optical fiber cabling, terminations, modules, etc.
- B. Suspension System: A unique assembly of rated hardware elements and accessories required for overhead installation (and attachment to building structure) of loudspeakers and other



technical system components. Elements of a suspension system may include: wire rope, shackles, eyebolts, chain, beam clamps, strut channel, etc.

#### 1.4 REFERENCE STANDARDS

- A. ANSI E1.6-1 - Entertainment Technology - Powered Hoist Systems; 2021.
- B. ANSI E1.6-2 - Design, Inspection, And Maintenance Of Electric Chain Hoists For The Entertainment Industry; current edition.
- C. ANSI E1.6-3 - Selection And Use Of Serially Manufactured Chain Hoists In The Entertainment Industry; current edition.
- D. ANSI E1.8 - Entertainment Technology - Loudspeaker Enclosures Intended For Overhead Suspension - Classification, Manufacture And Structural Testing; current edition.
- E. ANSI E1.47 - Entertainment Technology - Recommended Guidelines For Entertainment Rigging System Inspections; current edition.
- F. ANSI/Infocomm 10 - Audiovisual Systems Performance Verification; 2013.
- G. AVIXA A102.01 - Audio Coverage Uniformity in Listener Areas; 2017.
- H. AVIXA F501.01 - Cable Labeling for Audiovisual Systems; current edition.
- I. AVIXA F502.01 - Rack Building for Audiovisual Systems; current edition.
- J. JBL Professional Technical Note Volume 1, Number 14 - Basic Principles for Suspending Loudspeaker Systems; current edition.
- K. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. RaneNote 110 - Sound System Interconnection; last revised 11/15.
- N. TIA-607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises; 2019d, with Addendum (2021).

#### 1.5 SUBMITTALS

- A. Refer to requirements in Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO.
- B. Include the following items:
  - 1. Submittal #1: System Product Data (Pre-Construction). A separate product data submittal is required for each specification section, i.e., 27 41 00, 27 41 16, etc.
    - a. Equipment List (1A)
    - b. Manufacturers' cut sheets (1B)
    - c. Product Substitutions (1C)
    - d. Project Implementation Schedule (1D)
  - 2. Submittal #2: System Shop Drawings (Pre-Construction)
    - a. Pathways, Devices, and Cabling (2A) – Follow requirements of Section 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO-VIDEO. Indicate locations of all devices and equipment.
    - b. Signal Flow Shop Drawings (2B) – Any generic diagrams found within the Construction Documents shall be drawn to specific requirements. Alterations from



- basis of design found within the Construction Documents shall be reflected and identified. Include wire numbering scheme.
- c. Control System (2C) - Control system panel/screen layouts suitable for the Owner's Representative to understand the operation and flow (submitted no less than five months prior to system first use).
  - d. DSP Signal Flow (2D) - DSP signal flow configuration (submitted no less than three months prior to system first use).
3. Submittal #3: System Fabrication Drawings (Pre-Construction)
- a. Structural Details (3A)
    - 1) No suspended device shall be installed prior to the final approval of structural detail submittals by the HENDERSON ENGINEERS.
    - 2) For suspended equipment provide detailed, dimensioned drawings of each Suspension hardware assembly. Also indicate location relative to structure, location relative to other component(s) (Technical System or otherwise), configuration of suspended components, attachment to structure, suspension method, and calculations.
      - a) Calculations shall include weights of Technical System equipment including suspension hardware, and details of all suspension hardware including: manufacturer(s), part number(s) and pertinent technical information (i.e., Working Load Limit) of each part including nuts, bolts, and other accessories. All weight bearing hardware must be traceable, load rated, and domestically manufactured. All welds must be certified.
    - 3) Prior to submission, these drawings must be approved and signed/sealed by a structural engineer licensed for the location of the project. The following guidelines are applicable:
      - a) Contractors participating in the Suspension of Technical System components shall conform to industry best practice standards as set forth in:
        - (1) JBL Professional Technical Note Volume 1, Number 14
        - (2) ANSI E1.6-1
        - (3) ANSI E1.6-2
        - (4) ANSI E1.6-3
      - b) All Suspended loudspeakers shall conform to ANSI E1.8.
  - b. Equipment Rack Shop Drawings (3B) - Equipment rack front elevation for each rack showing equipment, panel layout, and electrical circuiting.
  - c. Panel, Patch Panel, and Plate Shop Drawings (3C) - All panel, patch panel, and plate layouts indicating locations of connectors, engraving, nomenclature, panel material, and finish. Include Structured Cabling Work required by the technical system.
  - d. Millwork Shop Drawings (3D) - Millwork details, and related equipment and panel layout.
  - e. Video Wall Shop Drawings (3E) – Dimensioned elevations (front and side) for each video wall showing mounting requirements, panel layout, ancillary equipment at wall location, low voltage/signal circuiting, and electrical circuiting.
4. Submittal #4: System Test Results (Prior to Substantial Completion)
- a. Preliminary Testing Documentation Package (4A) – Provide preliminary results of system testing as described in Part 3 of this section for review prior to final acceptance. Include final results with Closeout Documentation.

5. Submittal #5 : Digital Signal Processing and AV Control System Custom Programming (Per Milestones)
  - a. The successful deployment of the Digital Signal Processing and AV Control System aspects of this project require significant interactive input from a variety of project stakeholders including the HENDERSON ENGINEERS, Architect, Owner's Representative and others. During development, consistent and timely communication will be required among all the stakeholders to yield a final product capable of meeting the needs of the Owner's Representative.
    - 1) No less than four months after award of contract, the Contractor shall, with the assistance of the Contract Administrator, coordinate a custom programming kickoff meeting for the above-mentioned stakeholders.
    - 2) Ongoing meetings will be required and may occur as web or phone-based meetings.
  - b. Custom Programming Timeline – Digital Signal Processing and AV Control System programming development and related submittals shall be delivered per the following milestones:
    - 1) Digital Signal Processing
      - a) Milestone 1: DSP file(s) indicating basic system configuration including input/output hardware and audio network configuration.
      - b) Milestone 2: Updated DSP file(s) indicating continued development including subsystem specific (i.e., meeting rooms, Pre-Function, etc.) signal routing, equalization control strategy and presets, etc.
      - c) Milestone 3: Coordinate fire alarm processing and digital audio network connection strategy if applicable with appropriate Contractor(s).
      - d) Milestone 4: Final DSP file(s) with completed coordination to AV control system.
    - 2) AV Control System
      - a) Milestone 1: Narrative of intended control parameters and flow diagrams indicating control page hierarchy for each subsystem. Preliminary graphical user interface (GUI) of control system touch screen for review by HENDERSON ENGINEERS, Architect, and Owner's Representative – primary systems/spaces to convey intent.
      - b) Milestone 2: Updated control system narrative. Screen shots of GUI – all unique system types and GUI pages. Copy of source code and screen files developed to date.
      - c) Milestone 3: Finalized control system narrative. Screen shots of all final GUI pages throughout project.
6. Project Closeout
  - a. Refer to Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO and the Record Drawings and Operation and Maintenance Data sub-sections in Part 3 of this section for requirements.
7. Refer to child sections for additional requirements.

## 1.6 COORDINATION

- A. Contact the Architect, in writing, regarding the selection of colors for all exposed equipment.
- B. In addition to a complete set of the system project drawings and specifications, maintain at the job site a complete set of manufacturer's original operation, instruction, installation, and service

manuals for each equipment item, for reference.

- C. Comply with all applicable national and local codes and ordinances and obtain all required permits.
  - 1. Contractor shall be responsible for any and all violations within the scope of this work.
- D. Electronic File Sharing
  - 1. Refer to Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO for information on obtaining electronic versions of the construction drawings.

## 1.7 QUALITY ASSURANCE

- A. Contractor Qualifications:
  - 1. Compliance with the requirements of Division 01.
  - 2. Licensed to perform work of this type in the project jurisdiction.
  - 3. At least five (5) years of verifiable direct experience with the devices, equipment and systems of the type and scope specified herein.
  - 4. Prior successful experience of projects of similar size, scope and type as outlined in the Construction Documents.
  - 5. Active membership in the National Systems Contractors Association (NSCA).
  - 6. Active membership in The Audiovisual and Integrated Experience Association (AVIXA).
  - 7. Fully staffed and equipped maintenance and repair facility.
  - 8. Factory-authorized dealer and current certifications for the components specified.
- B. Personnel Qualifications:
  - 1. Skilled workers thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and the methods needed for proper performance of the work in this section. The workers shall have at least three (3) years direct experience in similar work, evidence of which shall be verified in writing with appropriate references.
  - 2. Supervisor with at least five (5) years direct experience in similar work. The supervisor shall be present for and in responsible charge of all work in the fabrication shop and on the project site during all phases of the installation and testing of the system(s). To assure continuity, this supervisor shall be the same individual throughout the execution of the work unless illness, loss of personnel, or other reasonable circumstances intervene. This person shall act as the Technical System Project manager and shall attend all scheduled project meetings.
  - 3. Minimum of one full-time staff member who has attended technical system design and installation courses taught by Syn-Aud-Con, Audio Engineering Society (AES), Professional Lighting and Sound Association (PLASA), National Systems Contractors Association (NSCA) and/or AVIXA in the past 5 years.
  - 4. Minimum of one AVIXA CTS-I (Certified Technology Specialist - Installation) systems technician.
  - 5. Minimum of one full-time staff member who has a minimum of three (3) years direct experience with and is factory-certified on the most recent version of the selected Digital Signal Processor (DSP) software and technology. This individual shall be responsible for the implementation of the DSP system including software. This individual shall be the same throughout the execution of the work unless illness, loss of personnel, or other reasonable circumstances intervene.

6. Minimum of one full-time staff member who has a minimum of three (3) years direct experience with the selected network-based AV transport and is factory-certified on the most recent version of the selected AV transport technology. The individual shall hold a current manufacturer's certification. This individual shall be responsible for the implementation and preliminary testing of the AV transport system. This individual shall be the same throughout the execution of the work unless illness, loss of personnel, or other reasonable circumstances intervene.
7. Minimum of one full-time staff member who has a minimum of three (3) years direct experience and is a factory certified Master Level Programmer on the most recent version of the selected AV control system software and technology. This individual shall be the same throughout the execution of the work unless illness or loss of personnel intervenes. A factory authorized independent programmer will also be accepted, providing the programmer meets the criteria identified in this paragraph.

## 1.8 WARRANTY

- A. Warrant all work executed under this contract, including all in-shop and onsite material, parts, and labor, for a period of twelve months after the date of final acceptance.
  1. Existing or any other Owner-furnished equipment shall not be included in this warranty.
  2. For equipment that has an advertised manufacturer's warranty longer than twelve months, include end date of warranty period.
- B. The warranty services are limited to normal business hours unless additional agreements are made between the Owner's Representative and the Contractor.
- C. Warranty work relating to technically complex equipment and/or programming such as for digital signal processing, control systems, and video projectors shall be performed by a factory authorized technician.
- D. Damage to the system resultant from improper use or adjustment by others, negligence, acts of nature, or other causes which are beyond the Contractor's control shall be excluded from the warranty.
- E. Visit the job six months after substantial completion and two weeks prior to the end of the warranty period to check all equipment for proper system operation. Any defective equipment found shall be replaced or repaired under the terms of the system warranty.
- F. Update Record Drawings and Operation and Maintenance Data to reflect work done during Warranty period and provide the updates to the Owner's Representative and HENDERSON ENGINEERS.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Scope of Work
  1. These specifications and the associated TA and TB series drawings describe the audio-video (AV) systems (hereafter referred to as the "Technical System") requirements to be furnished and installed as a portion of the project scope of work.
  2. Work includes all such work indicated in all of the Contract Documents, including, but not limited to: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Communications, Fire Alarm and Electronic Safety and Security Drawings and Specifications; and Addenda.

3. Work under this section of the specifications includes all labor, equipment, and installation as required to provide a complete technical system in compliance with the contract documents.
    - a. The Contract Documents are detailed to the extent of providing design intent and signal flow. Additional engineering, equipment, and/or coordination may be required for a complete technical system. The Contractor is required to provide a complete and working system.
  4. The work in this section shall be coordinated with other work to determine installation scope for conduit, outlet boxes, junction boxes, pull boxes, terminal cabinets, 120-volt AC power circuits, and insulated ground cables required for the technical system.
    - a. Provide related low-voltage "on/off" AC power control system wiring, low-voltage "on/off" control switches, and certain AC power/ground requirements internal to the equipment racks as specifically noted herein and/or on the drawings.
  5. Employ the services of a qualified Structural Engineer to review all overhead mounting and suspension details of the technical system equipment. All mounting and suspension schemes indicated on the drawings are shown for concept only. Submit shop drawings stamped by a Structural engineer of all details and weights for review by the project's Architect, Structural Engineer, and HENDERSON ENGINEERS.
- B. Examination of Site
1. This is a new facility.
- C. Equipment Requirements
1. Unless otherwise designated, provide all of one type of equipment from one manufacturer. For example, microphones of one type by one manufacturer, data switches of one type by one manufacturer, cabling of one type by one manufacturer, or loudspeakers of one type by one manufacturer.
  2. Equipment and wiring shown on the drawings represents the basis of design. Ensure similar or better performance is achieved by substituted equipment.
  3. All major components of technical system equipment shall be provided and installed by a qualified Contractor as outlined in Part 1 of this section.
  4. All equipment shall be new and of professional quality.
  5. Some items listed in these specifications are custom-made products. Ensure when pricing and ordering equipment that the exact part number called out is used. If there is a discrepancy, contact the HENDERSON ENGINEERS for clarification.
  6. Each software programmable device furnished (i.e., Digital Signal Processor, control system, etc.) shall include most recent software and appropriate computer interface (wired cable or wireless). Cable, software, source (uncompiled) code and all related aspects of all software-controlled equipment shall become the property of the Owner and will be furnished as a portion of the Operation & Maintenance (O&M) Data manuals (see Operation & Maintenance Manuals near the end of Part 3).
  7. The quantities of each item of portable or mobile equipment (and other portable or loose accessories), as well as those items associated with Alternates, are indicated in parenthesis. Such equipment is intended to be shared between rooms having technical systems, except where noted for use in one specific room.

## 2.2 TEMPORARY TECHNICAL SYSTEM

- A. Provide and operate a temporary technical system of reasonably equivalent function as determined by the HENDERSON ENGINEERS if the work in this section, as a failure of the

Contractor, is incomplete or found not in conformance with the contract documents. The temporary system shall remain in use until acceptance of the permanent system.

### **2.3 COMPUTER SYSTEM**

- A. Computer furnished shall be as recommended and approved by the manufacturer of the connected/controlled devices and the Owner's Representative. A UPS shall be included to keep the system operational for at least 10 minutes during a power failure.
- B. Configure the computer to allow for remote access on the facility LAN. Access shall be password protected.
- C. Submittal required showing all specifics relating to the computer system.

### **2.4 ETHERNET SWITCHES & ACCESSORIES**

- A. Ethernet switches are provided as a portion of Section 27 20 10 - DATA COMMUNICATIONS REQUIREMENTS. Coordination with party responsible for that section is required for a successful system implementation.
- B. Network Coordination:
  - 1. Coordinate required VLAN's as necessary for system operation. Obtain the network's IP addressing scheme prior to system configuration. At a minimum, provide the network engineer with the following information for network configuration:
    - a. Device Name / ID
    - b. Device Serial Number
    - c. Device MAC Address
    - d. Required VLAN
  - 2. Provide system protocol standards and requirements to the network engineer for each protocol type within the system.
  - 3. Label all devices per the network labeling standard.
- C. Audio-Video Network Protocol Requirements
  - 1. Coordinate standards based and manufacturer specific protocol requirements with the network configuration. Certain protocols may necessitate specific hardware, software, and/or licensing packages to facilitate protocol compliance.

### **2.5 DATA PATCH PANELS & ACCESSORIES**

- A. Data Patch Panels are acceptable for use in Ethernet, audio network, AVLAN, and digital multimedia network applications as required to provide a complete technical system.
- B. All Category and Fiber Optic cabling (of the acceptable applications listed above) entering a technical system rack shall be terminated to a Data Patch Panel. Rack inter- and intra-connect cabling utilizing factory-terminated cable assemblies are not required to pass thru a Data Patch Panel unless shown otherwise.
- C. Data Patch Panels shall be labeled per specification part 3 of this section.
- D. Category Cabling Patch Panels –
  - 1. Refer to Section 27 10 00 - STRUCTURED CABLING for product information and additional installation requirements.
- E. Fiber Optic Patch Panels & Enclosures –
  - 1. Refer to Section 27 10 00 - STRUCTURED CABLING for product information and additional installation requirements.

- F. Cable Management – 19” wide horizontal patch cable management system, 1 rack unit, with pass-through opening to allow patch cables access to rear of rack (one required per 24 port patch panel / switch):
  - 1. Chatsworth Velocity 13930-701; or
  - 2. Cooper B-Line RCM SB87019S1; or
  - 3. Middle Atlantic HHCM Series; or
  - 4. Panduit NetManager NMF1; or
  - 5. Approved equal.

## 2.6 A V CONTROL SYSTEM – GENERAL PROGRAMMING REQUIREMENTS

- A. Touch screen control interfaces shall follow the guidelines outlined in the “Dashboard for Controls” documents created on behalf of AVIXA International. Reference the Design Guide, Design Reference, and Integrators Guide for this project. Documents are available for download on the AVIXA web site.
- B. Contractor shall be responsible for complete configuration of the control system features including touch screen layouts, colors, appearance, operation, and coordination with systems external to the Technical System.
- C. Participate in planning meeting(s) (web/phone) with HENDERSON ENGINEERS and Owner’s Representative to review programming concepts and requirements before commencement of work.
- D. Panel layout and navigational flow concepts shall be developed during planning meeting(s) with HENDERSON ENGINEERS and Owner’s Representative.
- E. Refer to submittal requirements for additional information.
- F. This specification describes the initial touch screen programming concepts and requirements. Account for four (4) distinct changes for revisions requested by the Owner’s Representative or HENDERSON ENGINEERS after the system is substantially complete.
- G. Touch screen and keypad overall user interfaces shall comply with the following general guidelines where applicable:
  - 1. A common theme shall be employed and used with consistency throughout the layouts. Theme shall be discussed with the Owner’s Representative. The Owner’s standard theme template shall be used if available.
  - 2. Where Owner logos or colors are used, Owner branding guidelines shall be followed. Trademarks shall be used appropriately. Official graphical representations (logos, word marks, logotypes, etc.) may not be altered. Owner colors shall utilize official and exact color (Pantone, CMYK, RGB, hex, etc.) as provided by the Owner, visual matching is not allowed. Content shall be obtained from an official and authorized source, e.g., the use of content from Google images is not appropriate. Owner branding is encouraged where appropriate; however, proper use and compliance remains the responsibility of the Contractor.
  - 3. The use of a password hierarchy shall be employed as directed by the Owner's Representative as they deem appropriate.
  - 4. Power ON/OFF sequence shall control all applicable devices. Sequence time shall be the required time for all controlled devices to cycle. Projector lamp warm-up and cool-down period shall be taken into account. Shutdown shall utilize two-step verification.



5. Animated activity indicators (spinning ring, progress bar, etc.) shall be utilized to provide visual feedback while the system is processing tasks in the background. This will prohibit multiple button presses by the user and show feedback that the control system is processing the request. Relevant text shall be utilized where appropriate, e.g., "Please wait while the system shuts down."
6. Source selection shall be available for all devices. Sources shall be laid out and grouped in a logical manner. A 'blank source' or 'image blanking' feature shall be utilized to result in no image being displayed.
7. Button presses shall show instant visual feedback that they have been engaged and shall accurately reflect the response received from the device being controlled.
8. Current system status shall be always visible and be consistent across all adjoined screens. Buttons shall show current status (engaged or disengaged) via color, illumination, outline, greyscale, etc. as relevant. Sliders and level indicators shall show current and true system status (i.e., show true level based on system feedback, not status based on last touch screen input) via color, knob location, percentage, etc. as relevant.
9. All program source devices shall have the control screens emulate the appearance and functionality of all operational controls of the handheld remote control or user interface furnished with each device. The furnished handheld remote control and control system shall be interoperable allowing either to be used simultaneously without causing any lockups, inconsistencies, or false control system visual status. The use of (properly vetted) manufacturer control system modules is recommended.
10. Volume control of wired microphones, wireless microphones, and/or AV system program volume levels shall be discrete and shall be properly interfaced with the DSP (where applicable). Volume travel thresholds should be discussed with the Owner and HENDERSON ENGINEERS. The use of a master volume control is prohibited.
11. Audio Conferencing mode shall emulate a traditional audio-conferencing unit, allowing for all typical operational controls including automated dialing, privacy microphone mute, level adjustments, control of individual microphones, storage of frequently called sites, manual dialing, answering, etc.
12. Where applicable, show the current operation mode. For example, in the case where two rooms combine/separate, the word "Combined" or "Separated" shall be displayed on each applicable screen.
13. Room combining/separating shall utilize an image of the floor plan of the associated spaces with a button residing on the operable wall which will toggle "Combined" (green) and "Separated" (red). When combined, all touch screens shall operate in unison providing full control/selection of all aspects of the combined rooms as if they were one.
14. Control of other building systems shall be coordinated with appropriate parties. Lighting and shading systems shall be controlled via preset recall. Refer to the TA series drawings showing required interfaces.

## 2.7 CABLE - BULK

- A. The products in this section have been approved for use in the project as necessary to facilitate a complete and working system. Inclusion in this section does not indicate a requirement for use.
- B. Product must be procured from the original cable manufacturer.
- C. AWG wire sizes indicated herein or on the drawings are the minimum size conductors required. Larger size conductors (i.e., smaller AWG number) are permitted assuming no impact on the



project will occur (such as the resulting need for larger or additional conduit, cable trays, chases, etc.) to accommodate such cable.

- D. Where cable is run exposed (such as in ceiling plenums, cable trays, chases, or below accessible floors):
  - 1. Verify which locations do and do not require plenum-rated cable.
  - 2. Furnish the appropriate cable type.
  - 3. Obtain written authorization from the Architect (or the Architect's designated Engineer) in this regard.
- E. Category cabling:
  - 1. Refer to Section 27 10 00 - STRUCTURED CABLING for product information and additional installation requirements.
- F. Fiber Optic cabling:
  - 1. Refer to Section 27 10 00 - STRUCTURED CABLING for product information and additional installation requirements.
- G. Twisted Pair – Shielded: Twisted pair, shielded 22 AWG cable; interior rated 2 conductor cable with drain wire suitable for microphone, line, or production intercom level circuits:
  - 1. Communications plenum rated cable (CMP) is suitable for use in all indoor environments including environmental air plenums as defined per NFPA 70 Article 800.
    - a. The use of performance equivalent substituted cables of lesser type is permitted at the Contractor's discretion where allowable by NFPA 70 Article 800, local codes, and the connected equipment manufacturer's listed requirements.
    - b. Performance equivalence to the below specified products shall be determined by the cable manufacturer's listed product equivalents provided in tables and cut sheets.
  - 2. Tinned copper cables are required in locations subject to corrosion, such as natatoriums.
  - 3. 22 AWG/CMP: 22 AWG Communications Plenum rated bare copper conductor cable:
    - a. Belden 9451P or 6500FC; or
    - b. Clark Wire SPA22GSP; or
    - c. Gepco IP222AL or 61801HS; or
    - d. West Penn 25291B.
  - 4. 22 AWG/CMR: 22 AWG Communications Riser rated bare copper conductor cable:
    - a. Belden 8451 or 9451 or 5500FE; or
    - b. Clark Wire SPA22GS; or
    - c. Gepco IR222AL or 61801 or 61801EZ; or
    - d. West Penn 291 or 452.
- H. Twisted Pair – Unshielded: Twisted pair, 2-conductor interior installation loudspeaker cable:
  - 1. Class 3 remote-control, signaling, and power-limited plenum rated cable (CL3P) is suitable for use in all environments including environmental air plenums as defined per NFPA 70 Article 725.
    - a. The use of performance equivalent substituted cables of lesser type is permitted at the Contractor's discretion where allowable by NFPA 70 Article 725, local codes, and the connected equipment manufacturer's listed requirements.
    - b. Performance equivalence to the below specified products shall be determined by the cable manufacturer's listed product equivalents provided in tables and cut sheets.
    - c. Wire gauge shall not be reduced to gain a higher cable rating.

2. Tinned copper cables are required in locations subject to corrosion, such as natatoriums.
3. AWG/CL3P: As listed AWG Class 3 Plenum rated bare copper conductor cable:
  - a. Belden 1862A or 6200UE (16 AWG), 6300UE (18 AWG); or
  - b. Gepco IP122BA19 (12 AWG), IP142BA19 (14 AWG), IP162BA19 (16 AWG), IP182BA7 (18 AWG); or
  - c. West Penn 25210 (10 AWG), 25227B (12 AWG), 25226B (14 AWG), 25225B (16 AWG), 25224B (18 AWG).
4. AWG/CL2P: As listed AWG Class 2 Plenum rated bare copper conductor cable:
  - a. Belden 6T00UP (10 AWG), 1860A or 6000UE (12 AWG), 1861A or 6100UE (14 AWG), 1863A (18 AWG); or
  - b. Clark Wire CW1002P (10 AWG), CW1202P (12 AWG), CW1402P (14 AWG), CW1602P (16 AWG), CW1802P (18 AWG).
5. AWG/CL3R: As listed AWG Class 3 Riser rated bare copper conductor cable:
  - a. Belden 5000UE (12 AWG), 5100UE (14 AWG), 5200UE (16 AWG), 5300UE (18 AWG); or
  - b. Clark Wire CW1202HS (12 AWG), CW1402HS (14 AWG); or
  - c. Gepco IR122BA19 (12 AWG), IR142BA19 (14 AWG), IR162BA19 (16 AWG), IR182BA7 (18 AWG); or
  - d. West Penn 227 (12 AWG), 226 (14 AWG), 225 (16 AWG), 224 (18 AWG).
6. AWG/CL2R: As listed AWG Class 2 Riser rated bare copper conductor cable:
  - a. Clark Wire CW0802 (8 AWG), CW1002 (10 AWG), CW1202 (12 AWG), CW1402 (14 AWG), CW1602 (16 AWG), CW1802 (18 AWG).
7. AWG/CL3: As listed AWG Class 3 rated bare copper conductor cable:
  - a. Belden 1313A (10 AWG), 1311A (12 AWG), 1309A (14 AWG), 1307A (16 AWG); or
  - b. Gepco 122HBW (12 AWG), 142HBW (14 AWG).
8. AWG/CL2: As listed AWG Class 2 rated bare copper conductor cable:
  - a. Belden 5T00UP (10 AWG); or
  - b. West Penn HA210 (10 AWG).
9. AWG/CL1: As listed AWG Class 1 rated bare copper conductor cable (subject to specific NFPA 70 requirements):
  - a. Belden 8806 (6 AWG), 8808 (8 AWG), 8810 (10 AWG), 8812 (12 AWG), 8814 (14 AWG).
- I. Twisted Pair – Unshielded – EXT: Twisted pair, unshielded exterior use cable; 2-conductor loudspeaker, sunlight resistant, direct burial:
  1. Exterior cable shall be listed as suitable for use in Class 3 General Purpose indoor environments as defined per NFPA 70 Article 725.
  2. AWG/EXT: As listed AWG indoor/outdoor rated bare copper conductor cable:
    - a. Belden 8808WB (8 AWG), 1313A (10 AWG), 1311A (12 AWG), 1309A (14 AWG), 1307A (16 AWG); or
    - b. Clark Wire CW1002DB (10 AWG), CW1202DB (12 AWG), CW1402DB (14 AWG), CW1602DB (16 AWG); or
    - c. Gepco SSUB102 (10 AWG), SSUB122 (12 AWG), SSUB142 (14 AWG), SSUB162 (16 AWG); or
    - d. West Penn C208 (8 AWG), C210 (10 AWG), AQ227 (12 AWG), AQ226 (14 AWG), AQ225 (16 AWG).

- J. RG-59: Single 75-ohm coax, RG-59/U precision video cable:
1. RG-59/NP: Non-plenum cable installed in conduit, equipment racks, or other non-plenum spaces:
    - a. Belden 1505A; or
    - b. Clark Wire CD7559; or
    - c. Gepco VPM2000; or
    - d. West Penn 819.
  2. RG-59/P: Plenum rated cable:
    - a. Belden 1506A; or
    - b. Clark Wire CD7559P; or
    - c. Gepco VPM2000TS; or
    - d. West Penn 25819.
  3. RG-59/Flex: Non-plenum flexible cable, for use with portable cables, exposed, or other locations where cable movement can or does occur:
    - a. Belden 1505F; or
    - b. Clark Wire CD7559F; or
    - c. Gepco VHD2000M.
- K. RG-6: Single 75-ohm coax, RG-6/U precision video cable:
1. RG-6/NP: Non-plenum cable installed in conduit, equipment racks, or other non-plenum spaces:
    - a. Belden 1694A or Gepco VSD2001; or
    - b. Belden 1694wb (outdoor water block); or
    - c. Clark Wire CD7506; or
    - d. Clark Wire CD7506DB (direct burial, water block); or
    - e. West Penn 6350.
  2. RG-6/P: Plenum rated cable:
    - a. Belden 1695A; or
    - b. Clark Wire CD7506P; or
    - c. Gepco VSD2001TS; or
    - d. West Penn 256350.
- L. RG-11: Single 75-ohm coax, RG-11/U precision video cable:
1. RG-11/NP: Non-plenum cable installed in conduit, equipment racks, or other non-plenum spaces:
    - a. Belden 7731A; or
    - b. Clark Wire CD7511; or
    - c. Gepco VHD1100; or
    - d. West Penn 1135.
  2. RG-11/P: Plenum rated cable:
    - a. Belden 7732A; or
    - b. Clark Wire CD7511P; or
    - c. Gepco VHD1100TK.
- M. RG-58: Single 50-ohm coax, RG-58/U radio frequency cable (50-ohm lowest performance):
1. RG-58/NP: Non-plenum cable installed in conduit, equipment racks, or other non-plenum spaces:

- a. Belden 7806R; or
    - b. Clark Wire CV5058; or
    - c. West Penn 812.
  2. RG-58/P: Plenum rated cable:
    - a. Belden 82240; or
    - b. Clark Wire CV5058P; or
    - c. West Penn 25812.
  3. RG-58/P/WR: Indoor/Outdoor Plenum rated cable:
    - a. Belden 88240.
- N. RG-8X: Single 50-ohm coax, RG-8X radio frequency cable (50-ohm good performance):
1. RG-8X/NP: Non-plenum cable installed in conduit, equipment racks, or other non-plenum spaces:
    - a. Belden 9258; or
    - b. Clark Wire CV5008X; or
    - c. West Penn 807X.
  2. RG-8X/WR: Outdoor rated cable:
    - a. West Penn 808XWB.
- O. RG-213: Single 50-ohm coax, RG-213/U radio frequency cable (50-ohm better performance):
1. RG-213/NP: Non-plenum cable installed in conduit, equipment racks, or other non-plenum spaces:
    - a. Belden 8267; or
    - b. Clark Wire CV50213; or
    - c. West Penn 810.
  2. RG-213/P: Plenum rated cable:
    - a. West Penn 25810.
- P. RG-8/U: Single 50-ohm coax, RG-8/U radio frequency cable (50-ohm best performance):
1. RG-8/U/NP: Non-plenum cable installed in conduit, equipment racks, or other non-plenum spaces:
    - a. Belden 9913; or
    - b. Clark Wire RF50LL; or
    - c. West Penn 98G8.
  2. RG-8/U/P: Plenum rated cable:
    - a. Belden 89913; or
    - b. Clark Wire RF50LLP; or
    - c. West Penn 2598G8.
  3. RG-8/U/WR: Indoor/Outdoor rated cable:
    - a. Belden 9914.
- Q. Control cable, power and control in one jacket, one unshielded 18 WG pair, one shielded 22 AWG pair:
1. Control cable - NP, not plenum rated:
    - a. Belden 1502R or Gepco 18/22AXL; or
    - b. Clark Wire ULK2218; or
    - c. Crestron CRESNET-NP; or
    - d. West Penn 77350.

2. Control cable - P, plenum rated:
  - a. Belden 1502P or Gepco 18/22AXLP; or
  - b. Clark Wire ULK2218P; or
  - c. Crestron CRESNET-P; or
  - d. West Penn D25350.
- R. RS-232: Low capacitance computer cable for EIA RS-232/422, 24 AWG, 4-conductor, shielded, minimum conductor-to-conductor capacitance: 22pF/ft, PVC jacket:
  1. RS-232/NP: Non-plenum cable installed in conduit, equipment racks, or other non-plenum spaces:
    - a. Belden 8102; or
    - b. Clark Wire SMP2404.
  2. RS-232/P: Plenum rated cable:
    - a. Belden 88102; or
    - b. Clark Wire SMP2404P.

## 2.8 CABLES – FACTORY TERMINATED – INSTALLED

- A. The products in this section have been approved for use in the project as necessary to facilitate a complete and working system. Inclusion in this subsection does not indicate a requirement for use.
- B. Factory terminated cable assemblies specified in this subsection are only permitted for use within racks or between devices external to racks. Permitted for rack inter-connect when racks are in close proximity (same room) and may pass thru conduit if necessary, in this situation. Not permitted for use in conduit unless specifically noted as such.
- C. Factory terminated cable assemblies shall be the minimum length needed to accomplish the connection. Portable cable assemblies are specified in Section 27 41 16 - AUDIO VIDEO SYSTEMS EQUIPMENT and are required to be furnished in addition to those required for system installation.
- D. All cable assemblies must be factory tested and certified.
- E. Category cabling:
  1. Refer to Section 27 10 00 - STRUCTURED CABLING for product information and additional installation requirements.
- F. Fiber Optic cabling:
  1. Refer to Section 27 10 00 - STRUCTURED CABLING for product information and additional installation requirements.
- G. DisplayPort, version 1.1a or higher, Acceptable lengths: 1'-25':
  1. Clark Wire DP Series (3', 6', 10', 15'); or
  2. Comprehensive DisplayPort Standard Series (3', 6', 10', 15', 25'); or
  3. Extron DisplayPort M-M Series (3', 6', 12', 25'); or
  4. Approved equal.
- H. HDMI Locking Cable, version 1.4 or higher compliant, locking connectors, male HDMI to male HDMI, Acceptable lengths: 1'-25':
  1. Belden HD-800 Series (2', 4', 8', 25'); or
  2. Clark Wire HDMI-L Series (3', 6', 10', 16'); or
  3. Perfect Path 800 Series (2', 4', 8', 16', 25'); or

4. Approved equal.
- I. USB, Type B male (device square) to Type A male (computer flat) or Type A male to Type A male USB 2.0 compliant, Acceptable lengths: 1'-25':
  1. Comprehensive; or
  2. Extron; or
  3. Approved equal.
- J. Video Cable BNC, RG-59 BNC to BNC, 75-ohm, Acceptable lengths: 1'-25':
  1. Canare VAC Series (3', 5', 25'); or
  2. Comprehensive Pro AV/IT Series (3', 6', 10', 25'); or
  3. Hosa BNC-59-1 Series (3', 5', 25'); or
  4. Whirlwind VID BNC3 Series (5', 25'); or
  5. Approved equal.

## 2.9 CONNECTORS

- A. The products in this section have been approved for use in the project as necessary to facilitate a complete and working system. Inclusion in this section does not indicate a requirement for use.
- B. All XLR receptacles located outdoors, in boxes that are located outdoors, in natatoriums, or in areas where moisture or other corrosive materials are present shall have gold plated contact pins.
- C. XLR Cable Connector, cable mounted connector for line-level, microphone level, and intercom circuits:
  1. Amphenol AC series; or
  2. Neutrik X-series; or
  3. Switchcraft E Series Q-G.
- D. XLR Panel Connector, panel mounted audio connector for line-level, microphone level, and intercom circuits, color shall match plate color where possible:
  1. Amphenol AC "DZ" series; or
  2. Neutrik D-Series; or
  3. Switchcraft standard AAA Series Q-G with metal handle.
- E. XLR Combo Connector, female XLR and 1/4" TRS receptacle in one chassis-mount connector:
  1. Neutrik NCJ6FI-S.
- F. 1/4" TRS Cable Connector, three-conductor (Tip Ring Sleeve) connector with a metal barrel and solder lugs:
  1. Amphenol TS3PN; or
  2. Canare F-16; or
  3. Neutrik NP3C; or
  4. Switchcraft 267.
- G. 1/4" TS Cable Connector, two-conductor (Tip Sleeve) connector with a metal barrel and solder lugs:
  1. Amphenol TM2PN; or
  2. Canare F-15 plug; or
  3. Neutrik NP2C plugs; or
  4. Switchcraft 250.

- H. 1/4" TRS Panel Connector, three-conductor (Tip Ring Sleeve) connector with the sleeve contact isolated from the panel or plate to which it is mounted:
    - 1. Neutrik NJ3FP6C; or
    - 2. Switchcraft E112BL.
  - I. 1/8" TRS Cable Connector, 1/8" (3.5mm) three-conductor mini-plugs which have a metal barrel and solder lugs:
    - 1. Amphenol KS3P; or
    - 2. Canare F-12; or
    - 3. Neutrik NTP3RC; or
    - 4. Switchcraft 35HDNN plug.
  - J. Locking LS Cable Connector, twist-lock cable mount male loudspeaker connector, minimum 2-two conductors. Coordinate connector with associated intended panel mount connector, including those on loudspeakers:
    - 1. Amphenol SP-2-FN (two conductor); or
    - 2. Neutrik speakON NL2FC (two conductor); or
    - 3. Amphenol SP-4-FN (four conductor); or
    - 4. Neutrik speakON NL4FC (four conductor); or
    - 5. Neutrik speakON NL8FC (eight conductor).
  - K. Locking LS Panel Receptacle, twist-lock chassis mount female loudspeaker connector, minimum two conductors. Coordinate receptacle with associated intended cable connector:
    - 1. Amphenol SP-2-MD (two conductor); or
    - 2. Neutrik speakON NL2MP (two conductor); or
    - 3. Amphenol SP-4-MD (four conductor); or
    - 4. Neutrik speakON NL4MP. Male connector (four conductor); or
    - 5. Neutrik speakON NL8MPR-BAG (eight conductor)
  - L. RJ45 Keystone Connector, permanent link connector for category cable:
    - 1. Cabling shall be terminated with tested permanent link per Section 27 10 00 - STRUCTURED CABLING.
    - 2. Provide keystone connector plate for adaptation of keystone termination to the provided faceplate.
  - M. RJ45 Panel Mount Connector, D-Mount pass-thru connector for category cable:
    - 1. Cabling shall be terminated with tested permanent link per Section 27 10 00 - STRUCTURED CABLING.
    - 2. Provide Neutrik EtherCON pass-thru connector panel mount. EtherCON connector series shall be coordinated with category cable type and data rate.
    - 3. The following structured cabling termination conditions are approved:
      - a. Field terminated RJ45 plug, meeting all warranty requirements per the Section listed above. The use of field terminated crimp connectors is not permitted. Provide pass-thru EtherCON connector for plate.
      - b. Biscuit enclosure with keystone punch down connectors and patch cable. Provide pass-thru EtherCON connector for plate.
  - N. BNC Cable Connector, 75-ohm BNC, compression fitting for coaxial cable furnished:
    - 1. Liberty CM-RG-BNC series; or
    - 2. West Penn CN-CS-BNC and CN-FS-BNC series.
-

- O. BNC Panel Connector, 75-ohm BNC, pass-through, D-style mounting:
  - 1. Neutrik NBB75DFI; or
  - 2. Approved equal.
- P. Terminator, RF or SDI terminator plug:
  - 1. Extron T-BNC series; or
  - 2. Pomona 3840 series; or
  - 3. Trompeter TNA series.
- Q. Terminal Block Terminations
  - 1. Utilize as applicable and only as allowed per Part 3.
  - 2. Acceptable mounting methods include:
    - a. For small quantities in AV Closets: Mount DIN rail within rear of AV equipment rack. Utilize as preferred method wherever feasible and provide a compatible DIN rail rack mount kit.
    - b. For large quantities in AV Closets: Mount DIN rail(s) to plywood backing on wall. Utilize wall mounting DIN rail brackets.
      - 1) Microphone level cable shall be mounted within an enclosure.
      - 2) Ensure mounting location is safe from accidental damage, mounting all terminations within an enclosure may be necessary.
    - c. For field locations: Provide a minimum NEMA 1 rated enclosure and locate DIN rail(s) within enclosure. Ensure enclosure is properly labeled and identified on as-builts.
  - 3. Insulation Displacement Connection (IDC) Type Terminal Block: modular terminal blocks for mounting on DIN rails; required for all microphone, line level, intercom, and similar cable types:
    - a. Entrelec (TE); or
    - b. Omega; or
    - c. Phoenix Contact; or
    - d. Approved equal.
  - 4. Spring Loaded Conductor Connection Type Terminal Block: modular terminal blocks for mounting on DIN rails; required for all speaker level cable types:
    - a. Entrelec (TE); or
    - b. Omega; or
    - c. Phoenix Contact; or
    - d. Approved equal.
  - 5. Terminal Block DIN Mounting Rails: DIN rails for mounting of terminal blocks:
    - a. Crestron DIN-EN series; or
    - b. Entrelec (TE); or
    - c. Hoffman DIN Rail LMK series; or
    - d. Middle Atlantic FWD-DIN1H; or
    - e. Omega; or
    - f. Phoenix Contact; or
    - g. Approved equal.

## 2.10 EQUIPMENT RACKS

- A. Furnish complete equipment racks including all top, bottom, and sides as necessary.



- B. Furnish all necessary accessories including ganging hardware, blank plates (to fill all unoccupied space), vent panels (as applicable), shelves, security covers, mounting screws, trim kits, lacing bars, cable management, leveling feet, casters, etc. to provide a complete solution which complies with "best practice" guidelines.
  - 1. Full-solution accessories are not detailed in this specification. They shall be provided as needed and shall be approved by the manufacturer for use with the intended rack series (i.e., Middle Atlantic casters must be used with a Middle Atlantic rack).
- C. Furnish all required components for a complete thermal management solution within each location to ensure enclosure interior temperature does not exceed manufacturer's recommended operating temperatures.
  - 1. Rack fans shall be quiet, such as the Middle Atlantic QFAN.
  - 2. Thermostatic fan control shall be utilized where available.
- D. Furnish all required components for a complete rack ground isolation solution.
  - 1. Racks shall be isolated from the floor by the use of isolated leveling feet (such as Middle Atlantic LF-ISO) or an isolation pad/system (such as Middle Atlantic ISO-1).
- E. Equipment racks and all associated blank panels located in equipment rooms shall be factory finished semi-gloss black. Equipment racks and associated blank panels located in control booths or other visible locations shall be factory-finished color as selected by the Architect.
- F. Furnish locking storage drawers, hinged security covers, and racks with locking doors all keyed alike. Furnish four keys total.
- G. Equipment rack specification indicates the system basis of design. Verify equipment layout, rack size, and number of equipment racks required for equipment furnished. Refer to "Audio-Video Equipment Rack Schedule" for specific model, depth, and height information.
- H. Floor Rack:
  - 1. Open Sides, open-rack style with open sides, rear locking door, minimum 44RU height, depth as scheduled. Furnish one side panel at each end of each row of equipment racks:
    - a. Lowell LGR Series; or
    - b. Middle Atlantic Products BGR Series; or
    - c. Middle Atlantic Products WRK Series.
  - 2. SA, standalone floor rack, rear locking door, minimum 44RU height, depth as scheduled:
    - a. Lowell LER Series; or
    - b. Middle Atlantic Products BGR SA Series; or
    - c. Middle Atlantic Products WRK SA Series.

## 2.11 EQUIPMENT RACK ACCESSORIES

- A. The following equipment rack accessories shall be provided as indicated on the rack elevations or within this section.
- B. Equipment rack accessories located in equipment rooms shall be factory finished semi-gloss black. Equipment rack accessories located in control booths or other visible locations shall be factory-finished color as selected by the Architect.
- C. Logo rack panel, single vertical rack space, labeled with contact information for the Contractor and HENDERSON ENGINEERS. Panel specified is custom and already has the information for the HENDERSON ENGINEERS; the Contractor shall coordinate their logo/information with the panel manufacturer (shop drawing required). One required to be installed at the top of each

- bank of equipment racks:
1. Liberty AV Solutions model HEI-RHIM-TEMPLATE.
- D. Storage drawer, specification indicates the system basis of design. " " in part number denotes (RU) height as indicated in rack elevations.
1. Locking rack drawer keyed to match rack rear door, approximately 16" deep, color to match adjacent rack-mounting panels:
    - a. Atlas Sound SD -14 with optional SD-LOCK installed; or
    - b. Middle Atlantic D -LK; or
    - c. Chief SDR- -L.
  2. Rack drawer, approximately 16" deep, color to match adjacent rack-mounting panels:
    - a. Atlas Sound SD -14; or
    - b. Middle Atlantic D ; or
    - c. Chief SDR- .
- E. Rack Shelf:
1. 1RU, utility rack shelf, 3.5" high, approximately 10" deep, color to match adjacent rack-mounting panels:
    - a. Atlas Sound SH1-10; or
    - b. Lowell 1556-USV110; or
    - c. Middle Atlantic UTR1.
  2. 2RU, utility rack shelf, 3.5" high, approximately 16" deep, color to match adjacent rack-mounting panels:
    - a. Atlas Sound SH2-15; or
    - b. Lowell 1556-USV110; or
    - c. Middle Atlantic U2.
  3. Pull-out shelf, requires rear rack rails, approximately 1.75" high (1RU), color to match equipment rack:
    - a. Atlas Sound VTD1-16; or
    - b. Lowell 1191-SLS; or
    - c. Middle Atlantic SS.
- F. Display rack mount, VESA mount for rack mounting a display, 3RU mount, provide one per display indicated in an equipment rack:
1. Middle Atlantic RM-LCD-PNLK.
- G. Gooseneck Lamp – LED – Rack, rack-mount, 1RU, dual LED, 12" gooseneck:
1. Littlite Raklite RL-10-D-LED with included power supply; or
  2. Approved equal.

## 2.12 AC POWER

- A. General
1. A complete AC power connection solution for each equipment rack and cabinet is required.
  2. Provide spare NEMA 5-15R or 5-20R outlets (single duplex receptacle) for temporary equipment (beyond that required for connected equipment, rack fan, etc.). These outlets shall be fed from an un-switched "Normal" power circuit.
    - a. For racks 16 RU or less: two spare outlets (minimum)
    - b. For racks greater than 16 RU: four spare outlets (minimum)

3. All power strips shall maintain integrity of system grounding requirements.
  4. All equipment shall be connected such that maximum rated performance can be obtained without exceeding the AC circuit load capacity.
  5. Coordinate with Electrical drawings and Division 26 specifications. Where outlets are provided under this section as a portion of power strips or power distribution units, receptacle types and colors shall match the supplied AC power circuit.
  6. Comply with all NFPA 70 requirements, including separation of loads classified as Life Safety from Normal loads via an independent Vertical / Horizontal Power Strip, PDU, and/or UPS.
- B. Uninterruptable Power Supply Requirements
1. UPS shall be provided in quantities as indicated on signal flows and/or rack elevations, and as described for components and equipment within this section and associated subsections.
  2. A UPS connected to a Normal power load shall be provided with enough battery capacity to bridge short duration loss of power and brownout events. The intent is to protect and prolong the life of sensitive processor-based equipment, reduce power cycle time upon restoration of Normal power, and/or allow the User time to safely shut down components.
  3. A UPS connected to Emergency (NFPA 70 Article 700), Legally Required Standby (NFPA 70 Article 701), or Optional Standby (NFPA 70 Article 702) AC power circuits shall be provided with enough battery capacity to bridge the maximum operation load of the connected equipment during the time from loss of Normal power to load handover to the electrical standby power system (typically generator startup time).
  4. Each UPS with an ethernet port shall be connected to the network. The Contractor shall configure the UPS (using additional software where required) per direction from the Owner's Representative. Configuration shall include, but not be limited to:
    - a. Remote access and diagnostics
    - b. Automated reporting for non-normal events (such as battery condition or power interruption)
- C. PS/V: Vertical Power Strip, single 120V 20A circuit, NEMA 5-20P plug input, minimum fourteen NEMA 5-15R outlets, mount to rear of rack interior (furnish where provided electrical receptacle quantities do not meet system requirements):
1. APC AP7530 with 40170-6INCH L5-20P adaptor; or
  2. Eaton EPBZ97; or
  3. Middle Atlantic PD-2420SC-NS; or
  4. Tripp Lite PDUV20 with included L5-20P adaptor; or
  5. Approved equal.
- D. PS/H: Horizontal Power Strip, single 120V 20A circuit, NEMA 5-20P plug input, minimum eight rear-facing NEMA 5-15R outlets, single rack space (furnish where provided electrical receptacle quantities do not meet system requirements):
1. APC AP9563; or
  2. Eaton EPBZ85; or
  3. Middle Atlantic PD-920R-NS; or
  4. Tripp Lite PDU 1220; or
  5. Approved equal.

- E. PDU/V: Vertical Power Distribution Unit, capable of multiple circuits and outlets, configured for circuit quantity, voltage, and amperage provided to rack; mount to rear of rack interior (furnish in coordination with provided electrical power):
  - 1. Juice Goose PD Series; or
  - 2. Middle Atlantic MPR Series; or
  - 3. Middle Atlantic PDW Series; or
  - 4. Approved equal.
- F. UPS:
  - 1. 1RU: Uninterruptable Power Supply, single rack space chassis, line interactive, surge suppression, 120V 20A circuit, minimum 750VA load, plug input, minimum four rear-facing NEMA 5-15R outlets:
    - a. APC Smart-UPS SUA750RM1U; or
    - b. Eaton 5P750R; or
    - c. Middle Atlantic UPS-S1000R; or
    - d. Tripp Lite SmartPro SMART750RM1U; or
    - e. Approved equal.
  - 2. 2RU: Uninterruptable Power Supply, two rack space chassis, line interactive, surge suppression, 120V 20A circuit, minimum 1950VA load, plug input, minimum eight rear-facing NEMA 5-15R outlets:
    - a. APC Smart-UPS SMT2200RMUS; or
    - b. Eaton 5P2200RT; or
    - c. Middle Atlantic UPS-2200R-8IP; or
    - d. Tripp Lite SmartPro SM2200RMXL2UP; or
    - e. Approved equal.
  - 3. 2RU/30: Uninterruptable Power Supply, two rack space chassis, line interactive, surge suppression, 120V 30A circuit, minimum 2880VA load, plug input, minimum four rear-facing NEMA 5-15R and two rear-facing NEMA 5-20R outlets:
    - a. APC Smart-UPS SMT3000RMUS; or
    - b. Eaton 5P3000RT; or
    - c. Middle Atlantic UPS-OL3000R; or
    - d. Tripp Lite SmartPro SMART3000RMXL2U; or
    - e. Approved equal.
  - 4. 3RU: Uninterruptable Power Supply, three rack space chassis, line interactive, surge suppression, 120/208V 3PH 5W 30A circuit, minimum 6000VA load, locking plug input, minimum four rear-facing NEMA 5-20R outlets:
    - a. APC Smart-UPS RT 6000 VA RM 208V to 208/120V; or
    - b. Approved equal.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Install in accordance with manufacturer's instructions.
- B. Comply with Section 27 00 13 - SUSTAINABLE DESIGN REQUIREMENTS.

### **3.2 PREPARATION**

- A. Coordinate locations and sizes of junction boxes, outlets, and conduit with the work of other trades. Field verify compliance with the construction documents.
- B. Carefully inspect areas where equipment will be installed. Notify the Contract Administrator of any conditions that would adversely affect the installation and subsequent operation of the system.
  - 1. Repeat inspection on a regular basis to ensure ongoing work by other trades does not pose a conflict to Contractor's pending work.

### 3.3 PROTECTION OF WORK

- A. Protect all work, materials, and equipment from damage due to any cause. Provide for the safety and new condition of the equipment and materials until final acceptance by the Owner's Representative. Replace all damaged or defective materials and/or equipment as directed by the Contract Administrator or HENDERSON ENGINEERS.
- B. Equipment racks, cabling racks, junction boxes, termination boxes, and other exposed equipment shall be kept covered and protected from airborne contaminants. Clean all debris from the equipment room(s)/location(s) and control areas, and clean all equipment and the interior rack floor, prior to system final acceptance activities.

### 3.4 INSTALLATION

- A. General
  - 1. Contractor shall demonstrate a reasonable standard of care. Installation shall be rendered in a workmanlike manner observing direction set forth herein as well as industry standard best practices. Comply with NECA 1.
  - 2. In addition to any spare cabling shown on drawings, utilize industry best practice to pull additional spare cabling in conduit where logical. Neatly bundle a usable length of cable at each end of each spare circuit. All spare circuits shall be labeled and noted on the field drawings for inclusion into the record drawings.
  - 3. Install any floor-mounted receptacles so that release buttons (for both receptacles and cable connectors) are easily accessible when cable connectors are installed.
  - 4. Blank panels and/or vent panels shall be installed in unused rack spaces. Ensure that air flow within the rack is maintained (i.e., cool air can enter the rack and hot air can exit the rack).
  - 5. Equipment racks and other exposed equipment shall be kept covered and protected from airborne contaminants. Clean all equipment racks and the interior rack floor, prior to system final acceptance activities.
  - 6. Where the design location requires products, materials, or equipment to be visible to the public, manufacturers logos shall be removed if possible. Unless otherwise directed, neatly remove logos.
  - 7. AC power switches located on the front panel of equipment mounted in racks shall be covered by a security cover or utilize front panel lockout features. Exclusions from this list are items requiring user interface such as tuners and wireless microphone receivers. This is not required in controlled access equipment rooms.
  - 8. Furnish all equipment with factory finish where possible using the standard available factory color(s) as selected by the Architect. Notify the Architect regarding color options of relevant equipment prior to ordering equipment from each manufacturer.
  - 9. Pathways shall meet Section 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO-VIDEO.

**B. Suspended Systems****1. General**

- a. Contractor shall provide Suspension system, including connection to structure, for all suspended components including but not limited to: loudspeakers, video projectors, flat panel displays, televisions, projection screens, etc.
- b. Suspension system design shall be created by the Contractor and include fully dimensioned detail documentation stamped by a Structural Engineer licensed in the location of the project per submittal requirements in Part 1 of this document.
- c. Contractor shall include a safety cable or other backup support mechanism.
- d. Suspension systems and installation shall conform to industry best practice standards as set forth in:
  - 1) JBL Professional Technical Note Volume 1, Number 14
- e. Coordinate with General Contractor any supplemental building structure necessary to facilitate the approved suspension design.
- f. Field verify conditions for compliance with the approved suspension plan prior to installation, placement of equipment orders, or material fabrication. Coordinate with other trades as necessary.

**2. Loudspeakers**

- a. Install loudspeakers so there are no obstructions to loudspeakers' coverage pattern.
- b. Loudspeakers shall be installed such that they do not produce or cause mechanical rattles in the surrounding structure. There shall be no audible vibration or noise caused by improper mechanical installation or defective components.
- c. Paint loudspeaker and/or grille assembly (at discretion of Architect or HENDERSON ENGINEERS) color as selected by the Architect. Use primer per manufacturer's recommendations. Do not paint loudspeaker cones or high frequency diaphragms. Materials and labor provided by Contractor.
- d. Provide access to loudspeakers during installation, testing, and final acceptance activities to allow for modifications to location or installation. Access includes all necessary resources required to obtain direct physical contact to loudspeakers (front and rear), including: scaffolding, motorized lift, etc.
- e. Provide ability to reorient loudspeakers in all axes (yaw, pitch, and/or roll) if so requested by HENDERSON ENGINEERS during system final acceptance activities.
  - 1) Do not perform final suspension connections prior to final acceptance by the HENDERSON ENGINEERS including: permanent cable swage, elimination of wire rope service loop, etc.

**C. Video**

1. Coordinate structural backing required for wall mounted flat panel displays/televisions prior to the installation of drywall or other wall materials.

**D. Bonding and Grounding**

1. Comply with NFPA 70 and TIA-607 bonding and grounding requirements.
2. Each equipment rack within a row of racks and each row of racks within a room shall be electrically bonded to each other. Bonding shall be via copper ground bus. Any bolts shall fasten to unpainted sheet metal.

**E. Equipment Power Control**

1. Low voltage "ON/OFF" control of system equipment shall be provided via the control system.
2. Operation of the following components is required, at a minimum:
  - a. Power amplifiers as indicated in Part 2 requirements.
  - b. UPS connected devices where components do not require power under system shutdown.
  - c. Components equipped with power state control.
3. Make all low-voltage connections as required to provide a complete and working control system.
4. Refer to drawings for additional low-voltage sequencing system requirements.
5. Refer to electrical drawings for AC power information.
6. Coordinate with Electrical Contractor as necessary to verify proper circuit assignment and sequencing order.
7. UPS and PDU equipment with an IP / LAN connection shall be configured to e-mail up to (3) Owner e-mail accounts for each type of alarm. Also, train Owner on use of web interface and how to update e-mail alarm settings.

### **3.5 RACK BUILDING CABLE MANAGEMENT AND TERMINATION**

- A. Employ techniques to fulfill AVIXA F502.01 as a minimum standard with the additional requirements as described in this paragraph.
  1. Reference below for additional requirements and stipulations related to zip tie utilization.
- B. General
  1. Do not violate the minimum cable bend radius as specified by the cable manufacturer.
  2. Dress cables so terminations are free from stress due to gravity acting on the cabling. Use cable supports as required depending on the size and stiffness of the cable.
  3. Terminate cables with sufficient service loop to allow at least two re-terminations without having to open a cable bundle or pathway.
  4. All circuits, including various audio signal levels, shall be separated according to function. Where audio and video circuits are installed in conduit or other raceway, separate conduits are required for the various circuit functions.
  5. Where circuits are exposed in the equipment racks or large junction or pull boxes, circuits shall be bundled according to function. Refer to "Conduit/Circuit Group Divisions" and "Conduit Routing and Separation" schedules for additional information.
  6. All solder connections shall be made with soldering iron and rosin core solder. All solder connections shall be checked for "cold" solder joints.
  7. If equipment is removed or replaced for service, ensure the proper cable termination points are apparent when the equipment is re-installed.
  8. Use hook and loop tie wraps for all category, coaxial, or fiber cables and additionally as practical for other types of cables. Do not use zip ties on any category, coaxial, or fiber cables and limit use where possible otherwise.
  9. Do not tighten cable wraps so the cable is deformed. Zip ties should never be used in locations prone to damage due to cable sagging.
- C. Equipment Racks
  1. Utilize hook and loop cable wraps for dressing cables within the rack(s). Cable wraps shall be hand tightened and spaced at various inconsistent distance intervals. The use of zip ties is not allowed inside equipment racks.



2. Install rack-mounted equipment manufactured without IEC removable power cords so the power cords are dressed using removable fasteners such as hook and loop wraps and there are no obstructions to the item being pulled out from the front of the rack. Avoid coiled or bundled cable loops.
  3. For rack-mounted equipment manufactured with IEC removable power cords, provide power cord assemblies of the minimum length needed to accomplish connection to the PDU. Avoid excess power cabling including coiled or bundled cable.
  4. Factory terminated cable assemblies are only permitted for use within racks, between devices external to racks, as portable equipment, or for use in conduit as specifically noted as follows: Permitted for rack inter-connect when racks are in close proximity (same room) and may pass thru conduit, if necessary, in this situation. Cable assemblies shall be the minimum length needed to accomplish the connection.
  5. Install rack equipment to enable repair or replacement without hindrance. If there are obstructions prohibiting the disconnection of terminations on the back side of the technical equipment, there must be sufficient cabling to permit the equipment to be pulled from the front allowing for easy disconnection and reconnection.
- D. Paralleling and Extension Connections
1. Circuits shall not be joined by butt-splice, solder-splice, wire nut, or similar.
  2. Circuits requiring parallel connection as indicated on signal flows shall be extended via approved termination in an appropriately sized junction box and shall conform to the following guidelines:
    - a. Approved connections include DIN mounted terminal blocks as specified in Part 2.
    - b. Field splicing techniques such as wire nuts, "twist and solder", etc. are not allowed.
    - c. Any circuit requiring parallel connection shall be permanently labelled on every cable as defined herein.
    - d. Care must be taken to maintain appropriate protection and shielding of circuits in order to maintain a fully functional system.
  3. Circuits requiring extension (non-data) due to field conditions such as excessive conduit bends, etc., shall be extended via approved termination in an appropriately sized junction box and shall conform to the following guidelines:
    - a. Extension of circuits is to be avoided if at all possible.
    - b. Contact the HENDERSON ENGINEERS via documented project communication. Inform the HENDERSON ENGINEERS of the circumstances regarding the desired extension. Contractor and HENDERSON ENGINEERS will coordinate to determine the most appropriate course of action.
    - c. Approved connections include DIN mounted terminal blocks as specified in Part 2.
    - d. Any circuit requiring extension shall be permanently labelled on every cable as defined herein.
    - e. Care must be taken to maintain appropriate protection and shielding of circuits in order to maintain a fully functional system.
  4. Document each parallel connection and extension on the field drawings and transfer same to the final record drawings.
- E. Telecommunications Cabling
1. Refer to Section 27 10 00 - STRUCTURED CABLING for all work associated with data-related cabling including Category and Fiber Optic cabling.



2. All data-related cabling entering a rack shall be terminated to a Data Patch Panel. Rack inter- and intra-connect cabling utilizing factory-terminated cable assemblies are not required to pass thru a Data Patch Panel.
  3. All Fiber Optic cabling entering a rack shall be terminated to a Fiber Patch Panel. Rack inter- and intra-connect cabling utilizing factory-terminated cable assemblies are not required to pass thru a Fiber Patch Panel.
- F. Microphone/Line Level Audio
1. Audio circuit termination shall observe the methods set forth in RaneNote 110.
  2. Key methods include, but are not limited to the following:
    - a. All audio circuits shall be balanced two-wire circuits, with a separate grounding shield conductor, unless noted otherwise. All circuits shall have either the red or white wires as the "high" or " " side of the line and connect to pin 2 of microphone-type XLR audio connectors and the tip of 3-conductor phone connectors. The black wire of the two-wire circuit shall be the "low" or "- " side of the line and connect to pin 3 of microphone connectors and the ring of 3-conductor phone connectors. The shield conductor shall connect to pin 1 of microphone connectors or to the sleeve of phone connectors.
    - b. Shield conductors shall be connected at each end of each wire to the pin 1 of each XLR, shield connection for each electronic device, etc. No shield wires shall be left unconnected except where noted on the drawings, nor shall any shield come in contact with conduit, pull boxes, or other building steel. Audio line-level circuit shield wires shall be grounded to rack sheet metal only via rack-mounted equipment. Shields shall be electrically isolated in multi-conductor cables. Shields for audio line-level circuits connected to audio transformers shall be connected to transformer electro-static shields and case ground.
    - c. In the case of an unbalanced source feeding into a balanced input and the cable run is short (i.e., less than fifteen feet), connect the signal connection of the unbalanced connector to the "high" side of the balanced input. Connect the "ground" connection of the unbalanced line to the "low" side of the balanced connector. Connect the cable shield to the shield connection of the balanced input but do not connect it to the unbalanced connector. If the cable run is longer than fifteen feet, balance the line at the unbalanced source using specified balancing devices.
    - d. In the case of a balanced source feeding into an unbalanced input and the cable run is short (i.e., less than fifteen feet), connect the "high" side of the balanced output to the signal input of the unbalanced connection. Connect the "shield" of the balanced connection to the "ground" of the unbalanced connection. Leave the "low" side of the balanced output floating.
- G. Loudspeaker Level Audio
1. Loudspeakers in the same acoustic space shall all be wired to produce consistent polarity with a mono input signal. They shall also be polarized such that a positive acoustic pressure on a microphone results in a positive acoustic pressure at all loudspeakers.
- H. Video
1. Compression fittings shall be used for all BNC and F connector terminations.
  2. Terminate all unused RF and SDI outputs with impedance matching terminators.
  3. Neatly dress all cables behind a flat panel display/television. Cables and connections should not be visible from the viewing locations. Power cables for displays shall not be

- bundled with signal cables nor visible.
4. For fixed projector or pole mounted flat panel display installations, signal cables shall be routed within the mounted pipe. Signal cables shall not be tied to the outside of the pipe. Provide cabling of appropriate distance to minimize excess cable at device. Bundle excess cable above the ceiling, not at the device.

### 3.6 LABELING

- A. Adhere to AVIXA F501.01 as a minimum standard with additional requirements as described in this paragraph.
- B. Refer to Section 27 10 00 - STRUCTURED CABLING for all labeling requirements associated with data-related cabling including Category and Fiber Optic cabling.
- C. Develop and utilize a consistent numbering scheme across the entire project. Utilize system names and building references where applicable, such as the rack number or rack room in a distributed system. All labels for input/output plates and control panels shall be consistent with the final room numbering for the facility.
- D. Adhere to the labeling standard across all platforms, including within the DSP programming.
- E. Refer to general notes, the signal flows, and panel and plate details for expected labeling scheme of system equipment and components. Comply with any specific color coding as described.
- F. All equipment in equipment racks shall be labeled front and rear for ease of identification. Labels shall be of a contrasting color with that of equipment color to promote visibility.
- G. Install permanent labeling on the front of each equipment rack in a row of racks identifying the rack designation (number).
- H. Within each rack and at other remote locations for technical system equipment, label all associated AC power receptacles reflecting the appropriate circuit breaker. Ensure that the circuit breakers are labeled as to the rack or remote equipment location.
- I. Document the labeling standard for inclusion in the Operation and Maintenance Data.
- J. Document all labels for the Record Drawings.
- K. Pre-approved labelling systems include:
  1. Cable Labeling:
    - a. Brady Jet-30 Type; or
    - b. Phoenix Contact Adhesive Wrap Labels.
  2. Equipment Labeling:
    - a. Lamacoid.

### 3.7 SYSTEM CONFIGURATION

- A. Coordination
  1. Coordinate and take responsibility for the approval of all system configuration components as described in this paragraph.
  2. Coordinate all aspects of the technical system network, including configuration and connection with to the Owner's LAN. Utilize Owner's designated configuration style, standards, and security requirements.
- B. Software

1. Furnish, install, and configure the most recent approved, non-beta, software for each device or system.
  2. Provide software as identified in other areas of these specifications or on the drawings.
  3. Provide software not specifically identified but required to allow for system operation and/or to allow for more efficient system configuration, setup, and operation.
- C. Firmware
1. Ensure the firmware for each device is the most recent manufacturer approved version and is installed and operational.
- D. Operating Systems
1. Gain approval of the operating system version and type from the Owner's IT representative and associated equipment manufacturer(s).
  2. Ensure the operating system for each device is the most recent, installed, and fully operational.
  3. Ensure the latest security patches are installed.
- E. Network Configuration
1. All technical system devices with an Ethernet port shall be connected to the associated network.
  2. Secure the entire network, documenting all passwords. Comply with the Owner's IT representative's requirements with respect to password selection and network security implementation.
- F. Network Documentation
1. Document the IP and MAC addresses of all IP capable equipment for inclusion with the Operation & Maintenance Manuals.

### 3.8 TESTING AD USTMENT AND SUBMITTAL REQUIREMENTS

- A. At the completion of the installation, perform the following tests on the system to ensure proper installation and operation. The technical system shall be fully tested with all equipment on site, installed, connected, and fully operational.
- B. Adhere to ANSI/Infocomm 10 as a minimum standard with additional requirements as described in this paragraph.
- C. The Contractor shall submit the results of all tests prior to on-site system review by the HENDERSON ENGINEERS. Where available, provide documentation obtained directly from the test equipment. Other acceptable documentation includes screen captures, photos, and spreadsheets.
- D. General
1. Utilize the technical support services offered by the manufacturers of the various technical system components to ensure optimum performance.
  2. All test equipment used for these tests shall be on site during the system final acceptance activities should verification of submitted measurements be required.
  3. Ensure that all equipment is on the jobsite and fully operational. This includes portable (not installed) items and other loose equipment. Remove all devices from shipping or packaging containers, ready for use, and place in equipment storage cabinet.
  4. The functional tests shall include operational tests of all program source equipment (record and playback), wireless microphone system, mixing console, system inputs and outputs, all patch panel receptacles, intercom system, video routing, video distribution,

- operational controls, AC power sequencing, operation of software, and all system electronics. Functional tests include examination for hum, buzz, hiss, ghosts, hum bars, oscillation, thumps, unintended reception of other signals such as AM or FM radio, TV, CB, ham radio, cell phones, or any other unwanted signals through the system.
5. Ensure all inputs and outputs are wired to the appropriate devices per construction documents.
  6. Verify system startup and shutdown operates in the proper sequence.
    - a. System head end components shall be energized at the beginning of the startup sequence in an appropriate order to guarantee proper communication with associated devices.
    - b. Loudspeaker power amplifiers shall be energized at the end of the sequence in order to eliminate unwanted transients being reproduced through system loudspeakers.
    - c. System shutdown sequence shall be in reverse order.
  7. Where a system computer is furnished, load and configure all necessary control software. Examples include but are not limited to the following as applicable: wireless microphone management, amplification management, projector/display management, audio console configuration/control, DSP configuration/management, and active loudspeaker management.
  8. Where audio or video digital signal transport is required, ensure all network setup is complete including the installation and licensing of network management application software.
- E. Required testing equipment:
1. Certain systems/subsystems require testing and documentation via approved test equipment.
    - a. Systems requiring testing via approved devices will be identified below.
    - b. Required test devices will be listed in related sections.
    - c. Provide unified testing results of similar systems. Describe testing procedure including all test equipment used.
    - d. Provide original results from testing equipment (as applicable).
    - e. Failure to submit testing documentation conducted via approved devices will result in delayed final acceptance by the Design Consultant.
    - f. Contractors unable to provide required test equipment shall employ the services, at their own expense, of a certified Sub-Contractor to assist in testing and documentation.
- F. Audio System
1. Electronics
    - a. Test all system audio electronic components for uniform frequency response from input to power amplifier output:
      - 1) Supply pink noise to a single system input which engages most of the system electronics. For example, connect pink noise to a microphone receptacle at the presenter location.
      - 2) With all signal processing bypassed (equalization band pass filters, crossovers, dynamics, etc.), independently route the signal through audio console, DSP, and any other system processing components to an amplifier output.
      - 3) With speaker load disconnected, measure the signal response of the selected amplifier output (to obtain viable measurement results, ensure output level is set

- to match the ability of the measurement device to display accurate information. This can be accomplished via attenuation of signal or insertion of a speaker level to line level attenuator).
- 4) Verify the measured response is uniform and matches the reference input signal within  $\pm 1$ dB from 30 Hz to 18 kHz.
  - 5) Required test equipment - Signal Generation:
    - a) Terrasonde/Sencore Audio-Toolbox; or
    - b) Japan Audio Society CD-1 test compact disc
    - c) NTI Minirator MR-PRO
  - 6) Required test equipment – Measurement Device:
    - a) AFMG Sys-Tune system; or
    - b) Rational Acoustics SMAART system v7 or later; or
    - c) NTI Audio XL2 Analyzer; or
    - d) Studio Six Digital Audio Tools RTA or FFT Module, with
      - (1) Studio Six Digital iAudioInterface 2
- b. Repeat measurement for each amplifier output channel.
2. Loudspeaker Impedance
    - a. Measure and record the impedance of all loudspeaker circuits at the output of each amplifier. During this process, also check each loudspeaker circuit for shorts to ground.
    - b. Required test equipment:
      - a) Dayton Audio DATS; or
      - b) NTI Minirator MR-PRO; or
      - c) Sennheiser ZP-3; or
      - d) Terrasonde/Sencore Audio Toolbox; or
      - e) Approved equal.
    - 2) Unacceptable measurement devices for loudspeaker impedance include the following:
      - a) Digital Multimeter (DMM); or
      - b) TOA ZM-104; or
      - c) TOA ZM-104A; or
      - d) Approved equal.
  3. Loudspeaker Band Pass/Amplifier Assignment Confirmation
    - a. For full range loudspeakers, apply full spectrum pink noise at sufficient level in order to:
      - 1) Verify subjectively that each loudspeaker is emitting full spectrum signal (both woofer and tweeter/horn are operating)
      - 2) Confirm each loudspeaker is connected to the proper amplifier chassis and output channel.
      - 3) Verify proper phase of each loudspeaker.
      - 4) Required test equipment:
        - a) Galaxy Audio CPTS Cricket Polarity Tester; or
        - b) NTI Audio MR-PRO generator with XL2 Analyzer; or
        - c) Studio Six Digital Audio Tools Speaker Polarity Module; with
          - (1) Studio Six Digital iAudioInterface 2 and Type 1 or 2 Test microphone; or

- (2) Studio Six Digital iPrecisionMic; or
      - (3) Studio Six Digital iTestMic; or
    - d) Studio Six Digital Speaker Pop; with
      - (1) Studio Six Digital iAudioInterface 2 and Type 1 or 2 Test microphone; or
      - (2) Studio Six Digital iPrecisionMic; or
      - (3) Studio Six Digital iTestMic; or
    - e) Approved equal.
  - b. For loudspeakers with multiple band pass sections (bi-amp, tri-amp, etc.), apply appropriately band-limited pink noise at sufficient level to each device or band pass (i.e., high frequency section, mid frequency section, low frequency section):
    - 1) Verify subjectively that each loudspeaker is emitting appropriately band-passed spectrum signal.
    - 2) Confirm each band pass is connected to the proper amplifier chassis and output channel.
    - 3) Verify phase of each band pass
    - 4) Required test equipment:
      - a) Galaxy Audio CPTS Cricket Polarity Tester; or
      - b) NTI Audio MR-PRO generator with XL2 Analyzer; or
      - c) Studio Six Digital Audio Tools Speaker Polarity Module; with
        - (1) Studio Six Digital iAudioInterface 2 and Type 1 or 2 Test microphone; or
        - (2) Studio Six Digital iPrecisionMic; or
        - (3) Studio Six Digital iTestMic; or
      - d) Studio Six Digital Speaker Pop; with
        - (1) Studio Six Digital iAudioInterface 2 and Type 1 or 2 Test microphone; or
        - (2) Studio Six Digital iPrecisionMic; or
        - (3) Studio Six Digital iTestMic; or
      - e) Approved equal.
4. Loudspeaker Rattle
- a. Verify each loudspeaker is connected to the respective power amplifier and test each loudspeaker throughout its usable frequency range using 1/3-octave bands of pink noise to ensure loudspeaker and related building systems do not rattle.
  - b. Required 1/3-octave band pink noise sources and test equipment include:
    - 1) Terrasonde/Sencore Audio-Toolbox; or
    - 2) Japan Audio Society CD-1 test compact disc
    - 3) NTI Minirator MR-PRO
5. Loudspeakers Uniformity of Coverage
- a. Perform audio system verification per AVIXA A102.01 for all loudspeakers. Document per guidelines set forth in the standard.
6. Loudspeakers Equalization
- a. Perform sound system equalization to optimize system performance for the intended uses.
  - b. Every loudspeaker shall be equalized.
  - c. Required test equipment:

- 1) Calibrated Type 1 or Type 2 microphones shall be used
  - 2) Studio Six Digital Audio Tools (for applicable spaces); with
    - a) Studio Six Digital iPrecisionMic; or
    - b) Studio Six Digital iTestMic; or
    - c) Approved equal.
  - 3) SmaartLive (most current non-beta version) with SmaartLive approved:
    - a) Appropriate laptop
    - b) Microphone interface
  - 4) AFMG Sys-Tune (most current non-beta version) with Sys-Tune approved:
    - a) Appropriate laptop
    - b) Microphone interface
7. Microphone/Line Level
- a. Verify that all microphone and line level cabling and connectors are installed with Pins 1, 2, and 3 wired properly and there are no shorts to ground. Ensure proper polarity.
  - b. Verify that all microphone connectors, extension cables, and microphones are wired properly and in polarity.
  - c. Required test equipment:
    - 1) Alphon ACT-100 Remote Tester; or
    - 2) NTI Minirator MR-PRO with Cable Test Adapter; or
    - 3) Approved equal.
    - 4) A microphone is NOT an acceptable measurement device for cable tests.
8. Wireless Microphones
- a. Setup and configure each wireless microphone system using the software provided by the manufacturer of the wireless microphone system. The following tasks are required:
    - 1) Utilize wireless microphone management system if applicable, e.g., Shure Wireless Workbench, to perform an RF spectrum sweep.
    - 2) Perform frequency coordination with Owner. Take into account any existing wireless microphone system(s).
    - 3) Calculate spare RF channels (based on 5% of the total wireless system channels).
    - 4) Perform frequency assignment of all transmitters/receivers per the results of the frequency coordination and RF spectrum sweep.
    - 5) Verify all receivers are set to maximum line level audio output.
    - 6) Set all handheld wireless transmitter microphone sensitivity settings to allow high level voice output without AF over modulation. All transmitters should be set the same.
    - 7) Set all body pack wireless transmitter microphone sensitivity settings to allow high level voice output without AF over modulation. All transmitters should be set the same.
    - 8) Using subjective listening, adjust the body pack settings to match the audio level of the handheld transmitters.
    - 9) Walk the entire performance coverage area using speech as the program material to verify signal performance. Utilize wireless microphone management system (software) if applicable to perform a QOS test.



- 10) Document wireless microphone frequency assignments including coordinated spare channels.
9. Production Intercom System
  - a. Verify that all intercom level cabling is installed with pins 1, 2, and 3 wired properly and there are no shorts to ground. Ensure intercom system power supply is disconnected for these tests.
  - b. Required test equipment:
    - 1) Alphonson ACT-100 Remote Tester; or
    - 2) NTI Minirator MR-PRO with Cable Test Adapter; or
    - 3) Approved equal.
10. Assistive Listening System
  - a. Setup and configure the assistive listening system. Verify proper input signal level.
  - b. Walk the entire coverage area using speech as the program material to verify signal performance.
  - c. Set all receivers to match the selected transmit channel(s).
- G. Video System
  1. Verify that all coax video cables pass a DC continuity cable test and contain no electrical shorts. Required test equipment includes:
    - a. Fluke MicroScanner2; or
    - b. Test-Um CX200; or
    - c. Triplet 8-Way WireMaster Coax; or
    - d. Approved equal.
  2. Verify that all coax video cables pass a frequency sweep test for the bandwidth of intended use. Required test equipment includes:
    - a. Tektronix RSA5000; or
    - b. Rhode & Schwarz FPC1500; or
    - c. Keysight Technology N9340B; or
    - d. Approved equal.
  3. Verify that all video cabling intended for use in SDI signals are tested to allow system conformance with SMPTE 424M. Required test equipment includes:
    - a. Phabrix SxE; or
    - b. Harris VideoTek HD-Star; or
    - c. Quantum Data QD780C; or
    - d. Approved equal.
  4. Verify that all video systems utilizing DVI cabling are tested to confirm the signal path passes full system bandwidth, full system resolution, HDCP as applicable, correct color space and bit depth, and correct frame rate. Required test equipment includes:
    - a. Murideo Fox & Hound A/V Testing and Troubleshooting Kit; or
    - b. Murideo Fresco Field Test Suite; or
    - c. Proton-LVDS Video Generator Analyzer; or
    - d. Purelink HDG 2.0; or
    - e. Approved equal.
  5. Verify that all video systems utilizing HDMI or DisplayPort cabling are tested to confirm the signal path passes full system bandwidth, full system resolution, HDCP, correct color space and bit depth, correct frame rate, HDR signal and metadata as applicable, and



- audio as applicable. Required test equipment includes:
- a. Hall Research PGA-VHD; or
  - b. Murideo Fox & Hound A/V Testing and Troubleshooting Kit; or
  - c. Murideo Fresco Field Test Suite; or
  - d. Quantum Data QD780C; or
  - e. Purelink HDG 2.0; or
  - f. Approved equal.
6. Setup and calibrate each visual display using current edition of Spears & Munsil High-Definition Benchmark Disc. Perform calibration with environmental lighting set to level representative of the system while in use. Verify each source and variety of resolutions. For projector/screen combinations, the screen drop shall be set to maximize observation from all seats and the image shall fill the available space on the screen.
  7. Calibrate each video image using a repeatable, calibrated system. Provide documentation for each calibrated image. Results shall also become a part of the Operation/maintenance manuals. Required test equipment includes:
    - a. Datacolor Spyder5ELITE Display Calibration; or
    - b. SpectraCal CalMAN Ultimate software (most recent version) running on Contractor-provided laptop which exceeds the minimum requirements stipulated by SpectraCal.
      - 1) Supported Meters: as recommended by SpectraCal
      - 2) Supported Pattern Sources: as recommended by SpectraCal; or
    - c. X-Rite ColorMunki Display; or
    - d. Approved equal.
- H. Control System
1. Verify performance of the Control System including the operation of all control features.
- I. Adjustment
1. Repair or replace any defects or malfunctions found prior to the commencement of final acceptance activities by the HENDERSON ENGINEERS.
- J. Testing Documentation Submittal
1. Document the results of all tests and compile into a complete Testing Documentation submittal with the following items:
    - a. Results of the tests detailed herein; and
    - b. Documentation of changes to the systems as a result of any project Change Order, ASI, field directive, Owner's Representative direction or the Testing and Adjustment process. Scans of current field set are acceptable for this submittal; and
    - c. Digital photographs or explanation of reasoning for failed test results due to reasons such as site conditions, constraints, equipment availability, equipment failure, direction required from design team or Owner's Representative, etc.; and
    - d. Written notice to the HENDERSON ENGINEERS that the system(s) are ready for final acceptance.
  2. Include the final approved Testing Documentation package in the Operation and Maintenance Data package.
  3. Modify the Record Drawings to include any changes as a result of the adjustment process.
- K. Contact the HENDERSON ENGINEERS should problems or concerns arise during the testing activities.

- L. Transmit the Testing Documentation submittal to the HENDERSON ENGINEERS in a timely fashion to allow the HENDERSON ENGINEERS appropriate time for review and comment prior to scheduling of final acceptance. The HENDERSON ENGINEERS cannot visit the site or begin the acceptance phase until the submittal has been approved.
- M. Should the HENDERSON ENGINEERS be required to invest time performing some or all of the tests, the Contractor will compensate the HENDERSON ENGINEERS for all associated costs.

### 3.9 FINAL ACCEPTANCE

- A. After completion of the system installation and after the preliminary tests and adjustments are complete, the Contractor in conjunction with the HENDERSON ENGINEERS shall perform on-site acceptance of the technical system. This process will include, but not be limited to the following, as applicable:
  - 1. Random verification of Contractor tests
  - 2. System check-out
  - 3. Tailoring of the technical system's frequency response to the facility's acoustical environment (where required)
  - 4. Observation of video system to verify proper image display
  - 5. Function and operability of the control system.
- B. Provide the services of the designated supervisor and any other technicians who are familiar with the system, for approximately four ten-hour days. Additional time may be required due to Alternates accepted by the Owner's Representative, or due to Addenda or Change Orders (if any) which modify the scope of work. The supervisor shall provide personal assistance during these activities. This duration does not include time for correcting wiring errors, equipment malfunctions, or problems related to the installation of the technical system. This work could occur at any time day, night, weekends, or holidays without additional claims for expense.
- C. At the discretion of the HENDERSON ENGINEERS, the Contractor shall participate in the control and adjustment of computer-controlled systems including but not limited to the following systems: main control system, DSP, wireless microphone, amplifier, active loudspeaker, display systems, etc.
- D. At the completion of the final acceptance period, the Contractor shall compile all system configuration settings (files) with copies as required for inclusion in the O&M Manuals described later in these specifications.
- E. In addition, provide the following: hand and power tools appropriate for the type of installation, ladders, lifts, and/or scaffolding as required to reach all high-mounted devices, spare wire and cable of the types used in the installation, selection of wiring fasteners used in the installation, complete set of the most recent reviewed shop drawings, complete set of all manufacturers' original installation/operation/maintenance manuals, and specific test equipment used during the preliminary testing activities.
- F. After the technical system is operational, the Contractor shall provide verbal instruction to designated Owner's Representative as to proper methods of system operation. Video record the instruction class and provide the recording in a usable digital format to the Owner's Representative.
- G. Provide operational assistance for the first major use of the completed system as directed by the Owner's Representative, including being present for: one prior rehearsal associated with the event (if applicable); a technical check immediately prior to the event; and the event itself.

**3.10 OPERATION AND MAINTENANCE DATA**

- A. At the completion of the project, compile thorough copies of the Operation and Maintenance (O&M) Data per Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO.
- B. O&M data shall be assembled according to rooms or areas as it relates to the project site. The intent is to allow the Owner's Representative to easily locate information relating to a specific system/room without having to spend an inordinate amount of time searching. Include complete information for each system/room – this may involve duplication of information.
- C. Include ANSI E1.47 within the O&M data.
- D. As applicable, save full digital version to the system computer.

**END OF SECTION**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 27 41 16 - AUDIO VIDEO SYSTEMS EQUIPMENT****PART 1 GENERAL****1.1 SUMMARY**

- A. This section describes the equipment for the audio-video (AV) system (hereafter referred to as the "Technical System").

**1.2 RELATED REQUIREMENTS**

- A. Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO
- B. Section 27 41 00 - AUDIO VIDEO SYSTEMS

**PART 2 PRODUCTS****2.1 GENERAL**

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for general product requirements.
- B. All components of the technical system equipment shall be provided and installed by a qualified contractor as outlined in Section 27 41 00 - AUDIO VIDEO SYSTEMS.
- C. All electronic audio devices shall have electronic or transformer balanced inputs and outputs except for specific program source equipment and mixing console inputs and/or outputs. If an electronic device specified or furnished has an unbalanced input and/or output, make provisions to balance said input/output (i.e., active signal balancing device as approved) unless other arrangements have been agreed upon with the HENDERSON ENGINEERS.

**2.2 COMMON EQUIPMENT**

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for common equipment and components.

**2.3 EQUIPMENT LIST**

- A. Refer to the attached Appendix A equipment list for major components of the Technical System basis of design. Alterations from the established basis of design product selections shall follow the Product Substitution and Submittal requirements per Section 27 41 00 - AUDIO VIDEO SYSTEMS.
- B. Major components are included herein to convey design intent and may not reflect every element required for a complete and working system. A fully functional and complete system including minor components is required, whether explicitly indicated or not.

**2.4 WIRELESS MICROPHONE SYSTEMS - GENERAL REQUIREMENTS**

- A. Furnish complete wireless microphone system(s) including all accessory components from a single manufacturer for the entire project. Where applicable, multi-channel receiver chassis models are preferred to reduce hardware counts.
- B. Each receiver shall be connected via Ethernet to the computer. Furnish the most recent configuration software, install on the computer, and configure each receiver and transmitter for optimum operation. Test each and all receiver/transmitters to ensure no problems arise.
- C. Rechargeable batteries shall be provided for all transmitters. Label each battery using a logical scheme so batteries can be tracked as they are shuffled among transmitters. Document labels into a spreadsheet which will become a portion of the Operation & Maintenance manuals described in Part 3 of these specifications.
  - 1. Charging equipment shall be provided to accommodate all batteries / transmitters.

- D. Where remote 1/4 wavelength antennas are used, and mounting conditions allow, mount each antenna on a standard metal wall plate to serve as a ground plane.
- E. Provide all connections and components necessary for proper operation of the wireless systems described above.
- F. Coordinate the selection of transmitter/receiver frequencies to be free of interference from outside sources or interference between wireless systems. Select the frequency from an unused channel between (470 - 698 MHz) per FCC regulations Part 74, subpart H.
- G. Label each receiver/transmitter combination as noted on the drawings or as coordinated with the Owner's Representative. See Labeling in Section 27 41 00 - AUDIO VIDEO SYSTEMS for additional labeling requirements.

## **2.5 PROGRAM SOURCE EQUIPMENT**

- A. Rack-mount kit for equipment that requires rack mounting but is not provided with rack mount ears or optional rack mount kit:
  - 1. Lowell RMK series; or
  - 2. Middle Atlantic Products RSH series; or
  - 3. Approved equal.
- B. For each portable item of program source equipment, furnish one set of input/output cables (6-foot minimum length) and adapters (as required) to allow for connection to technical system inputs/outputs.

## **2.6 MIXING CONSOLES**

- A. The drawings reflect specific mixing consoles. If a mixing console different from the mixer shown on the drawings is furnished, shop drawings are required indicating proposed wiring configuration, patch panel configuration / labeling, I/O configuration, and any modifications to the console millwork. All of the features shown for the console on the drawings shall be maintained with the substitute mixer.

## **2.7 DIGITAL SIGNAL PROCESSING (DSP)**

- A. The AC power cord of the DSP shall be connected to a rack-mount uninterruptible power supply (UPS). Refer to the AC Power in Section 27 41 00 - AUDIO VIDEO SYSTEMS for specific models. The UPS shall be connected to an unswitched (unsequenced) AC power circuit.
- B. The Contractor shall create all schematics for the DSP and submit as a shop drawing. Refer to Submittals section for additional information.
- C. Provide one computer with mouse and system features as recommended and approved by the manufacturer of the DSP system for use during final acceptance.
  - 1. If a computer is provided or designated for use as a system operation and configuration device, DSP software shall be loaded, and the computer shall be operational during system final acceptance.
  - 2. If a permanent computer is not configured for technical system usage, furnish a wireless 802.11ac router and laptop computer configured to allow for wireless control of the DSP during system final acceptance. This equipment shall remain on site until final acceptance activities have been completed. Retain ownership of the router and laptop computer.

- D. Password protection shall be included. One password shall be provided to allow operator access to select functions. Another password shall be provided for technical staff to access all aspects of the software.
- E. DSP programming of Fire Alarm connection
  - 1. General
    - a. Sound system operation in relation to fire alarm system is subject to NFPA, local building codes, and the local Authority Having Jurisdiction.
    - b. Sound system mute for fire alarm audible notification shall be provided for all assembly areas, locations with systems capable of prolonged operation in excess of 100dBA, and all facility background music systems.
    - c. Coordinate with the fire alarm contractor and local AHJ.
  - 2. Sound system mute initiation signal
    - a. Fire alarm system connection to audio system shall be via contact closure circuit in location as indicated on signal flows.
      - 1) Normal condition of contact closure circuit shall be "closed".
      - 2) Alarm condition of contact closure circuit shall be "open".
    - b. Upon fire alarm activation, all sound system audio shall mute.
    - c. DSP shall be programmed to mute audio sources until the alarm is cleared, upon which normal operation shall resume. Activation of Alarm signal may include General Alarm, keying of the fire alarm microphone, or initiation of preprogrammed severe weather (or the like) announcement.
    - d. DSP programming shall include clear visible status of alarm state for troubleshooting purposes.
  - 3. Supplemental voice via fire alarm system (seating bowl)
    - a. Fire alarm supplemental voice connection shall be via DSP mic/line level input in location as indicated on signal flows.
    - b. Sound system mute via contact closure shall operate independent of supplemental voice operation. When in Alarm signal mode, the supplemental voice input shall be the only active audio source.
    - c. Sound system shall enter supplemental voice DSP state upon receipt of system Alarm signal or via keying of the fire alarm microphone.
  - 4. Refer to signal flows and coordinate connections with Fire Alarm System Contractor to ensure compatibility with connections to Fire Alarm System. The following components may be required, dependent on system configurations:
    - a. Loudspeaker Level to Line Level Transformer: 25V, 70V, or 100V loudspeaker level input, unbalanced line level output, selectable input voltage, for connection from loudspeaker level fire alarm connection to line level DSP input:
      - 1) RDL TX-70A.
    - b. Logic Controlled Relay – Momentary: momentary latching logic-controlled relay, contact closure output, for connection from DSP GPIO to fire alarm relay module when DSP GPIO does not have native contact closure outputs:
      - 1) RDL ST-LCR1.
- F. Furnish all components for a fully functioning digital signal processing system.
- G. DSP system basis of design is shown on the signal flows. Unterminated I/O or additional I/O cards shall be provided as shown on the signal flows for future use or additional requirements.

- H. Substitutes to the basis of design will be considered if all features and functionality of the system requirements are met. I/O requirements shall meet or exceed the quantity of the basis of design. Processing requirements shall meet or exceed the basis of design to ensure proper operation of the system. The following manufacturers are pre-approved substitutes to the basis of design shown on the signal flows:
  - 1. Biamp Tesira with:
    - a. The most recent Tesira software; or
  - 2. BSS Soundweb with:
    - a. The most recent Architect software; or
  - 3. QSC Q-Sys with:
    - a. The most recent Q-Sys Designer software
    - b. The following software licenses per core:
      - 1) UCI deployment; and
      - 2) Scripting engine; and
      - 3) Dante channel license (as required).
- I. Audio Network Management Server: Audio network control, monitoring, and management platform; virtual application with dedicated hardware appliance for facility audio network management; provide server setup and system configuration (one required):
  - 1. Audinate Dante Domain Manager, with:
    - a. Dante Domain Manager virtual application
    - b. Software license tier as required per quantity of audio network endpoints
    - c. Audinate approved hypervisor
    - d. Audinate approved hardware appliance (server) per specifications as listed with the selected hypervisor:
      - 1) Dell Server
      - 2) HP Server
      - 3) IBM Server.

## 2.8 POWER AMPLIFIERS

- A. Power amplifiers shall be selected in a manner to reduce quantity of distinct manufacturers for consistency of product across the project. Multi-channel amplifiers shall be selected to reduce chassis counts.
- B. All power amplifier inputs shall be either balanced analog inputs or digital network.
- C. All front panel controls and AC power switches shall be either:
  - 1. concealed via a perforated metal security cover,
  - 2. concealed via manufacturer-supplied security cover,
  - 3. electronically disabled.
  - 4. The security cover shall not block air-flow for amplifier internal cooling.
- D. All power amplifiers shall have standby/sleep mode functionality. This functionality shall be implemented on a system wide scale to provide a fully controlled power sequencing system. Preferred solution is network based; if amplifier does not have necessary features via network control, contact closure solution shall be utilized. Contact closure solution shall utilize a control system for triggering power on/off cycle.
  - 1. Upon system shutdown, power amplifiers shall enter standby/sleep mode per manufacturer's functionality.



- E. Power amplifiers are listed by series, with the basis of design model shown on the amplifier schedule(s) and/or signal flows. Deviation from the basis of design to an approved substitute shall be allowed as follows:
1. Power rating for high impedance (70V) operation shall meet or exceed the basis of design load requirement on the channel. Load shall be calculated based on total power (addition of all loudspeaker tap values) as indicated on the signal flows.
  2. Power rating for low impedance operation shall meet or exceed the basis of design load requirement on the channel. Load shall be as indicated on the loudspeaker schedules and/or signal flows.
  3. Channel count per chassis shall produce the most efficient solution of maximum channels vs appropriate power rating.
  4. Proposed substitute should take into account:
    - a. alterations of audio network requirements, as applicable. Alterations may include the need for additional network infrastructure, including network switches.
    - b. alterations of audio system requirements, as applicable. Alterations may include the need for additional digital signal processing infrastructure.
    - c. standby/sleep mode functionality. Alterations may include the need for additional network infrastructure or control system infrastructure.
    - d. all other parameters, including but not limited to rack requirements and environmental considerations (AC power, thermal dissipation, weight, etc.).
- F. Specification naming scheme: Power Amplifier – Type ( )x/( )N(A)(B)(C)(D)(E)(Q)
1. Key:
    - a. x minimum power rating listed at 8-ohm load, also capable of providing high impedance (70V) operation (x)
    - b. / number of channels per chassis
    - c. N network control capabilities
    - d. A AVB network capability
    - e. B BLU-Link
    - f. C Cobranet capability
    - g. D Dante network capability
    - h. E EtherSound
    - i. Q Q-SYS network capability
- G. Basis of Design
1. Refer to Audio Video Amplifier Schedule for basis of design product information.

## 2.9 LOUDSPEAKERS – INSTALLED

- A. General loudspeaker requirements:
1. Loudspeaker, and related mounting bracket(s) where appropriate, color shall be as selected by the Architect from the available color selection offered from each loudspeaker manufacturer.
  2. For loudspeakers located outdoors or in an indoor humid environment (such as natatoria):
    - a. Encapsulate all exposed loudspeaker wiring terminations in clear silicon type sealant or Star Brite Liquid Electrical Tape (800) 327-8583.
  3. Utilize the most recent manufacturer-recommended DSP settings if available.
- B. Basis of Design

1. Refer to Audio Video Loudspeaker Type Schedule for basis of design product information.

#### **2.10 ASSISTIVE LISTENING SYSTEM - GENERAL REQUIREMENTS**

- A. The transmitter shall be installed in the audio equipment racks and the transmitting antenna shall be remotely mounted/suspended at the location shown on the drawings. The antenna shall be installed in a vertical orientation.
- B. Select interference-free frequencies corresponding to the space assignments listed in the documents. Coordinate system wording with the Owner's Representative. Permanently and clearly label each receiver.
- C. The Assistive Listening System (ALS) shall include all hardware as required to provide a fully-functional system.
- D. A single manufacturer shall be selected for all systems.
- E. Signage shall be handed over to the Owner's Representative for installation at a location of their choosing.

#### **2.11 PRODUCTION INTERCOM SYSTEM - WIRED**

- A. The production intercom system equipment shall be supplied from one manufacturer only. Ensure that power supply can operate all intercom equipment without interruption.
- B. Contractor shall clearly and accurately document all locations where intercom wiring is connected in parallel. Utilize industry best-practices to eliminate excessive parallel connections. Connection locations are required to be accessible, with all wiring clearly labeled.

#### **2.12 PRODUCTION INTERCOM SYSTEM – WIRELESS**

- A. The wireless production intercom system shall be configured to function as a stand-alone system or to interface with the wired intercom system.
- B. The wireless intercom system equipment shall be supplied from one manufacturer only.

#### **2.13 VIDEO DISTRIBUTION SYSTEM - EQUIPMENT**

- A. The AC power cord of the Video Distribution System Processor shall be connected to a rack-mount uninterruptable power supply (UPS). Refer to the AC Power in Section 27 41 00 - AUDIO VIDEO SYSTEMS for specific models. The UPS shall be connected to an unswitched (unsequenced) AC power circuit).
- B. Video distribution system equipment shall either be furnished from one manufacturer only or shall conform to an industry standard with demonstrated compatibility with non-proprietary devices.
- C. The drawings reflect a specific system manufacturer(s) as the basis of design. If a different system is furnished, shop drawings are required indicating proposed wiring configuration and equipment used. All of the features shown for the system on the drawings shall be maintained with the substitute system. Include coordination and costs related to back boxes, electrical, and other associated items.
- D. System shall be compatible and coordinated with selected Control System.
- E. All equipment necessary shall be furnished to provide a complete operating system. Additionally required accessories and components may not be indicated on the signal flows, such as routing processors, control system interface processors, software licenses, etc.

- F. The system shall utilize an IP network-based topology as the primary transport method. Coordination with the network system is required.
- G. The following manufacturers are pre-approved substitutes to the basis of design found on the signal flows:
  - 1. Crestron NVX
    - a. Approved with Crestron control
  - 2. Extron NAV
    - a. Approved with Extron control

#### **2.14 VIDEO DISPLAY EQUIPMENT – PROJECTORS**

- A. Projector lens recommendations are based on conditions anticipated during the design phase. Site conditions may differ from the design documents. The Contractor shall be responsible for field verifying the screen size/location, projector mounting location, throw distance, lens shift capability and selection of the appropriate lens. Projectors shall be installed perpendicular to their objective screen or projection surface. Image alignment shall be via projector placement and lens shift only. Digital keystone correction is not acceptable. Digital manipulation of the image size is not an acceptable alternative to incorrect lens selection. Incorrect selection of the projector lens or incorrect installation of the projector in relation to the projection surface will not be an acceptable request for a change order.
- B. All projectors specified in this section shall have the following features or options included, unless noted otherwise for specific projectors:
  - 1. Aspect ratio as indicated on the schedule
  - 2. Capable of minimum native resolution no less than 1920x1080
  - 3. Ability to calculate lumen output per ANSI standard specification
  - 4. Potential for DVI, HDMI, or SDI input (as indicated on signal flows)
  - 5. Control via LAN or RS-232
  - 6. Include or provide lens capable of meeting site conditions as described above
  - 7. Include one spare/replacement lamp assembly (one spare lamp required per non-laser projector)
- C. Basis of Design
  - 1. Refer to Audio Video Projector Schedule for basis of design product information.

#### **2.15 PROJECTOR MOUNTS & ACCESSORIES**

- A. Unless noted otherwise, provide the appropriate mount for each projector furnished. Mount color as selected by Architect. Match mount to the projector and the mounting surface.
- B. Full assembly (projector, mount, and all associated connections/equipment) shall be adequately supported with the appropriate safety factor to building structure. Appropriate structural support shall be provided. No mounts shall fasten directly to the roof deck.
- C. Shop drawing required. Refer to submittal requirements.
- D. Furnish all components to provide a complete installation, including fastening systems suitable for the mounting surface.
- E. All recessed or built-in projectors require shop drawings showing the surrounding architecture to ensure proper fit and ventilation requirements.

#### **2.16 FRONT PROJECTION SCREENS – INSTALLED**

- A. All projection screens specified in this section shall have the following features or options included, unless noted otherwise for specific screens:
  - 1. Ambient Light Rejecting screen surface, 0.9 gain
  - 2. Black backing on screen surface
  - 3. Extra drop to allow for bottom of screen image to reach height per schedule
    - a. Screen fabric shall be fully deployed when at the specified height
  - 4. Aspect ratio as indicated on the schedule
  - 5. Motorized screen and concealment door, if applicable
  - 6. Externally mounted electrical junction box / low voltage control interface
  - 7. Low voltage wall switch, location as shown on plans
- B. Projection screens are specified by series. Refer to drawings for exact screen size required per screen. Size listed as: (height in inches)-(width in inches). Deviance from basis of design size allowed  $\pm 2"$ .
- C. Coordinate final mounting position with appropriate parties. Ensure screen is mounted such that screen drop is not impeded by wall mounted devices, including any electrical devices or marker boards and trays. Screen drop shall not impact wall during deployment.
- D. Ceiling mounted screens shown directly parallel to a wall surface without a given dimension are intended to be mounted such that the deployed screen surface is no more than 12" off the wall surface. If mounting conditions necessitate violation of this dimension, approval is required on an individual basis.
- E. Basis of Design
  - 1. Refer to Audio Video Projector Screen Schedule for basis of design product information.

## 2.17 FLAT PANEL DISPLAYS - GENERAL REQUIREMENTS

- A. Flat panels in this section shall be LCD, by one manufacturer, unless noted otherwise.
- B. All LCD flat panel displays specified in this section shall have the following features or options included, unless noted otherwise:
  - 1. Display response time of 10ms or less
  - 2. LED backlighting
  - 3. VESA mounting compatible
  - 4. Minimum viewing angle of 175°horizontal x 175°vertical
- C. LCD flat panels are listed by series, with the basis of design model shown on the schedules and/or signal flows. The minimum requirements for inputs, outputs, control connections and optional interfaces/accessories shall be as indicated on signal flow diagrams.
- D. Deviation from the basis of design to a proposed substitute will be allowed as follows:
  - 1. All audio, video, and control connections shown on signal flow (connectors shown on equipment block but without any connections are not required for substitution) shall meet or exceed the basis of design with respect to quantity, type, version, and supported protocols. This shall include the standard features of the display as well as any optional interfaces/accessories.
    - a. Example connections include but are not limited to:
      - 1) TV tuner (NTSC, ATSC, and Clear QAM compatible),
      - 2) HDMI (HDCP compatible),
      - 3) DVI-D (HDCP compatible),

- 4) SDI (SD, HD, 3G, Dual Link, 6G),
  - 5) DisplayPort (HDCP Compatible),
  - 6) HD15 RGB with 3.5mm audio,
  - 7) Component with stereo audio,
  - 8) Composite with stereo audio,
  - 9) Multi-channel audio,
  - 10) RJ45 LAN,
  - 11) RJ45 HDBaseT,
  - 12) RS232 control via DB9 connector, and
  - 13) USB.
2. Contractor shall be responsible that the proposed substitute meets or exceeds the basis of design and will:
    - a. have an equivalent aspect ratio.
    - b. have an equivalent rated operation (24/7, 16/7, etc.)
    - c. meet the capabilities of any built-in speakers.
    - d. physically fit in the location with sufficient space for ventilation and servicing.
    - e. have an equivalent brightness rating and backlighting technology (edge light, direct back light, etc.)
    - f. utilize the same touch sensing technology (resistive, capacitive, etc.)
    - g. be compatible with the display mount.
    - h. allow for multiple mounting orientation capabilities (horizontal, vertical/portrait, etc.).
    - i. have an equivalent manufacturer's warranty.
  3. Contractor shall submit details (and shop drawings where applicable) for each proposed substitute. Include information relating to the above.

E. Basis of Design

1. Refer to Audio Video Flat Panel Display Schedule for basis of design product information.

## 2.18 FLAT PANEL DISPLAY TELEVISION MOUNTS

- A. Unless noted otherwise, provide the appropriate mount for each display furnished. Mount color as selected by Architect. Match mount to the display and the mounting surface.
- B. Full assembly (display, mount, and all associated connections/equipment) shall be adequately supported with the appropriate safety factor to building structure. Appropriate structural backing/support shall be provided. No mounts shall fasten directly to the roof deck. Refer to submittal requirements.
- C. Furnish all components to provide a complete installation, including fastening systems suitable for the mounting surface.
- D. All recessed or built-in displays/televisions require shop drawings showing the surrounding architecture to ensure proper fit and ventilation requirements.
- E. Refer to drawings for anticipated mount type required for each display location.
- F. Provide outdoor rated mount variants in locations as applicable.
- G. Mounts shall be selected and installed to ensure the full display/mount assembly meets all ADA requirements, including Protrusion Limits into Circulation Paths of no more than 4" (as defined by the ADA Accessibility Guidelines). Additional considerations may include:

1. The use of thin mounts in lieu of standard depth display mounts to reduce mounting depth.
  2. Where wall standoffs are utilized, ensure overall depth is no greater than 4”.
  3. The use of “right angle” plugs or terminations may be required to maintain minimum cable bend radius.
  4. The use of recessed back boxes may be required to accommodate plugs or terminations and any display mounted equipment.
  5. The use of recessed back boxes with thin profile articulating mounts may be utilized in lieu of thin mounts.
- H. Flat Panel Mount – Wall - Fixed: fixed wall mount, fully adjustable, lockable, sized for display as required:
1. Chief FUSION SM Series; or
  2. Peerless SF Series; or
  3. Premier Mounts P F Series.
- I. Flat Panel Mount – Wall – Tilt: tilt wall mount, fully adjustable, lockable, sized for display as required:
1. Chief FUSION TM Series (OD for outdoor series); or
  2. Peerless ST Series (EPT for outdoor series); or
  3. Premier Mounts P T Series (-EX for outdoor series).
- J. Flat Panel Mount – Wall – Fixed Thin: fixed wall mount, low profile, fully adjustable, lockable, sized for display as required:
1. Chief FUSION ST; or
  2. Peerless Ultra Slim SUF Series; or
  3. Premier Mounts Low-Profile P F Series.
- K. Flat Panel Mount – Wall – Tilt Thin: tilt wall mount, low profile, fully adjustable, lockable, sized for display as required:
1. Chief FUSION TT; or
  2. Peerless Ultra Slim SUT Series; or
  3. Premier Mounts Low-Profile P T Series (-EX for outdoor series).
- L. Flat Panel Mount – Wall – Articulating: articulating arm wall mount that pulls out, rotates, and tilts down, fully adjustable, lockable, sized for display as required:
1. Chief TS T Series (OD for outdoor series); or
  2. Peerless SA Series (ESA for outdoor series); or
  3. Premier Mounts AM Series.
- M. Flat Panel Mount – Wall – Articulating ADA: articulating arm wall mount that pulls out, rotates, and tilts down, fully adjustable, lockable, sized for display as required; with recessed back box for retain mount within wall cavity, maximum depth of mount at face of wall no greater than 0.5”:
1. Chief RIW Series mount with PAC501B in-wall back box; or
  2. RP Visuals Wallmate Series; or
  3. Approved equal.
- N. Flat Panel Mount – Desk – Articulating Computer: articulating arm mount that permanently mounts to a desk or lectern, full rotation, sized for computer monitor display as required:
1. Chief KC Series; or
  2. Peerless LCT Series; or

3. Premier Mounts MM Series.
- O. Flat Panel Mount – Videowall: arrayed video wall flat panel mount, micro adjustment in all axis, adjustable depth, front service display release, requires coordination with surrounding architectural elements, refer to Shop Drawing requirements:
  1. Chief ConnexSys Video Wall Series; or
  2. Peerless EDS-VW765 Series (outdoor rated); or
  3. Premier Mounts LMV Series (standard) or LMVS Series (slim); or
  4. RP Visuals RPMM Matrix Series.
- P. Flat Panel Mount – Ceiling - Pole: ceiling mounts one display from 1.5" pipe, fully adjustable, locking, sized for display as required:
  1. Chief FUSION CM Series; or
  2. Peerless PLCM Series (ECMU for outdoor series); or
  3. Premier Mounts CTM Series.
- Q. Flat Panel Mount – Ceiling – Pole – Dual Display: ceiling mounts two back-to-back displays from one 2" pipe, fully adjustable, locking, sized for two like displays as required:
  1. Chief FUSION CB Series; or
  2. Peerless DST Series; or
  3. Premier Mounts ECM Series.
- R. The maximum allowable lateral movement of a ceiling pole mounted display assembly shall not exceed one inch at the bottom of the display. Where these conditions cannot be met by the standard installation requirements, the following components are approved where necessary to facilitate compliance with this guideline.
  1. Where pole length creates excessive "shaking" of the display under normal operating conditions due to structural deflections, the following components may be utilized to mitigate the issue.
  2. Mitigation methods do not alleviate the Contractor's responsibility for proper rigid support methods to prevent these concerns.
- S. Flat Panel Mount Accessory – Lateral Bracing – Wall: Provides additional lateral support to flat panel displays or other equipment suspended by NPT pipe assemblies. For use in close proximity to wall or other structural element. Minimum two (2) assemblies required per installation. Install per Anvil International Seismic-10.13, pg. 5.
  1. Anvil International Q Brace Clamp, P/N: fig.770; with
    - a. Anvil International Sway Brace Swivel Attachment, P/N: fig.770; or
  2. Approved equal.
- T. Flat Panel Mount Accessory – Lateral Bracing – Cable: Provides additional lateral support to flat panel displays or other equipment suspended by NPT pipe assemblies. For use when primary support pipe is not in close proximity to wall or other structural element.
  1. Display Devices Pole Stabilizing Kit; or
  2. Approved equal.
- U. Flat Panel Mount Accessory – Column Mount: Adapts standard display mounts to a structural column:
  1. Chief FCAVCA Variable Column Adapter, with:
    - a. FCAVCSU80 Square 8"x6" U-Bolt Set (for rectangular columns)
    - b. FCASCA Structural Column Adapter (for round columns between 12" – 24" diameter)



2. For conditions outside the above parameters, a custom mounting assembly provided by miscellaneous metals and produced as a shop drawing is required.

### **2.19 A V CONTROL SYSTEM – EQUIPMENT**

- A. The AC power cord of the Control System Processor shall be connected to a rack-mount uninterruptible power supply (UPS). Refer to the AC Power in Section 27 41 00 - AUDIO VIDEO SYSTEMS for specific models. The UPS shall be connected to an unswitched (unsequenced) AC power circuit.
- B. Control system equipment shall be furnished from one manufacturer only. Program the system to provide acceptable operation by the HENDERSON ENGINEERS and/or Owner's Representative.
- C. Select equipment that can be fully controlled by the control system furnished.
- D. The drawings reflect a specific system manufacturer as the basis of design. If a different system manufacturer is furnished, shop drawings are required indicating proposed wiring configuration, control panel layouts, and equipment used. All of the features shown for the system on the drawings shall be maintained with the substitute system. Include coordination and costs related to back boxes, electrical, and other associated items.
- E. All systems shall be accessible remotely via the Owner's LAN as directed by the Owner's Representative.
- F. All control equipment necessary shall be furnished to provide a complete operating system. Additionally required accessories and components may not be indicated on the signal flows, such as power supplies, expansion modules, software licenses, etc.
- G. The following manufacturers are pre-approved substitutes to the basis of design found on the signal flows:
  1. AMX; or
  2. Crestron 4-Series; or
  3. QSC Qsys.

### **2.20 A V CONTROL SYSTEM – GENERAL PROGRAMMING REQUIREMENTS**

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for general programming requirements with the following revisions and additions:
  1. No additional requirements.

### **2.21 CABLES – FACTORY TERMINATED – PORTABLE**

- A. Factory terminated cable assemblies in this section are approved for portable use only.
- B. Portable cable assembly quantities are identified in parenthesis and are required to be furnished in addition to those required for system installation. Portable cable lengths are a minimum not to exceed the maximum acceptable length identified in the cable descriptions below. Where specific lengths are cited adjacent to quantities, these lengths are to be taken as ideal lengths. If a pre-approved model series is not offered in the specific length cited, then the cable length closest to the cited length shall be provided unless the difference is greater than twenty percent. In this case, contact the HENDERSON ENGINEERS for direction.
- C. All cable assemblies must be factory tested and certified.
- D. Microphone Cable – Microphone cables shall be black with colored boot or ring on the male connector as a color code to identify length (colors as identified for each length below). Custom



print "PROJECT NAME" and cover with clear heat shrink tubing approximately 6-inches from the male connector or use custom engraving on the male connector. Microphone cable part numbers are custom products.

## **2.22 STANDBY EQUIPMENT**

- A. The following equipment shall be on-hand at the time of system final acceptance and system first-use for possible replacement of defective equipment or for field conditions noted. Maintain ownership of this standby equipment. However, if any item of this standby equipment is used to replace defective equipment, the installed item of standby equipment becomes Owner's property. Assume ownership of the defective equipment:
  - 1. Backup software for programmable devices.
  - 2. Laptop computer for all programmable devices.
- B. Allowances for overnight shipping shall be included and utilized if any component is required for Owner's initial operation, first-use, or as directed by either the Owner's Representative or the HENDERSON ENGINEERS prior to Substantial Completion.

## **PART 3 EXECUTION**

### **3.1 COMMON REQUIREMENTS**

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for common requirements.

### **END OF SECTION**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 27 41 22 - LARGE FORMAT DISPLAY SYSTEMS****PART 1 GENERAL REQUIREMENTS****1.1 SECTION INCLUDES**

- A. Summary
- B. General Requirements
- C. Common Equipment
- D. Direct View LED Display
- E. Scoring/Timing System

**1.2 RELATED SECTIONS**

- A. Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO
- B. Section 27 41 00 - AUDIO VIDEO SYSTEMS

**1.3 ACRONYMS AND DEFINITIONS**

- A. DVLED: Direct View LED Display – A display type comprised of light-emitting diodes (LEDs) mounted to a panel without the use of a backlight and liquid crystal or polarized glass.
- B. DVLED System: A complete and operational system comprising of the DVLED Display and all components to facilitate the functionality described herein.
- C. Large Format Display System Contractor: Contracting firm that has been retained to do the work noted within these specifications and associated drawings.
- D. Scoreboard: A fixed digit display consisting of permanent caption lettering and controllable digits utilizing monochrome LED digit panels.

**1.4 REFERENCES**

- A. 47 CFR 15 - Radio Frequency Devices; current edition.
- B. UL 48 - Standard for Electric Signs; current edition.

**1.5 SUBMITTALS**

- A. Refer to requirements in Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO
- B. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for submittal requirements, including definitions of submittals. The following submittals are required as a portion of this section:
  - 1. Submittal #1: System Product Data (Pre-Construction)
    - a. Equipment List (1A)
    - b. Manufacturer's cut sheets (1B)
    - c. Product Substitutions (1C)
    - d. Project Implementation Schedule - submit as portion of overall submittal in Section 27 41 00 - AUDIO VIDEO SYSTEMS submittal.
  - 2. Submittal #2: System Shop Drawings (Pre-Construction)
    - a. Pathways, Devices, and Cabling (2A)
    - b. Signal Flow Shop Drawings (2B)
    - c. Control System - submit any applicable requirements as portion of overall submittal in Section 27 41 00 - AUDIO VIDEO SYSTEMS submittal.

3. Submittal #3: System Fabrication Drawings (Pre-Construction)
  - a. Structural Details (3A)
  - b. Equipment Rack Shop Drawings - submit as portion of overall submittal in Section 27 41 00 - AUDIO VIDEO SYSTEMS submittal.
  - c. Panel, Patch Panel, and Plate Shop Drawings - submit as portion of overall submittal in Section 27 41 00 - AUDIO VIDEO SYSTEMS submittal.
  - d. Large Format Display System Shop Drawings (3B) - Dimensioned, detailed drawings including:
    - 1) Physical dimensions of the display, including any required clearances for ventilation or otherwise (as applicable) with front elevation and section (side). Include panel layout and ancillary equipment as applicable.
    - 2) Electrical Detail(s) – indicating all required Electrical and grounding connections, including their locations within the display
      - a) Clearly indicate required electrical circuit quantities with voltage and amperage listed at maximum output brightness
    - 3) Mechanical Detail(s) – indicated all required Mechanical and ventilation requirements
    - 4) Low Voltage Cabling Detail(s) – indicating all required Communications cabling requirements, including their locations within the display
4. Submittal #4: System Test Results (Prior to Substantial Completion)
  - a. Preliminary Testing Documentation Package (4A)
5. Project Closeout

## 1.6 COORDINATION

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for requirements.

## 1.7 QUALITY ASSURANCE

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for requirements.

## 1.8 BASE BID AND ALTERNATES

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for requirements.
- B. The following Alternates are included in this section:
  1. ADD Alternate No. 14 Rectangle Center Hung Score/Video Board
  2. Refer to Direct View LED Schedule for list of physical sizes and resolutions & details on Sheet TB303.
  3. Performance requirements for this alternate must meet specifications outlined below in section 2.4 (B)
  4. Provide cost difference between curved scoreboard in section 2.4 B and this add alternate number 14.

## 1.9 WARRANTY

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for requirements.

## PART 2 PRODUCTS

### 2.1 SUMMARY

- A. These specifications and the associated TA series drawings describe the requirements for the Large Format Display System.

- B. Work includes all such Work indicated in all of the Contract Documents, including, but not limited to: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Communications, Fire Alarm and Electronic Safety and Security Drawings and Specifications; and Addenda.
- C. Work under this section of the specifications includes all labor, equipment, and installation as required to provide a complete Large Format Display System in compliance with the contract documents.
- D. The Large Format Display System Contractor shall employ the services of a qualified structural engineer to review all overhead mounting, suspension, and rigging details of the Large Format Display System equipment, as well as seismic restraints. All mounting and rigging schemes indicated on the drawings are shown for concept only. Submit shop drawings stamped by the Contractor's structural engineer of all details and weights for review by the project's Architect, Structural Engineer, and HENDERSON ENGINEERS.
- E. The work in this section shall be coordinated with other work to determine installation scope for conduit, outlet boxes, junction boxes, pull boxes, terminal cabinets, 120-volt AC power circuits, and insulated ground cables required for the Large Format Display System.

## 2.2 GENERAL REQUIREMENTS

- A. The products listed below represent unique product offerings relative to the basis of design. Due to the unique performance capabilities of these components, selection of alternate product(s) will require design modification to maintain system functionality. When alternate products are desired, Contractor shall:
  - 1. Submit Product Substitution Request(s) per instructions in this section and in accordance with Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO.
  - 2. Submit proposed signal flow and equipment rack shop drawings with the required system modifications clouded.
- B. Final acceptance for any Product Substitution Request(s) shall be at the discretion of the HENDERSON ENGINEERS.
- C. Comply with UL 48, 47 CFR 15

## 2.3 COMMON EQUIPMENT

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for equipment and components not listed under this section.

## 2.4 DIRECT VIEW LED DISPLAY

- A. Basis of Design and Alternates
  - 1. The following manufacturer forms the Basis of Design as indicated within the plans and schedules:
    - a. Planar.
  - 2. Pre-approved manufacturers include:
    - a. Daktronics.
  - 3. Alternate manufacturers will only be considered after bid.
    - a. Submit substitution request in accordance with Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO.

- B. DVLED Display System - 3.9MM Indoor - Main Curved Center Hung Board
1. Display Requirements
    - a. Refer to Direct View LED Schedule for list of physical sizes and resolutions & Details on Sheet TB302.
    - b. Service access: Front and Rear
    - c. Durability rating: Indoor (No IP rating required)
    - d. Maximum depth from mounting surface: 8"
    - e. Required Manufacturer's services:
      - 1) System engineering
      - 2) Shop Drawings
      - 3) Onsite system adjustment and commissioning (duration and scope per Manufacturer's recommendation)
  2. LED Module Requirements
    - a. Pixel pitch: 3.9mm ( +/- 0.10
    - b. Pixel configuration: 3-in-1 SMD (Surface Mount Device)
    - c. Minimum brightness after calibration: 1000 nits
    - d. Horizontal viewing angle (minimum): 140 degrees
    - e. Vertical viewing angle (minimum): 140 degrees
    - f. Color processing: 10bit
    - g. Grayscale processing: 14bit
    - h. Video frame rate: 60 FPS
    - i. LED lifespan: 100,000 hours
  3. LED Display Controller Requirements
    - a. Controller configuration: Rack mount
    - b. Display LED module interface connections: Single-mode fiber
    - c. Source connections: SDI
    - d. Provide redundant signal (secondary / backup signal transmission)
  4. Spare Parts
    - a. Spare parts shall consist of a minimum of 5% of major components, including but not limited to LED modules, receiving card(s).
- C. DVLED Display System - 3.9MM Indoor - Ribbon Boards
1. Display Requirements
    - a. Refer to Direct View LED Schedule for list of physical sizes and resolutions.
    - b. Service access: Top and Front
    - c. Durability rating: Indoor - Splash Proof
    - d. Maximum depth from mounting surface: 8"
    - e. Required Manufacturer's services:
      - 1) System engineering
      - 2) Shop Drawings
      - 3) Onsite system adjustment and commissioning (duration and scope per Manufacturer's recommendation)
  2. LED Module Requirements
    - a. Pixel pitch: 3.9mm ( +/- 0.10
    - b. Pixel configuration: 3-in-1 SMD (Surface Mount Device)
    - c. Minimum brightness after calibration: 1000 nits

- d. Horizontal viewing angle (minimum): 140 degrees
  - e. Vertical viewing angle (minimum): 140 degrees
  - f. Color processing: 10bit
  - g. Grayscale processing: 14bit
  - h. Video frame rate: 60 FPS
  - i. LED lifespan: 100,000 hours
- 3. LED Display Controller Requirements
    - a. Controller configuration: Rack mount
    - b. Display LED module interface connections: Single-mode fiber
    - c. Source connections: SDI
    - d. Provide redundant signal (secondary / backup signal transmission)
  - 4. Spare Parts
    - a. Spare parts shall consist of a minimum of 5% of major components, including but not limited to LED modules, receiving card(s).

## 2.5 SCORING TIMING SYSTEM

- A. General Requirements
  - 1. All required infrastructure to complete the fully wired scoring configuration is required under this specification section scope.
  - 2. Cabling system shall confirm to scoring Manufacturer's requirements.
  - 3. Termination plates shall be provided at all locations. Outdoor locations shall be within weather resistant enclosures.
  - 4. Additional components not listed herein may be required for a complete solution, and may include:
    - a. Fiber conversion kits due to distance
    - b. Terminal blocks for parallel connections
    - c. Fiber patch panels and other accessories
- B. Interior Clocks
  - 1. General Requirements
    - a. Construction
      - 1) Face, side, and back cabinet color: Black
      - 2) Environmental rating: Interior
    - b. LED Digits
      - 1) LED color: Red
      - 2) Dimming capability
    - c. Control
      - 1) Control signal: Wired
  - 2. Game / Locker Clock - quantity per plans
    - a. Digit size: 4"
    - b. Digit quantity: Four-digit with colon
    - c. Basis of design: OES M1202
  - 3. Shot Clock - quantity four
    - a. Digit size (game): 7"
    - b. Digit size (shot): 14"
    - c. Digit quantity (game): Four-digit with colon

- d. Digit quantity (shot): Two-digit
- e. Integral horn
- f. Basis of design: OES SHOTS-ST
- 4. Hockey Goal Lights - quantity two
  - a. Red and green lights
  - b. Attachment to dasher board glass
- C. Scoring Console
  - 1. User interface tabletop control console capable of controlling multiple scoreboards, clocks, displays, and additional components specified herein.
  - 2. Recall of clock, score, and game information if power is lost.
  - 3. Interface with handheld accessories for timing control.
  - 4. System interface method: Wired
  - 5. Basis of Design: OES ISC EDGE
  - 6. Accessories:
    - a. Inserts/programming for required sports specific labeling.
    - b. All necessary power and control interface cables.
    - c. Hard side carrying / storage case.
    - d. Optional hand switch for accessory / time control: OES ISCRMT-ST
- D. Scoring Character Generator
  - 1. Interface device from scoring system to video system character generator. Provides all game information from scoring system as RS-232 and HDMI output.
  - 2. Basis of Design: OES

## **PART 3 EXECUTION**

### **3.1 INSTALLATION GENERAL**

- A. Install in accordance with manufacturer's instructions.
- B. Coordinate power requirements with Division 26.
- C. Coordinate structural conditions and reflect on shop drawings. Ensure display is plumb and level.

### **3.2 COMMON REQUIREMENTS**

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for common requirements.

### **3.3 TESTING AND ADJUSTMENT**

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for additional requirements.
- B. Utilize the technical support services offered by the manufacturer of the display components to ensure optimum performance.
- C. Protect finished display installation until final acceptance of the project.
- D. Verify earth ground does not exceed 15 ohms.

### **3.4 TRAINING**

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for additional requirements.
- B. Provide training to Owner's representative on setting, adjusting and configuring control and routine maintenance of system.



**3.5 PROJECT COMPLETION - CLOSE OUT DOCUMENTS**

- A. Provide Project Completion submittal requirements as outlined in Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO and the submittal requirements earlier in this section.
- B. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for additional requirements.
- C. Include all software and preliminary system content.

**END OF SECTION**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 27 41 33 - TELEVISION DISTRIBUTION SYSTEM****PART 1 GENERAL REQUIREMENTS****1.1 SECTION INCLUDES**

- A. General Requirements
- B. Antenna Equipment
- C. Broadband Video over Coaxial Distribution
  - 1. Coaxial Distribution Components
- D. Satellite Distribution
  - 1. Satellite Headend Equipment
  - 2. Satellite Amplification
  - 3. Satellite Distribution Equipment
  - 4. Satellite Receivers and Tuners
- E. IPTV Distribution
  - 1. IPTV Headend Equipment
  - 2. IPTV Receivers and Tuners
  - 3. IPTV Network Equipment
  - 4. IPTV Software
  - 5. IPTV Support Services
- F. Digital Signage Programming Requirements
- G. Cable, Connectors, & Faceplates
- H. AC Power

**1.2 RELATED REQUIREMENTS**

- A. Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO
- B. Section 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO-VIDEO
- C. Section 27 10 00 - STRUCTURED CABLING
- D. Section 27 21 10 - DATA COMMUNICATIONS NETWORK

**1.3 ACRONYMS AND DEFINITIONS**

- A. Agile Receiver – A broadband receiver that can be tuned to any desired channel.
- B. Balun – Balanced/Unbalanced signal converter.
- C. Cable television – Distribution of RF modulated television signals originating from service providers over a physical cable network.
- D. Carrier – A pure-frequency signal that is modulated to carry information. In the process of modulation, it is spread out over a wider band. For purposes of this section, carrier refers to the visual carrier, or the frequency at which the visual carrier of an analog channel would be.
- E. Channel – A 6 MHz frequency range capable of containing a single analog NTSC, ATSC or QAM modulated signal or multiple digital modulated signals. Each channel frequency range receives a numerical value equating to the specific channel.

- F. CATV – Community antenna television; a communication system that simultaneously distributes several different channels of broadcast programs and other information to customers via a coaxial cable.
- G. CEA – Consumer Electronics Association.
- H. dBmV – Decibels relative to 1 mV across 75 ohms. Zero dBmV is defined as 1 mV across 75 ohms.  $\text{dBmV} = 20 \log_{10}(V1/V2)$  where V1 is the measurement of voltage at a point having identical impedance to V2 (0.001 V across 75 ohms).
- I. DBS – Direct Broadcast Satellite; a satellite communication system commonly associated with DirecTV. The term DBS is often interchanged with DSS (Digital Satellite System). Transmission formats deployed via DBS include: DVB-S, DSS, and 4DTV. See SATV.
- J. Forward Path – Direction of the transmission path from the signal source (System Headend) to the output device (Signal Outlet).
- K. Forward Path System Bandwidth – Capable frequency range of the Forward Path portion of the system. For the purposes of any references within this section, the Forward Path System Bandwidth has a lowermost frequency of 54 MHz and an uppermost frequency of the upper limit of the System Bandwidth, as defined below.
- L. Headend – The control center of the master antenna television system, where incoming signals are amplified, converted, processed, and combined into a common cable along with any locally originated television signals, for transmission to user-interface points. It is also called the "Central Retransmission Facility."
- M. IF – Intermediate Frequency; a frequency to which a carrier frequency is shifted as an intermediate step in transmission or reception.
- N. MATV – Master antenna television; a small television antenna distribution system usually restricted to one or two buildings.
- O. OTA – Over-the-Air; See Terrestrial television.
- P. RF – Radio frequency.
- Q. Return Path – Lower band of frequencies with direction of transmission from the output device back to the signal source. Also referred to as sub-band, or "T" channels.
- R. Return Path System Bandwidth – Capable frequency range of the Return Path portion of the system. For the purposes of any references within this section, the Return Path System Bandwidth has a lowermost frequency of 5 MHz and an uppermost frequency of 42 MHz.
- S. SATV – Satellite (SAT) television; A television delivery method with signals broadcasting from multiple satellites in geosynchronous orbit to dish antennas on customer premises.
- T. Structured Cabling System – the physical infrastructure installed to support information technology/transport for voice and data applications, commonly referred to as a Telecommunications System. This includes, but is not limited to: Category 3/5e/6/6A copper cabling, terminations/blocks, modules, faceplates, etc., and optical fiber cabling, terminations, modules, etc.
- U. SWM – Single Wire Multiswitch; A method of DirecTV signal distribution that allows a single cable to be split and fed to multiple tuners.

- V. System Bandwidth – Capable frequency range of the system, measured from the center frequency of the lowermost channel to the center frequency of the uppermost channel. For the purposes of any references within this section, the System Bandwidth is defined as 5 MHz to 1000 MHz.
- W. Terrestrial television – A type of television broadcasting in which the signal is transmitted by radio waves from a terrestrial (Earth based) transmitter.
- X. Wet Location - as defined in the NEC, installations underground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather.
- Y. Wideband - A bandwidth that significantly exceeds the channel bandwidth.

#### 1.4 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices; current edition.
- B. 47 CFR 76 - Multichannel Video and Cable Television Service; current edition.
- C. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition; 2022.
- D. BICSI TDMM - Telecommunications Distribution Methods Manual, 14th Edition; 2020.
- E. EIA/ECA-310 - Cabinets, Racks, Panels, and Associated Equipment; 2005e.
- F. IEEE 142 - IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems; 2007, with Errata (2014).
- G. IEEE 1100 - IEEE Recommended Practice for Powering and Grounding Electronic Equipment; 2005.
- H. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set; 2023.
- K. UL (DIR) - Online Certifications Directory; Current Edition.
- L. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

#### 1.5 SUBMITTALS

- A. Refer to requirements in Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO.
- B. Include the following items:
  - 1. Submittal #1: System Product Data (Pre-Construction)
    - a. Equipment List (1A)
    - b. Manufacturer's cut sheets (1B)
    - c. Product Substitutions (1C)
    - d. Project Implementation Schedule
  - 2. Submittal #2: System Shop Drawings (Pre-Construction)
    - a. Pathways, Devices, and Cabling (2A) - Follow requirements of Section 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO-VIDEO. Indicate locations of all outlets, devices, and equipment.

- b. Signal Flow Shop Drawings (2B) - Any generic diagrams found within the Construction Documents shall be drawn to specific requirements. Alterations from basis of design found within the Construction Documents shall be reflected and identified. Include system labeling scheme.
      - c. Design Calculations (2C) - Calculate signal attenuation budget and show calculated line and equipment losses for the system. Calculate values required for all amplifiers, taps, splitters, and coaxial cable selection.
3. Submittal #3: System Fabrication Drawings (Pre-Construction)
  - a. Equipment Room Shop Drawings (3A) - Equipment room rack/wall elevations indicating equipment, device and panel layouts, and electrical circuiting.
  - b. Equipment Room Wall Elevations (3B) – As applicable for wall mounted equipment, provide Enlarged Plans of Communications Room Wall Elevations. Indicate and dimension the equipment in the location in which it is intended to be installed.
  - c. Panel, Patch Panel, and Plate Shop Drawings (3C) - All panel, patch panel, and plate layouts indicating locations of connectors, engraving, nomenclature, panel material, and finish. Include Structured Cabling Work required by the technical system.
4. Submittal #4: System Test Results (Prior to Substantial Completion)
  - a. Preliminary Testing Documentation Package (4A) - Provide preliminary results of system testing as described in Part 3 of this section for review prior to final acceptance. Include final results with Closeout Documentation.
5. Submittal #5: Digital Signage Custom Programming (Per Milestones)
  - a. The successful deployment of the Digital Signage aspects of this project require significant interactive input from a variety of project stakeholders including the HENDERSON ENGINEERS, Architect, Owner's Representative and others. During development, consistent and timely communication will be required among all the stakeholders to yield a final product capable of meeting the needs of the Owner's Representative.
  - b. No less than four months after award of contract, the Contractor shall, with the assistance of the Contract Administrator, coordinate a custom programming kickoff meeting for the above-mentioned stakeholders.
  - c. Ongoing meetings will be required and may occur as web or phone-based meetings.
  - d. Custom Programming Timeline – Programming development and related submittals shall be delivered per the following milestones:
    - 1) Milestone 1: Narrative of intended system strategy. Preliminary color scheme and system theme for review by HENDERSON ENGINEERS, Architect, and Owner's Representative.
    - 2) Milestone 2: Updated system narrative. Screen shots of preliminary signage concepts.
    - 3) Milestone 3: Live demonstration of all signage elements (static and motion) for review by HENDERSON ENGINEERS, Architect, and Owner's Representative. Provide digital submittal in form as coordinated between all parties.
    - 4) Milestone 4: Screen shots or videos of final concepts. Final system files.
6. Project Closeout
  - a. Refer to Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO and the Record Drawings and Operation and Maintenance Data sub-sections in Part 3 of this section for requirements.

**1.6 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70, NECA 1, and 47 CFR 15.
- C. Follow BICSI ITSIMM and BICSI TDMM.
- D. Equipment shall be UL (DIR) Listed
- E. Contractor Qualifications and Responsibilities
  - 1. Equipment shall be furnished and installed by a certified technician with proven experience in the design and installation of television distribution systems of this type. Installer shall be certified by the system manufacturer.
  - 2. Provide a list of projects (no less than 2) of similar size, scope and type in which the Bidder has performed in a capacity comparable to the size, scope and type outlined in these Construction Documents. Provide the project name, relevant project information for comparison evaluation, and contact names with telephone numbers of each such project.
  - 3. Periodically inspect portions of the system installed by other Contractors to minimize potential interference problems.
  - 4. Provide and maintain a Project Manager whom is a BICSI Registered Certified Technician Level 2 Installer in good standing on site at all times. This project manager shall attend all scheduled project meetings.
    - a. Project Manager shall be responsible for all aspects of the television distribution system: assuring that all cables, equipment, television signal quality and programming are provided for installation prior to substantial completion.

**1.7 WARRANTY**

- A. Warrant all work executed under this contract, including all in-shop and onsite material, parts, and labor, for a period of twelve months after the date of final acceptance.
  - 1. Existing or any other Owner-furnished equipment shall not be included in this warranty.
  - 2. For equipment that has an advertised manufacturer's warranty longer than twelve months, include end date of warranty period.
- B. The warranty services are limited to normal business hours unless additional agreements are made between the Owner's Representative and the Contractor.
- C. Warranty work relating to technically complex equipment and/or programming shall be performed by a factory authorized technician.
- D. Damage to the system resultant from improper use or adjustment by others, negligence, acts of nature, or other causes which are beyond the Contractor's control shall be excluded from the warranty.
- E. Visit the job six months after substantial completion and two weeks prior to the end of the warranty period to check all equipment for proper system operation. Any defective equipment found shall be replaced or repaired under the terms of the system warranty.
- F. Update Record Drawings and Operation and Maintenance Data to reflect work done during Warranty period and provide the updates to the Owner's Representative and HENDERSON ENGINEERS.

**PART 2 PRODUCTS****2.1 GENERAL REQUIREMENTS**

- A. Provide a complete functioning Television Distribution System that can distribute SATV, terrestrial (OTA) television, internally-generated video, digital signage, menu board content, and IP video throughout the facility across the Communications Network utilizing Structured Cabling Infrastructure. This system shall include, but is not limited to, the following:
  - 1. Cabling and outlets for distributing television signal to interface points.
  - 2. Modulation/Encoding of sources into the distribution system.
  - 3. Acquisition equipment, amplifiers, power supplies, and passive equipment necessary for reception and distribution of coaxial based signals.
  - 4. Reception / tuning of content to display elements.
  - 5. Implementation of centralized management and system control.
  - 6. Implementation of Digital Signage system.
  - 7. Anticipated system channel count: 85 channels
- B. Refer to TA-series drawings for locations of television outlets and headend equipment and for connection diagrams and details.
- C. Service Provider Coordination
  - 1. Satellite Television
    - a. Coordination with the Owner's selected service provider is required. Determine service package for compatibility with the Television Distribution System and coordinate activation of reception equipment. Provide satellite dish installation per service provider's instruction.
    - b. Anticipated service provider: DirecTV
  - 2. Internally Generated Content
    - a. Coordination with the internally generated content is required. Determine source type and protocol to verify compatibility with the Television Distribution System. Obtain signal type and level at the point of departure for system design details and final equipment selection.
    - b. Anticipated sources: 8 in-house broadcast channels
- D. Over-the-Air (OTA)
  - 1. Terrestrial signals shall include local over-the-air (VHF and UHF) and FM (VHF) stations.
- E. Coordination with the network system is required for a complete and working IPTV system. Provide system requirements and coordinate with Section 27 21 10 - DATA COMMUNICATIONS NETWORK network configuration for additional information.
- F. Coordinate with the Owner's Representative and Food Service / PoS vendors, co-develop content for all display types and zones, and configure system management system for up to four event types:
  - 1. Resident Team #1 Game (Basketball)
  - 2. Resident Team #2 Game (Hockey)
  - 3. Music Concert
  - 4. Other Event Type, as decided by the Owner's Representative (to include generic sports event by two auxiliary teams)
- G. Equipment Requirements



1. Hardware Requirements: Use modular, plug-in, solid-state electronic components. Rack mounted equipment shall be installed in standard 19 inches rack complying with EIA/ECA-310.
2. Environmental Limitations: System components shall be equipped and rated for the environments where installed.
3. Cable System Power Supplies: Plug-in modular construction, with surge, short circuit, and overload protection.
4. Components: Modular plug-in, heavy-duty, industrial- or commercial-grade units.
5. Terminating Resistors: Enclosed units rated 0.5 W and matched for coaxial impedance.
6. Impedance: All coaxial cables, connectors, and component ports shall be 75-ohm characteristic impedance.
7. Unused ports: All unused ports shall be terminated with appropriate termination devices.

## 2.2 ANTENNA EQUIPMENT

### A. General

1. Antenna(s) shall be mounted in location to allow for clear reception of signal(s) and clear of all obstructions, including trees, buildings, and overhangs.
2. Avoid overhead power lines. Observe safe mounting distance from all electrical services.
3. Antenna(s) shall be properly grounded. Comply with Manufacturer's requirements.
4. All outdoor connections shall be weather rated.
5. Unused ports shall be terminated with appropriate termination device.
6. Shop drawing stamped by structural engineer required for all antenna mounting conditions.

### B. Satellite Antenna - 5 LNB: Ka/Ku band outdoor satellite antenna, capable of HD and 4K reception from satellites at 99°W, 101°W, 103°W, 110°W, and 119°W longitudes, approx. 22.5" x 32.5" dish, with 5-LNB assembly, LNB arm, and mounting/aiming assembly:

1. DirecTV AU9-SL5-4KLNB; or
2. Approved equal.

### C. Satellite Antenna Power Inserter / Polarity Locker: six inputs/outputs minimum, 20 VDC minimum on each output to power LNB's, provides signals to lock LNB polarities, blocks polarity selection signals from multiswitches:

1. DirecTV DTV6PWRPOL-02; or
2. Approved equal.

### D. Terrestrial Antenna – Multi-Directional: outdoor mount, VHF/UHF band, front-to-back signal ratio $\geq 12$ dB, 180-degree pattern, 75 Ohm output impedance:

1. Televes Ellipse Series with 550104 power supply; or
2. Approved equal.

### E. OTA Amp – W(gain): Wall mount terrestrial television amplifier, VHF/UHF and FM frequencies, suitable for OTA Frequency Range, gain as shown on signal flows:

1. Televes AVANT X; or
2. Approved equal.

### F. Antenna Mast: antenna mast suitable for specified antenna(s) and mounting condition, capable of heavy antenna load and suitable for local wind conditions, allow 4 feet vertical separation between antennas mounted to same mast:

1. Pre-manufactured mast of appropriate diameter and length; or

2. Custom mast of appropriate diameter and length.

### 2.3 BROADBAND VIDEO OVER COAXIAL DISTRIBUTION

#### A. COAXIAL DISTRIBUTION COMPONENTS

1. CATV Amp – (R)(W)(gain): Cable television amplifier, two-way, silicone-based, solid-state, integrated circuit device; with Forward Path Frequency Range equal to full Forward Path System Bandwidth; Return Path Frequency Range equal to full Return Path System Bandwidth; and the following characteristics required as shown on the signal flows:
  - a. Blonder Tongue BIDA series; or Drake DA series; or Pico Digital PIDA series; or Toner Cable TIBA series; or approved equal.
    - 1) W, wall mount
    - 2) Gain, dB minimum amplifier gain value; verify required gain and submit appropriate hardware
  - b. Blonder Tongue RMDA series; or Drake DAR series; or Pico Digital CA- RK series; or Toner Cable HEA series; or approved equal.
    - 1) R, rack mount
    - 2) Gain, dB minimum amplifier gain value; verify required gain and submit appropriate hardware
2. CATV Directional Coupler – (value): cable television directional coupler, frequency range equal to full System Bandwidth, SCTE compliant, soldered cover back sealed, tin plated die cast housing, tap value as shown on signal flows:
  - a. Arris SSP-Q; or
  - b. Blonder Tongue SRT; or
  - c. Approved equal.
3. CATV Splitter – W(port quantity): Wall mount passive cable television splitter, Frequency Range equal to full System Bandwidth, low loss, SCTE compliant, soldered cover back sealed, tin plated die cast housing, refer to signal flows for port quantity:
  - a. Arris; or
  - b. Blonder Tongue SXRS or SDS series; or
  - c. Toner Cable XGHS series; or
  - d. Pico Digital TSB series; or
  - e. Approved equal.
4. CATV Tap – (port quantity)(value): cable television multi-port tap, frequency range equal to full System Bandwidth, SCTE compliant, soldered cover back sealed, tin plated die cast housing, port quantity and tap value as shown on signal flows:
  - a. Arris FFT series; or
  - b. Blonder Tongue DGT series; or
  - c. Approved equal.
5. In-Line Attenuator: F-type connector in-line attenuator with Frequency Range equal to full System Bandwidth, -1 to -20dB fixed values (furnish as required):
  - a. Blonder Tongue; series FAM; or
  - b. Drake; series 100273X; or
  - c. Pico Digital; series FAM; or
  - d. Toner Cable; series FAM; or
  - e. Approved equal.

6. Terminating Resistor: line terminator (one required for all unused ports of splitters, directional couplers, combiners, and taps)
  - a. Blonder Tongue; part number BTF-TP; or
  - b. Pico Digital; part number SGLR-01; or
  - c. Toner Cable; part number F59-T; or
  - d. Approved equal.

## 2.4 SATELLITE DISTRIBUTION

### A. SATELLITE HEADEND EQUIPMENT

1. SATV Tuner Headend: rack mount headend master tuner, eight blade slots, up to 138 channels of HD or SD tuning, integrated EdgeQAM capability, MPEG streaming, on screen program guide, remote management:
  - a. Technicolor COM3000 system, with the following components (configuration as shown on signal flows):
    - 1) COM400 chassis
    - 2) COM51 receiver blade
    - 3) COM20 modulator blade
  - b. Approved equal.

### B. SATELLITE AMPLIFICATION

1. SATV Launch Amp – W-AGC: minimum six inputs/outputs, 250 - 2150 MHz minimum bandwidth, automatic gain control on each output, -48 to -22 dBm minimum input level range, -15 to -24 dBm minimum output level, includes power supply:
  - a. DirecTV STA-R0-09; or
  - b. Sonora (DirecTV) TAMP6-12; or
  - c. Approved equal.

### C. SATELLITE DISTRIBUTION EQUIPMENT

1. SATV SWM Multiswitch: Optimized for DirecTV 5 LNB 4K operation, wideband, 6 Sat IF inputs, 2 SWM outputs to accommodate up to 30 tuners respectively:
  - a. DirecTV SWM30; or
  - b. Approved equal.
2. SATV Tap – (port quantity)(value): 250 - 2150 MHz minimum bandwidth satellite television wideband tap, six Satellite TV signals minimum, values as shown on signal flows:
  - a. DirecTV (AT&T) STTAP (dual); or
  - b. ProBrand DRETAP6DB-02 (single); or
  - c. Approved equal.
3. SATV SWM Expander: 2 – 2150 MHz minimum bandwidth satellite television SWM expander, 4 DSWM-30 module capacity, 6 satellite inputs:
  - a. SolidSignal (AT&T) SWM EXPANDR-A-R0-09; with
    - 1) One PI-29Z power supply for every two modules.
  - b. Approved equal.
4. SATV SWM Splitter – (port quantity): 2 – 2150 MHz minimum bandwidth satellite television SWM splitter:
  - a. DirecTV SPLIT MRV Series; or
  - b. Approved equal.

5. SATV Wideband Splitter – (port quantity): 250 - 2150 MHz minimum bandwidth satellite television wideband splitter, one input, multiple output, values as shown on signal flows:
  - a. Skywalker SKY233##D series; or
  - b. Approved equal.
6. SATV Wideband Directional Coupler: 250 - 2150 MHz minimum bandwidth, six Satellite TV signals minimum, tap values as shown on signal flows:
  - a. Sonora SD MST6 series; or
  - b. Approved equal.
7. SATV Equalizer: 250 – 2150 MHz minimum bandwidth, attenuates signals 11 dB at 250 MHz and 2 dB at 2150 MHz, for equalization of coaxial cable loss over 150 feet of RG-6:
  - a. Sonora SEQ409; or
  - b. Approved equal.
8. In-Line Attenuator: F-type connector in-line attenuator with Frequency Range equal to full System Bandwidth, -1 to -20dB fixed values (furnish as required):
  - a. Blonder Tongue; series FAM; or
  - b. Drake; series 100273X; or
  - c. Pico Digital; series FAM; or
  - d. Toner Cable; series FAM; or
  - e. Approved equal.
9. Terminating Resistor: line terminator (one required for all unused ports of splitters, directional couplers, combiners, and taps):
  - a. Blonder Tongue; part number BTF-TP; or
  - b. Pico Digital; part number SGLR-01; or
  - c. Toner Cable; part number F59-T; or
  - d. Approved equal.

#### D. SATELLITE RECEIVERS AND TUNERS

1. SATV Receiver – DVR: High definition (mpeg-2, mpeg-4) and standard definition (mpeg-2) enabled satellite receiver with DVR; 500gb hard drive capable of recording up to 400 hours of SD programming, up to 100 hours of HD programming; dual tuner unit with HDMI output for access to SD and HD DIRECTV programming; compatible and ready for activation on Owner's account:
  - a. DirecTV HR24-COM (for commercial account); or
  - b. Approved equal.

## 2.5 IPTV DISTRIBUTION

### A. IPTV HEADEND EQUIPMENT

1. IPTV Encoder Chassis - #RU: Rack mount modular chassis and card-based IPTV encoder, capable of HD quality encoding, MPEG-4 format, AES encryption, selectable bit-rate; card configurations including multiple-channel analog, HDMI, HD/SD-SDI, and IP inputs (chassis size and card configuration as shown on signal flows):
  - a. Vitec components as described below:
    - 1) MGW Series Chassis:
      - a) 4RU, 6 card slots: MGW-1100
    - 2) MGES-7000 Series cards:
      - a) (4) HDMI 4K video input card: MGES-7000-H
      - b) (4) 3G/12G-SDI 4K video input card: MGES-7000-D

- c) Processor blade: MGES-7000 Blade
    - 3) Portable Units
      - a) HDMI portable encoder: MGW Diamond-H
    - 4) Card software license
    - 5) Chassis management software license; or
  - b. Approved equal.
  - 2. IPTV Transcryptor: rack mount head end processor, capable of decrypting and re-encrypting content, reflecting unicast to multicast, fifty IP streams per server chassis, required for all 3rd party incoming IPTV streams (provide quantity/licensing of servers to exceed SATV channel count):
    - a. Vitec ChannelLink; or
    - b. Approved equal.
- B. IPTV RECEIVERS AND TUNERS
  - 1. IPTV Tuner – 4K: small form factor set top box capable of outputting 2160p content from the IPTV system, HDMI output, PoE powered, RS-232 control port for display control from system:
    - a. Vitec EZ TV EP5; or
    - b. Approved equal.
  - 2. IPTV Tuner - Signage: small form factor set top box capable of outputting 2160p digital signage content from the IPTV system, HDMI output, PoE powered, RS-232 control port for display control from system:
    - a. Vitec EZ TV EP5 with licensing as required; or
    - b. Approved equal.
  - 3. Local TV Control
    - a. For stand-alone displays in private areas, such as offices, provide an IR remote compatible with the set-top box.
    - b. Program the IR remote to control the display, including display power, volume control, and input selection.
      - 1) For remotes programmed for or compatible only with a unique display, label the rear of the remote with an appropriate identifier.
      - 2) For installation configurations where the set-top box IR receiver is concealed from normal IR remote operation, provide an IR extender.
    - c. For displays in areas served by an AV Control System via local touch screens, program the system to control the associated set-top boxes.
    - d. For displays in public areas requiring no user interaction, such as concourse displays, primary display control will be via the IPTV facility administration platform.
      - 1) Ensure display power, volume control, and input selection is available from the IPTV system.
- C. IPTV NETWORK EQUIPMENT
  - 1. Network Equipment: All network switches associated with the IPTV system shall be provided per Related Documents, with the following features:
    - a. IP Multicast
    - b. QoS
    - c. Network Time Protocol
    - d. Precision Time Protocol

- e. PoE and PoE
  - 2. IPTV Enterprise Management Server: Primary system central management server for all IPTV services; monitoring, control, and configuration of system functionality (one required):
    - a. Vitec EZ TV Enterprise Portal Server license for 3<sup>rd</sup> party install; and
      - 1) IPTV Server Hardware, as specified by manufacturer and compatible with system requirements.
    - b. Approved equal.
- D. IPTV SOFTWARE
- 1. IPTV Digital Signage Software: Development software for digital signage aspects of the IPTV system, for content creation and deployment (three required):
    - a. Vitec EZ TV Sign Creator; or
    - b. Approved equal.
  - 2. IPTV Endpoint Software – Digital Signage Player: Digital signage endpoint software platform to enable all available features (quantity required to match number of digital signage endpoints):
    - a. Supplied as portion of Digital Signage system, licensed for number of endpoints provided, include remote management and serial (RS-232) control modules.
  - 3. IPTV Endpoint Software – Set Top Box Player: Set-top-box software platform to enable all available features:
    - a. Supplied as portion of IPTV system, licensed for unlimited endpoints, include remote management and serial (RS-232) control modules.
  - 4. IPTV Management Software: Remote management of IPTV system from facility operator PC and/or mobile device:
    - a. Local control with 3<sup>rd</sup> Party Device or Web-based Application license.
  - 5. IPTV Electronic Program Guide: Custom configured program guide with facility logo and branding scheme, configured to available channels and channel availability dependent on client access level; connected to program guide information service provider for service-provider channels; configured for ability to recall in-house channel program guide information; coordinate with Owner's television service contract and in-house channel configuration requirements:
    - a. EPG module supplied as portion of IPTV system, licensed for continual program information updates.
  - 6. IPTV Software Client Player: Software based viewing platform, compatible with Windows and Mac, user dependent channel listing, customizable configuration and branding, configure IPTV system for this functionality and turn over software to Owner's Representative for installation on applicable facility computers:
    - a. Vitec EZ TV Player; or
    - b. Approved equal.
- E. IPTV SUPPORT SERVICES
- 1. IPTV Manufacturer Support Service: Annual contract, manufacturer 24x7x365 phone support, software/firmware updates, advance replacement service for faulty hardware:
    - a. Vitec Gold Service Program – 1 Years; or
    - b. Approved equal.
  - 2. IPTV Manufacturer Project Management and Configuration Services: Manufacturer engineering support services inclusive of pre-installation project management and

coordination, system solution support, implementation preparation, on-site at project completion time for configuration and Owner/Operator training:

- a. Vitec – As recommended by manufacturer; or
- b. Approved equal.

## 2.6 DIGITAL SIGNAGE PROGRAMMING REQUIREMENTS

- A. Provide programming and configuration services allowing “edge-based” media sources to provide the functions identified in this section. These services will be limited to general configurations and the development of first-use “templates” to be used by the Owner as a starting point for the ongoing administration of the system by internal staff. The programming scope required herein shall account for all aspects of the facility first-use, which is then intended to be handed off to facility administrators to govern from a daily operation standpoint. Scope shall include a complete and working system.
- B. Coordinate with Owner and Signage Consultant to help develop initial signage templates and configurations including:
  1. Event management:
    - a. Display current and upcoming schedules for meeting spaces.
    - b. Display current and upcoming facility events at exterior signage.
    - c. Integrate the digital signage content management system with the Owner's scheduling database, i.e., Microsoft Exchange Server, Google Online calendar, etc.
  2. Wayfinding:
    - a. Deploy static wayfinding applications to improve patron navigation of the facility.
  3. Social media feeds
  4. Establish monitoring of RSS feeds to include in signage display “ticker” templates. Typical RSS sources will include news, weather, sports, stock market, etc.
  5. Emergency messaging:
    - a. Integrate digital signage assets with facility life safety systems. Coordinate visual messaging to support facility emergency messaging.
    - b. Enable monitoring of RSS feeds and other online information services to notify facility management of weather, civil, and other emergency events which may impact the facility and/or patrons.
  6. Advertising and promotions:
    - a. Create templates into which Owner's promotional content may be loaded/displayed.
  7. Menu boards:
    - a. Facilitate a user-friendly interface (i.e., HTML 2.0) through which menu board and other time critical updates may be implemented.

## 2.7 CABLE CONNECTORS & FACEPLATES

- A. CATEGORY CABLE
  1. Refer to Section 27 10 00 - STRUCTURED CABLING for product information and additional installation requirements.
- B. COAXIAL CABLE
  1. Requirements
    - a. All coaxial cables shall be broadband type and recommended by cable manufacturer specifically for broadband RF distribution applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB minimum over the



- full System Bandwidth, and shall be listed to comply with NFPA 70, Articles 810 and 820.
- b. Wet-rated coaxial cables are required where any part of cable is routed outside the footprint of the building or in or below slab-on-grade concrete.
  - c. Conduit where wet-rated cables are installed in shall stub up directly into serving Communications Room. If that is not practical, conduit shall stub into a dual-gang junction box installed in accessible ceiling space, and cable shall transition (via coupler) to a plenum-rated indoor cable for distribution back to the serving Communications Room.
  - d. Cables supplied for indoor installations shall be suitable for their environment.
  - e. Cables shall consist of a solid, copper conductor and be suitable for Broadband Video/Video Distribution and MATV/CATV applications.
2. Plenum Rated:
- a. RG-6 Coax Cable: No. 18 AWG solid copper conductor plenum-rated coax Indoor Distribution cable; 0.275 inch maximum outside diameter (Drop cables up to 200 feet):
    - 1) Belden 1695A; or
    - 2) Commscope 2275V; or
    - 3) Gepco VSD2001TS; or
    - 4) West Penn 25Q841; or
    - 5) Approved equal.
  - b. RG-11 Coax Cable: No. 14 AWG solid copper conductor plenum-rated coax cable for In-door Backbone Distribution and drop cables over 200 feet; 0.4 inch maximum outside diameter (up to 300 feet):
    - 1) Belden 7732A; or
    - 2) Commscope 2285K; or
    - 3) Gepco VHD1100TK; or
    - 4) West Penn 25Q821; or
    - 5) Approved equal.
3. Wet Rated:
- a. RG-6 Coax Cable – Wet Rated: No. 18 AWG solid copper conductor wet-rated coax Indoor Distribution cable; 0.275 inch maximum outside diameter (Drop cables up to 200 feet):
    - 1) Commscope; or
    - 2) Gepco VSD2001PEF; or
    - 3) West Penn AQC841; or
    - 4) Approved equal.
  - b. RG-11 Coax Cable – Wet Rated: No. 14 AWG solid copper conductor wet-rated coax cable for Indoor Backbone Distribution and drop cables over 200 feet; 0.4 inch maximum outside diameter (up to 300 feet):
    - 1) Commscope; or
    - 2) Gepco VHD1100PEF; or
    - 3) Approved equal.

### C. CATEGORY CONNECTORS

1. Refer to Section 27 10 00 - STRUCTURED CABLING for product information and additional installation requirements.



**D. COAXIAL CONNECTORS**

1. Requirements
  - a. All connectors shall be 75 ohms.
  - b. Installation type shall be compression connector for drop cables.
  - c. Hex crimp connectors are unacceptable for drop cables (RG-6), but are acceptable for Hard-line Coax.
  - d. Twist-on connectors are unacceptable for all cable types.
  - e. Connector shall be installed using the connector manufacturer's approved tool.
  - f. Size connectors to each type of coaxial cable per Manufacturer recommendations.
2. RG-6 Connector: F-type:
  - a. Belden FS6PL2; or
  - b. Gepco FS6PL2; or
  - c. Thomas and Betts LRC Snap-n-Seal series (RG6); or
  - d. West Penn CN-F6MCV; or
  - e. Approved equal.
3. RG-11 Connector: F-type:
  - a. Belden 716SNS1P11HPLA; or
  - b. Gepco FS11PL; or
  - c. Thomas and Betts LRC Snap-n-Seal series (RG11); or
  - d. West Penn CN-FS11V; or
  - e. Approved equal.

**E. FACEPLATES**

1. Refer to outlet requirements as stated in General Requirements in Part 2 of this section.
2. Outlets may be co-located with data Category outlet. Coordinate faceplate and connectors with Section 27 10 00 - STRUCTURED CABLING.

**F. ENTRANCE PROTECTION**

1. Fully protect each end of all incoming conductors which are considered to have lightning exposure in accordance with NFPA 70 chapter 8.
  - a. Exception – incoming Service Provider cables shall be protected by the Service Provider.
2. Coaxial Surge Protection Wall-mount / Cable Protectors:
  - a. Emerson Edco CATV-145A; or
  - b. Commscope Surge Arrestors; or
  - c. Tii Technologies 212FF75F225-31; or
  - d. Approved equal.
3. Satellite Dish Surge Protection:
  - a. Tii Technologies 231-2; or
  - b. Approved equal.

**2.8 AC POWER**

- A. All active (powered) equipment shall be connected to a surge-protected Power Strip.
- B. Surge-Protected Power Strip: 15- or 20-Amp power rating surge protector, minimum of (4) NEMA 5-15P plugs/outlets, wall-mountable:
  1. Chatsworth 12850-702;

2. Middle Atlantic PDT-615C; or
3. Approved equal.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION GENERAL**

- A. Install in accordance with manufacturer's instructions.

#### **3.2 GENERAL**

- A. Examine pathway elements intended for cable installation. Check raceways, cables, trays, and other elements for compliance with accessibility for installation and maintenance, and other conditions affecting installation.
- B. Examine walls, floors, roofs, equipment bases, and roof supports for suitable conditions where television equipment is to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.3 WIRING METHOD**

- A. Unless otherwise noted, all cables shall be routed through the building cable tray/conduit/surface-mounted raceway system. Refer to the drawings for layout of cable tray.
  1. All horizontal cables shall be suitable for installation in their environment, either plenum (CMP, MPP, OFNP, or OFCP) or riser (CMR, MPR, OFNR, or OFCR) rated, unless otherwise noted.
  2. Horizontal cables installed in Wet or Damp locations as defined by the NFPA 70 or in these construction documents (such as conduits embedded or routed below a ground floor slab) shall be suitable for installation in such environments and follow the installation requirements for outside plant cables as specified herein.
    - a. Wherever unlisted (outside plant) cables enter the building in a room other than the Headend/Equipment/Communications Room, transition the unlisted cable to indoor rated (CMR / CMP as applicable) cable for continuation.
    - b. Use of J-hooks is allowed above accessible ceilings only; no cable shall be visible in exposed ceilings. Coordinate with Section 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO-VIDEO Contractor to provide appropriately-sized overhead conduit for Television Distribution cabling above inaccessible ceilings and in exposed ceilings; indicate proposed routing and conduit size on Shop Drawings.
  3. Wiring in Telecommunication Rooms: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- B. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- C. Grounding: According to recommendations in IEEE 142 and IEEE 1100.
- D. Existing amplifiers being adjusted by the Contractor shall be re-setup per manufacturer instructions prior to any adjustment.
- E. Cable products shall be sweep tested at the factory before shipping at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

- F. Provide CATV components to meet the requirements for signal strength at the new and existing work areas.
- G. Protect signal cables and connected components against transient-voltage surges by suppressors and absorbers designed specifically for the purpose.
- H. Provide AC-powered equipment with integral surge suppressors, complying with UL 1449.
- I. RF and Video Impedance Matching: Signal-handling components, including connecting cable, shall have end-to-end impedance-matched signal paths.
- J. Coordinate size and location of raceway system, and provisions for electrical power to equipment of this Section.
- K. Coordinate work of this Section with requirements of service provider.

### **3.4 TELEVISION DISTRIBUTION SYSTEM INSTALLATION**

- A. Terminate all unused ports.
- B. Ensure that the installed system is in accordance with 47 CFR 15 to ensure minimal RF signal leakage.
- C. Final checkout shall be coordinated with the local cable company to ensure system conforms to cumulative leakage index (CLI).
- D. Coordinate selection of modulator channels with selected Channel Elimination Filters (CEF) - verify with Owner's Representative and local cable company. Selected filters and subsequent deleted cable channels shall be provided in written form to the Owner's Representative, construction team, Architect, and HENDERSON ENGINEERS.
- E. Coordinate exact location of each television outlet. This includes coordination of associated AC power receptacle. This coordination shall occur in a timely fashion to not impede the progress of construction. Any additional costs due to the failure of the Contractor to coordinate the location of the receptacles shall be borne by the Contractor.
- F. Provide suitable AC power surge protection device(s) for all active electronic devices in the system.
- G. Provide a fully operating system. The drawings indicate specific products and values. However, verify all values and make adjustments where necessary to provide specified performance at each outlet.

### **3.5 COAXIAL CABLE INSTALLATION**

- A. When routing trunk cable in Communications Room, provide 10 feet (3.05 m) of coiled slack on the wall, U.O.N by Owner. Provide a coupler at trunk cable and transition to an RG-6 cable for supplying CATV signal to telecommunications rack splitters.
- B. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps may not be used for heating.
- C. Cable may not be installed in same raceway with power cable.
- D. Coaxial cable termination locations shall be documented and adhere to drawings.
- E. Do not use cable pulling lubricants.
- F. Do not exceed manufacturer's recommended minimum bending radii.

- G. Pulling Cable: Do not exceed manufacturer's recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
- H. J-hook-supported Cable: Install parallel to building lines, follow surface contours, and support cable according to manufacturer's written instructions.
- I. Cable Support: Install supports (J-hooks) at intervals recommended in writing by cable manufacturer. Install supports within 6 inches (150 mm) of connector so no weight of cable is carried by connector. Use no staples or wire ties, pull tie-wrap snug, and do not over tighten.
- J. Signal Equalization: Where system performance may be degraded in certain operating modes, revise component connections and install distribution amplifiers and attenuators as required, providing a balanced signal across the system.
- K. Label both ends of coax cable.

### 3.6 FIELD QUALITY CONTROL

- A. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
- B. Test Schedule: Schedule tests after pretesting has successfully been completed and system has been in normal functional operation for at least 7 days. Provide a minimum of 3 days' notice of test schedule.
- C. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

### 3.7 DISTRIBUTION SYSTEM ACCEPTANCE TESTS

- A. Minimum acceptable visual carrier signal level at the subscriber terminal/building service entrance based on 47 CFR 76 shall be 0 dBmV (1000 mV). If this situation is not the case, please contact cable provider to correct the issue.
- B. Field-Strength Instrument: Rated for minus 40-dBmV measuring sensitivity and a frequency range of the full Forward Path System Bandwidth, minimum. Provide documentation of recent calibration against recognized standards.
- C. Signal Level and Picture Quality: Use a field-strength meter or spectrum analyzer, and a standard TV receiver to measure signal levels and check picture quality at all User-interface outlets.
  - 1. Analog Channels
    - a. Test visual carrier signal level (peak envelope power) in dBmV over the full Forward Path System Bandwidth at user interface outlets.
    - b. Acceptable visual carrier signal level range at the user interface outlets over the entire frequency range, equal to the full Forward Path System Bandwidth, shall be between 3 and 15 dBmV. Contractor shall amplify or attenuate as required to meet acceptable signal level range at no cost to the Owner.
  - 2. Digital Channels
    - a. Test average power signal level in dBmV over the full Forward Path System Bandwidth at user interface outlets.

- b. Acceptable average power signal level range at the user interface outlets over the entire frequency range, equal to the full Forward Path System Bandwidth, shall be between -3 and 9 dBmV. Contractor shall amplify or attenuate as required to meet acceptable signal level range at no cost to the Owner.
3. Distribution system shall not be source of causing cross-channel intermodulation, ghost images, or beat interference at the television receiver. If these issues occur, the Contractor shall rectify the situation at no cost to the Owner.
- D. Signal-to-Noise-Ratio Test: Use a field-strength meter to make a sequence of measurements at the output of the last distribution amplifier or of another agreed-on location in system. With system operating at normal levels, tune meter to the picture carrier frequency of each of the designated channels in turn and record the level. With signal removed and input to corresponding headend amplifier terminated at 75 ohms, measure the level of noise at same tuning settings. With meter correction factor added to last readings, differences from first set must not be less than 43 dB for analog channels and 35 dB for digital channels.
- E. Record test results in electronic spreadsheet file with column headings representing various tests performed and row labels identifying test location (i.e., outlet location).
- F. Retest: Correct deficiencies identified by tests and observations and retest until requirements specified in Part 1 are met.

### **3.8 DEMONSTRATION**

- A. Conduct a minimum of one hours' training to Owner's employees on how to adjust, operate, and maintain RF Distribution equipment.
  1. Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining equipment.
  2. Train Owner's personnel on procedures to operate rebroadcast system.
  3. Train Owner's personnel on installation, setup, and use of software system.

### **3.9 MAINTENANCE SERVICE**

- A. After substantial completion, provide the following:
  1. Approximately 6 months after substantial completion, revisit the site and adjust the system as required for optimum system performance.
  2. Just prior to the end of the 1-year warranty period, revisit the site to check all equipment for proper system operation. Any defective equipment found shall be replaced or repaired under the terms of the system warranty.

**END OF SECTION**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 27 41 51 - BROADCAST SYSTEMS PRE-WIRE****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. System Description
- B. Common Equipment
- C. Cable & Terminations - Bulk - Audio
- D. Cable & Terminations - Bulk - Video
- E. Cable & Terminations - Category Ethernet
- F. Cable & Terminations - Bulk - Category
- G. Cable & Terminations - Bulk - Fiber
- H. Cable & Terminations - Bulk - Camera - Hybrid Fiber
- I. Termination Panels
- J. Cables - Factor Terminated - Portable
- K. Portable Accessories
- L. Standby Equipment

**1.2 RELATED SECTIONS**

- A. Division 01 GENERAL REQUIREMENTS
- B. Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO
- C. Section 27 00 13 - SUSTAINABLE DESIGN REQUIREMENTS
- D. Section 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO-VIDEO
- E. Section 27 10 00 - STRUCTURED CABLING
- F. Section 27 41 00 - AUDIO VIDEO SYSTEMS
- G. Section 27 41 16 - AUDIO VIDEO SYSTEMS EQUIPMENT

**1.3 ACRONYMS AND DEFINITIONS**

- A. Broadcast Cabling System Contractor – Contracting firm that has been retained to do the work noted within these specifications and associated drawings.
- B. Wet Location - as defined in the NFPA 70, installations underground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as outdoor broadcast junction boxes; and in unprotected locations exposed to weather.

**1.4 REFERENCES**

- A. EIA/ECA-310 - Cabinets, Racks, Panels, and Associated Equipment; 2005e.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. SVG-Section A - Mobile Broadcast Unit / Truck Compound Infrastructure and Operations; Current Edition, Including All Revisions.

- D. SVG-Section D - Maintaining Broadcast Cabling Infrastructure; Current Edition, Including All Revisions.
- E. TIA-455-78 - Measurement Methods and Test Procedures – Attenuation; Current Edition.
- F. TIA-526-7 - Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, Adoption of IEC 61280-4-2 Edition 2: Fibre-Optic Communications Subsystem Test Procedures – Part 4-2: Installed Cable Plant – Single-Mode Attenuation and Optical Return Loss Measurement; 2015a (Reaffirmed 2022).
- G. TIA-526-14 - Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant; IEC 61280-4.1 Edition 3.1, Fiber Optic Communications Subsystem Test Procedures- Part 4-1: Installed Cable Plant- Multimode Attenuation Measurement; 2023d.
- H. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set; 2023.

### **1.5 QUALITY ASSURANCE**

- A. Broadcast Cabling System Contractor Qualifications:
  - 1. Comply with Division 01.
  - 2. Licensed to perform work of this type in the project jurisdiction.
  - 3. At least five (5) years of verifiable direct experience with the devices, equipment and systems of the type and scope specified herein.
  - 4. Manufacturer-certified for the products furnished and installed.
  - 5. Fully staffed and equipped maintenance and repair facility.
- B. Broadcast Cabling System Contractor Personnel Qualifications:
  - 1. Skilled workers thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and the methods needed for proper installation and performance of the work in this section. The workers shall have at least three (3) years direct experience in similar work, evidence of which shall be verified in writing with appropriate references.
  - 2. Supervisor with at least five (5) years direct experience in similar work. The supervisor shall be present for and in responsible charge of all work in the fabrication shop and on the project site during all phases of the installation and testing of the system(s). To assure continuity, this supervisor shall be the same individual throughout the execution of the work unless illness, loss of personnel, or other reasonable circumstances intervene. This person shall act as the Cabling System Project manager, and shall attend all scheduled project meetings.
- C. Provide additional information as required for review by the Owner's Representative, Architect, and HENDERSON ENGINEERS to aid in proving acceptability.

### **1.6 SUBSTITUTIONS**

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for Substitution instructions.

### **1.7 SUBMITTALS**

- A. Refer to requirements in Section 27 00 11 - GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO-VIDEO.
- B. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for submittal requirements with the following alterations and additions:



1. Replace qualification requirements with requirements as included in this section per paragraph Quality Assurance.
2. Replace "Technical System" with "Cabling System".
3. Additionally comply to broadcast plate layout examples above and beyond standard plate examples and fabrication requirements.
4. Additionally refer to the Operation and Maintenance Data paragraph in Part 3 of this section for more requirements, including results of broadcast cabling systems testing/certification in O&M Manuals.
5. Preliminary Project Completion submittal requirements for Copper Category and Fiber Optic cabling:
  - a. To be submitted:
    - 1) After all cabling has been installed, terminated, labeled, tested, and corrected so that all cables and strands pass the Testing Requirements.
    - 2) In conjunction with the Substantial Completion Review request.
      - a) HENDERSON ENGINEERS requires a minimum of 1 week notice to schedule the on-site Final Acceptance.
  - b. Submittals shall include:
    - 1) Scanned Work Site Prints that include cable/outlet labels that correspond to the Test Results.
      - a) Test results per Section 27 10 00 - STRUCTURED CABLING.
6. Final Project Completion submittal requirements for Copper Category 3/5e/6 and Fiber Optic cabling:
  - a. Updated, complete Test Results per the requirements above (to include the retesting data of any cables installed or modified after Preliminary Project Completion submittal).
  - b. Per requirements outlined in Section 27 10 00 - STRUCTURED CABLING.

### **1.8 TEMPORARY BROADCAST CABLING SYSTEM**

- A. If the work in this section, as a failure of the Contractor, is incomplete or found not in conformance with the contract documents, provide and operate a temporary Cabling System of reasonably equivalent function as determined by the HENDERSON ENGINEERS. The temporary system shall remain in use until final acceptance of the permanent system.

### **1.9 WARRANTY**

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for warranty requirements with the following alterations:
  1. Warrant all work executed under this contract, including all in-shop and onsite material, parts and labor, for a period of fifteen months (or as required to allow the systems to be used for one complete season plus the first two months of the following season) after the date of final acceptance.

## **PART 2 PRODUCTS**

### **2.1 SYSTEM DESCRIPTION**

- A. These specifications and the associated TB series drawings describe the requirements for the Broadcast Systems Pre-wire cabling system (hereafter referred to as the "Cabling System").
- B. System is intended for in-house and remote broadcast trucks to transmit audio and video signals between cameras, production equipment, and broadcast/production spaces. It is

intended to be used for network play-by-play, in-house play-by-play/replay, officials review, electronic news gathering, satellite/landline uplink, and radio broadcast.

- C. Work under this section of the specifications includes all labor, equipment, and installation as required to provide a complete Cabling System in compliance with the contract documents.
- D. The products in this section have been approved for use in the project as necessary to facilitate a complete and working system. Inclusion in this section does not indicate a requirement for use.
- E. Equipment and wiring shown on the drawings represents the basis of design. Ensure similar or better performance is achieved by the use of equipment other than that shown.
- F. All equipment shall be new and of professional quality.
- G. Cable
  - 1. Unless otherwise designated, provide all of one type of product from one manufacturer; for example, category cabling of one type by one manufacturer, fiber of one type by one manufacturer, connectors of one type by one manufacturer.
  - 2. Product must be procured from the original cable manufacturer.
  - 3. All major components of Cabling System equipment shall be provided and installed by a qualified Contractor as outlined in Part 1 of this section.
  - 4. Flooded or direct burial cable shall be used in all underground conduits.
  - 5. AWG wire sizes indicated herein or on the drawings are the minimum size conductors required. Larger size conductors (i.e., smaller AWG number) are permitted assuming no impact on the project will occur (such as the resulting need for larger or additional conduit, cable trays, chases, etc.) to accommodate such cable.
  - 6. Where cable is run exposed (such as in ceiling plenums, cable trays, chases, or below accessible floors):
    - a. Verify which locations do and do not require plenum-rated cable.
    - b. Furnish the appropriate cable type.
    - c. Obtain written authorization from the Contract Administrator (or the Contract Administrator's designated HENDERSON ENGINEERS) in this regard.
- H. Provide stainless steel mounting hardware, such as product manufactured by McMaster-Carr, for all panel mounted and connector mounted devices.
- I. The quantities of each item of portable or mobile equipment (and other portable or loose accessories), as well as those items associated with Alternates, are indicated in parentheses.

## **2.2 COMMON EQUIPMENT**

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS and Section 27 41 16 - AUDIO VIDEO SYSTEMS EQUIPMENT for equipment and components not listed under this section.

## **2.3 CABLE & TERMINATIONS – BULK – AUDIO**

- A. Twisted Pair – Shielded: Twisted pair, shielded 22 AWG cable; 2 conductor cable with drain wire suitable for microphone, line, or production intercom level audio circuits:
  - 1. Communications plenum rated cable (CMP) is suitable for use in all indoor environments including environmental air plenums as defined per NFPA 70 Article 800.
    - a. The use of performance equivalent substituted cables of lesser type is permitted at the Contractor's discretion where allowable by NFPA 70 Article 800, local codes, and the connected equipment manufacturer's listed requirements.

- b. Performance equivalence to the below specified products shall be determined by the cable manufacturer's listed product equivalents provided in tables and cut sheets.
  2. Direct Bury cable (indoor/outdoor) is required for all locations considered damp or wet, exterior enclosures, floor boxes, and/or served by underground conduit. Direct Bury cable is additionally required to be tinned copper (TC).
  3. 22 AWG/CMP: 22 AWG Communications Plenum rated bare copper conductor cable:
    - a. Belden 9451P or 6500FC; or
    - b. Clark Wire SPA22GSP; or
    - c. Gepco IP222AL or 61801HS; or
    - d. West Penn 25291B.
  4. 22 AWG/CMR: 22 AWG Communications Riser rated bare copper conductor cable:
    - a. Belden 8451 or 9451 or 5500FE; or
    - b. Clark Wire SPA22GS; or
    - c. Gepco IR222AL or 61801 or 61801EZ; or
    - d. West Penn 291 or 452.
  5. 22 AWG/CMR/DB: 22 AWG Communications Riser Direct Bury rated tinned copper conductor cable; for use as indoor/outdoor cable and required listed above:
    - a. Belden 2451RW.
  6. 22 AWG/CMP/MC: 22 AWG Communications Plenum rated bare copper multi-conductor cable, individually shielded pairs, color coded (not for interconnection within equipment racks):
    - a. Belden 6541PA (2 pair), 1815P (TC) or 6543PA (4 pair), 1816P (TC) or 6545PA (6 pair), 1818P (TC) or 6548PA (12 pair); or
    - b. Clark Wire 706P (TC) (6 pair), 712P (TC) (12 pair); or
    - c. Gepco 6604HS (TC) (4 pair), 6606HS (TC) (6 pair), 6612HS (TC) (12 pair).
  7. 22 AWG/CMR/MC: 22 AWG Communications Riser rated bare copper multi-conductor cable, individually shielded pairs, color coded (not for interconnection within equipment racks):
    - a. Belden 1814R (TC) or 1325R (2 pair), 1815R (TC) (4 pair), 1816R (TC) (6 pair), 1818R (TC) (12 pair), 1819R (TC) (16 pair), 1821R (TC) (24 pair); or
    - b. Clark Wire 704 (TC) (4 pair), 706 (TC) (6 pair), 712 (TC) (12 pair), 716 (TC) (16 pair), 724 (TC) (24 pair); or
    - c. Gepco D61802GFC (TC) (2 pair), GA61804GFC (TC) (4 pair), GA61806GFC (TC) (6 pair), GA61812GFC (TC) (12 pair), GA61816GFC (TC) (16 pair); or
    - d. West Penn 77510 (TC) (2 pair).
  8. 22 AWG/CMR/DB/MC: 22 AWG Communications Riser Direct Bury rated tinned copper multi-conductor cable, individually shielded pairs, color coded; for use as indoor/outdoor cable and required as listed above (not for interconnection within equipment racks):
    - a. Belden 2814RW (2 pair), 2815RW (4 pair), 2816RW (6 pair), 2818RW (12 pair); or
    - b. Clark Wire 702DBR (2 pair), 704DBR (4 pair), 706DBR (6 pair), 712DBR (12 pair).
- B. Audio Connectors
  1. Audio XLR, panel mounted audio connector, gold plated contacts, black plated metal housing, metal shell and body:
    - a. Neutrik DL Series; or
    - b. Approved equal.

2. Audio DT-12, 37-pin, 12 channel audio panel connector, gold plated contacts, metal shell, with dust cap:
    - a. Female, chassis:
      - 1) Canare FK37-31S; or
      - 2) Clark Wire DT12-F-PM; or
      - 3) Gepco G37FP; or
      - 4) Whirlwind DT12CF; or
      - 5) Approved equal.
    - b. Male, chassis:
      - 1) Canare FK37-32S; or
      - 2) Clark Wire DT12-M-PM; or
      - 3) Gepco G37MP; or
      - 4) Whirlwind DT12CM; or
      - 5) Approved equal.
- C. Audio Patch Panels
1. Add any and all additional normal-thru patch panel connections requested by the Owner's Representative or HENDERSON ENGINEERS.
  2. Audio Patch Panel, audio, with 24 positions per row (48 positions per assembly), ELCO connectors on the rear, enclosed assembly for dust/dirt protection, switched grounds:
    - a. With normals "#" (full, half, non) as listed on drawings:
      - 1) Bittree 489-S Series B48DC-#NSST/E3 M2OU12L; or
      - 2) Approved equal.
  3. Patch Hole Plug, audio patch panel hole plugs ¼", for unused jack panel spaces, black:
    - a. ADC PJ29; or
    - b. Audio Accessories PHP-1.
  4. Patch Cable Lacing Bar, for cable management support from the rear (as required):
    - a. Bittree LB-17500; LB-175-3; or
    - b. Canare 1U-AS3; Canare 2U-AS5; Canare 3U-AS7; or
    - c. Middle Atlantic LBP-1A, LBP-2A, LBP-4A, LBP-6A; or
    - d. Approved equal.
  5. Patch Cable Holder, for ¼" audio patch cables, wall-mount in location as later directed (one required):
    - a. ADC PPH; or
    - b. Audio Accessories PCH-X; or
    - c. Bittree PCHA; or
    - d. Middle Atlantic CLAW.
- D. Audio Patch Panel Accessories – Portable
1. Connector Tool Kit – Audio, crimp tool for audio patch panels (one required):
    - a. Bittree E3 (EPIN) Tool Kit SBCTLKT01.
  2. Patch Cord –
    - a. Audio 12", ¼", twelve-inch audio patch panel patch cords, nickel plated plugs, red cable color code indicates length (brass plugs will not be accepted) (quantity per equipment list):
      - 1) ADC R1 (red); or
      - 2) Audio Accessories 621A (red); or

- 3) Bittree LPC 12 02 - 110 (red).
- b. Audio 24", ¼", twenty-four-inch audio patch panel patch cords, nickel plated plugs, green cable color code indicates length (brass plugs will not be accepted) (quantity per equipment list):
  - 1) ADC G2 (green); or
  - 2) Audio Accessories 622D (green); or
  - 3) Bittree LPC 24 05 - 110 (green).
- c. Audio 36", ¼", thirty-six-inch audio patch panel patch cords, nickel plated plugs, blue cable color code indicates length (brass plugs will not be accepted) (quantity per equipment list):
  - 1) ADC B3 (blue); or
  - 2) Audio Accessories 623C (gray); or
  - 3) Bittree LPC 36 06 - 110 (blue).
- d. Audio 48", ¼", forty-eight-inch audio patch panel patch cords, nickel plated plugs, black cable color code indicates length (brass plugs will not be accepted) (quantity per equipment list):
  - 1) ADC BK4 (black); or
  - 2) Audio Accessories 624B (black); or
  - 3) Bittree LPC 48 00 - 110 (black).
- e. Audio 72", ¼", seventy-two-inch audio patch panel patch cords, nickel plated plugs, red cable color code indicates length (brass plugs will not be accepted) (quantity per equipment list):
  - 1) ADC R6 (red); or
  - 2) Audio Accessories 626A (red); or
  - 3) Bittree LPC 72 02 - 110 (red).

## 2.4 CABLE & TERMINATIONS – BULK – VIDEO

- A. Coax - Mini HD-SDI, suitable for digital HD-SDI signal, 23AWG solid conductor:
  - 1. Allowed for equipment rack intraconnect only:
    - a. Belden 1855A; or
    - b. Clark Wire CD7523; or
    - c. Gepco VDM230; or
    - d. Approved equal.
- B. Coax – RG-59 HD-SDI, suitable for digital HD-SDI signal, 20AWG solid conductor:
  - 1. RG-59/CMP: Communications Plenum rated:
    - a. Belden 1506A; or
    - b. Clark Wire CD7559P; or
    - c. Gepco VPM2000TS; or
    - d. Approved equal.
  - 2. RG-59/CMR: Communications Riser rated:
    - a. Belden 1505A and Belden 1505S5 (five conductor); or
    - b. Clark Wire CD7559; or
    - c. Gepco VPM2000; or
    - d. Lake Cable AVBRG59HDTV; or
    - e. Approved equal.

3. RG-59/CMR/DB: Communications Riser Direct Bury rated; for use as indoor/outdoor cable and required at all exterior and floor box locations:
  - a. Approved equal.
- C. Coax – RG-6 HD-SDI, suitable for digital HD-SDI signal, 18AWG solid conductor:
  1. RG-6/CMP: Communications Plenum rated:
    - a. Belden 1695A and Belden 1695S5 (five conductor); or
    - b. Clark Wire CD7506P; or
    - c. Gepco VSD2001TS; or
    - d. Lake Cable AVPRG6HDTV; or
    - e. Approved equal.
  2. RG-6/CMR: Communications Riser rated:
    - a. Belden 1694A and Belden 1694S5 (five conductor); or
    - b. Clark Wire CD7506; or
    - c. Gepco VSD2001; or
    - d. Lake Cable AVBRG6HDTV; or
    - e. Approved equal.
  3. RG-6/CMR/DB: Communications Riser Direct Bury rated; for use as indoor/outdoor cable and required at all exterior and floor box locations:
    - a. Belden 1694WB (not riser rated); or
    - b. Clark Wire CD7506DBR; or
    - c. Gepco VSD2001PEF (not riser rated); or
    - d. Approved equal.
- D. Coax – RG-11 HD-SDI: suitable for digital HD-SDI signal, 14AWG solid conductor:
  1. RG-11/CMP: Communications Plenum rated:
    - a. Belden 7732A; or
    - b. Clark Wire CD7511P; or
    - c. Gepco VHD1100TK; or
    - d. Lake Cable AVPRG11HDTV; or
    - e. Approved equal.
  2. RG-11/CMR: Communications Riser rated:
    - a. Belden 7731A; or
    - b. Clark Wire CD7511; or
    - c. Gepco VHD1100; or
    - d. Lake Cable AVBRG11HDTV; or
    - e. Approved equal.
  3. RG-11/CMR/DB: Communications Riser Direct Bury rated; for use as indoor/outdoor cable and required at all exterior and floor box locations:
    - a. Belden 7731WB (not riser rated); or
    - b. Clark Wire CD7511DBR; or
    - c. Gepco VHD1100SC; or
    - d. Gepco VHD1100PEF (not riser rated); or
    - e. Approved equal.
- E. Video Patch Panels

1. Add any and all additional normal-thru patch panel connections requested by the Owner's Representative or HENDERSON ENGINEERS.
2. Capable of handle high bandwidth performance for 3.0Ghz HD/SDI, 3 Gb/s, and 4K.
3. SMPTE 259M, 292M, and 424M compliant.
4. RoHS compliance, section EU Directive 2011/65/EU, Exemption 6c and 8b.
5. True 75-ohm impedance low loss.
6. Video Patch Panel with 32 positions per row (64 positions per assembly), female BNC connectors on the rear interface, enclosed assembly for dust/dirt protection, and easy access for insert/removal tool. Paint mounting flange and associated mounting screw heads semi-gloss black to match face of panel:
  - a. With normaled midsize terminating jacks; 1 RU
    - 1) AVP AV-D232E1-AMN75; or
    - 2) Bittree B64S-2MWTHTD; or
    - 3) Canare 32MD-ST.
  - b. With normaled midsize terminating jacks; 2 RU
    - 1) AVP AV-D232E2-AMN75; or
    - 2) Bittree B64T-2MWTHTD; or
    - 3) Canare 32MD-ST-2U.
7. Video Patch Cables, WECO standard, flexible, to match patch panel, color-coded for length furnished (quantity per equipment list):
  - 1) AVP MPC series (24": red, green; 36": blue, purple; 48": black, green, yellow); or
  - 2) Bittree VPCM 1200-75 series (12", 18", 24", 36", 48", 60", 72") (each available in black, red, yellow, green, blue, purple); or
  - 3) Canare VPC series (12", 24", and 36" standard, custom lengths available) (each available in black, red, yellow, green, blue, purple, brown, gray, orange, white).
8. Patch Cable Holder, for video patch cables, wall-mount in location as later directed (one required):
  - a. Bittree PCHV; or
  - b. Pomona 4408; or
  - c. Approved equal.
9. Patch Cable Lacing Bar, for cable management support from the back (as required):
  - a. Bittree LB-175-3 (3") or LB-17500 (6"); or
  - b. Middle Atlantic LBP series; or
  - c. Approved equal.

## 2.5 CABLE & TERMINATIONS - CATEGORY ETHERNET

- A. Category cabling utilized for ethernet connections and adhering to structured cabling requirements shall be per Section 27 10 00 - STRUCTURED CABLING. Refer to listed Section for product information and additional installation requirements.
- B. Termination Coordination
  1. Structured cabling shall be provided with a terminated and tested permanent link per the Section listed above. Coordinate termination configuration with the structured cabling Contractor.
  2. All category cabling shall be plated onto Neutrik EtherCON connector panel mounts. EtherCON connector series shall be coordinated with category cable type and data rate.
  3. The following structured cabling termination conditions are approved:



- a. Field terminated RJ45 plug, meeting all warranty requirements per the Section listed above. The use of field terminated crimp connectors is not permitted. Provide pass-thru EtherCON connector for plate.
- b. Biscuit enclosure with keystone punch down connectors and patch cable. Provide pass-thru EtherCON connector for plate.
4. The following environmental considerations shall be maintained:
  - a. For locations in floor boxes: Provide dust cover, Neutrik SCDD or similar.
  - b. For exterior locations: Provide IP65 rated connector and/or cover.

## 2.6 CABLE & TERMINATIONS – BULK – CATEGORY

### A. Category Cable:

1. General Requirements:
  - a. Cable jacket marking: Shall be legible and shall contain the following information:
    - 1) Manufacturer's name
    - 2) Copper Conductor Gauge
    - 3) Pair Count
    - 4) UL and CSA listing
    - 5) Manufacturer's Trademark
    - 6) Category rating
    - 7) Sequential distance markings, in one-foot increments
2. Outside Plant (rated for Wet Location):
  - a. Limited to 50 feet inside of building; for distances greater than 50 feet, transition to riser- or plenum-rated cable.

### B. Multi-pair Category Cable

1. General Requirements
  - a. See drawings for required cable type and pair count.
  - b. Cables shall consist of 24 AWG thermoplastic insulated conductors formed into binder groups of 25 pairs. Grouped and color coded as required by the referenced standards.
  - c. Cable construction specifications
    - 1) Core wrap - Polypropylene Film
2. Category 3 Multi-pair (for installed lengths greater than 300 feet)
  - a. Requirements:
    - 1) At a minimum, the cables shall meet the requirements of TIA-568 (SET) for Category 3 100-Ohm UTP Multi-pair Cable.
  - b. Cables for dry environments
    - 1) Riser-rated (CMR)
      - a) Belden – D-Inside Wire
      - b) General Cable – Category 3 Non-Plenum
      - c) Mohawk Cable – Category 3 Riser
    - 2) Plenum-rated (CMP)
      - a) Belden – D-Inside Wire
      - b) General Cable – Category 3 Plenum
      - c) Mohawk Cable – Category 3 Plenum
  - c. Outside Plant (rated for Wet Location)
    - 1) General Cable – PE-89



- 2) Mohawk Cable – LAN-Trak OSP Category 5
3. Category 5e Multi-pair (for installed lengths less than 300 feet)
  - a. Requirements:
    - 1) At a minimum, the cables shall meet the requirements of TIA-568 (SET) for Category 5e 100-Ohm UTP Multi-pair Cable.
  - b. Cables for dry environments
    - 1) Riser-rated (CMR)
      - a) Belden – IBDN Plus 25-pair Cable Series Category 5E
      - b) General Cable – GenSPEED 5000 Category 5e Backbone 25 Pair Cable
      - c) Mohawk Cable – Power Sum Category 5e Riser
    - 2) Plenum-rated
      - a) Belden – IBDN Plus 25-pair Cable Series Category 5E
      - b) General Cable – GenSPEED 5000 Category 5e Backbone 25 Pair Cable
      - c) Mohawk Cable – Power Sum Category 5e Plenum
  - c. Outside Plant (rated for Wet Location)
    - 1) Superior Essex – 25-Pair Category 5e Indoor/Outdoor
    - 2) Or approved equal.
- C. 4-pair F/UTP (Shielded) Category 6A
  1. Requirements:
    - a. At a minimum, the cables shall meet the requirements of TIA-568 (SET) for Category 6A.
    - b. Aluminum foil shield
  2. Cables for dry environments
    - a. Riser-rated (CMR); Color shall be: blue
      - 1) Belden
      - 2) General Cable
      - 3) Mohawk
      - 4) Superior Essex
    - b. Plenum-rated (CMP); Color shall be: purple
      - 1) Belden
      - 2) General Cable
      - 3) Mohawk
      - 4) Superior Essex
  3. Outside Plant (rated for Wet Location)
    - a. Superior Essex OSP Broadband Category 6A
- D. Category Cable Connectivity:
  1. General Requirements:
    - a. Comply with referenced standards. Cables shall be terminated with connecting hardware of same category or higher.
    - b. Patch panels and rack-mounted blocks shall be provided complete with all mounting hardware, jacks, retainers, wire guides, designation strips, etc.
    - c. Provide enough ports/termination blocks to support the quantity of cables/pairs indicated on the drawings. Provide all connector blocks, including plugs and jacks where required to fill each panel completely. Do not leave any blank openings.

- d. Modular Patch Panels shall be of a metal design with snap in module frames. Modules shall be releasable from the front to provide access to the modules and terminated cable. Patch panels shall be available with labels.
  - e. Ports and panels shall be easy to identify with label holders for machine-printed and color-coded labels. Rack mountable patch panels shall mount to EIA/ECA-310 19 inches racks.
- 2. For Multi-pair Category 3 cabling:
    - a. Multi-pair Category 3 UTP cabling shall be terminated onto 19 inches wide rack-mounted 110-style termination block(s).
    - b. Manufacturer shall be:
      - 1) Leviton 41DBR
      - 2) Panduit P110B100
      - 3) Or approved equal.
  - 3. For Multi-pair Category 5e cabling:
    - a. Multi-pair Category 5e UTP cabling shall be terminated onto a four-pair Category 5e jack module. All jack modules shall be terminated so that all four pairs are utilized. Cable pairs shall be terminated in sequential order. For every 6 ports leave the 25th pair of the cable for future (do not cut off at sheath, provide enough length to terminate on any jack on patch panel.)
    - b. Manufacturer shall be:
      - 1) Coordinate with Owner's Telecommunications System.
      - 2) Belden KeyConnect Modular Patch Panel with KeyConnect jacks
      - 3) Leviton QuickPort Modular Patch Panel with Atlas-X1 jacks
      - 4) Or approved equal.
  - 4. For 4-pair UTP Category 5e/6/6A:
    - a. Cabling shall be terminated with tested permanent link via one of the following conditions:
      - 1) Field terminated RJ45 plug directly into pass-thru connector.
      - 2) Biscuit enclosure with keystone punch down connectors and patch cable to pass thru connector.
      - 3) The use of field terminated crimp connectors is not permitted.
    - b. Cabling shall be plated onto Neutrik EtherCON connector pass-thru panel mounts in custom patch panel or plate. EtherCON connector series shall be coordinated with category cable type and data rate.
    - c. The following environmental considerations shall be maintained:
      - 1) For locations in floor boxes: Provide dust cover, Neutrik SCDD or similar.
      - 2) For exterior locations: Provide IP65 rated connector and/or cover.

## 2.7 CABLE & TERMINATIONS – BULK – FIBER

- A. General Requirements
  - 1. Cable shall meet the transformation performance and physical specifications of TIA-568 (SET).
  - 2. Refer to drawings for cable type, strand counts and locations - minimum strand count of 6 strands and in multiples of 12 strands.
  - 3. Cable jacket marking: Shall be legible and shall contain the following information:
    - a. Manufacturer's name and trademark

- b. Fiber size
  - c. Fiber Grade
  - d. UL listing (Shall be suitable for the application)
  - e. Sequential length markings
  - 4. Cable environmental requirements:
    - a. Dry location:
      - 1) Tight-buffered construction
      - 2) Cable shall have an overall armor of steel or aluminum
    - b. Wet Location:
      - 1) Tight-buffered or loose-tube construction
      - 2) Cable shall have an overall armor of steel or aluminum
      - 3) Cable jacket shall be suitable for installation in standing water
- B. Single-mode Fiber Optic Cable
- 1. Non-Armored
    - a. Non-armored cable is suitable for use in full conduit raceways
    - b. Indoor
      - 1) Riser rated:
        - a) Belden; or
        - b) Mohawk; or
        - c) Superior Essex; or
        - d) Approved equal.
      - 2) Plenum rated:
        - a) Belden; or
        - b) Mohawk; or
        - c) Superior Essex; or
        - d) Approved equal.
    - c. Indoor/Outdoor
      - 1) Riser rated:
        - a) Belden; or
        - b) Clark Wire DR Series; or
        - c) Gepco FSDR Series; or
        - d) Mohawk; or
        - e) Superior Essex; or
        - f) Approved equal.
      - 2) Plenum rated:
        - a) Belden; or
        - b) Clark Wire DP Series; or
        - c) Gepco FSDP Series; or
        - d) Mohawk; or
        - e) Superior Essex; or
        - f) Approved equal.
  - 2. Armored
    - a. Armored cable is suitable for use in full conduit raceways and required for use in all other raceway types (j-hooks, cable tray, etc.)
    - b. Indoor
-

- 1) Riser rated:
  - a) Belden; or
  - b) Clark Wire DRIA Series; or
  - c) Mohawk; or
  - d) Superior Essex; or
  - e) Approved equal.
- 2) Plenum rated:
  - a) Belden; or
  - b) Clark Wire DPIA Series; or
  - c) Mohawk; or
  - d) Superior Essex; or
  - e) Approved equal.
- c. Indoor/outdoor
  - 1) Riser rated:
    - a) Belden; or
    - b) Clark Wire DRIOA Series; or
    - c) Mohawk; or
    - d) Superior Essex; or
    - e) Approved equal.
  - 2) Plenum rated:
    - a) Belden; or
    - b) Clark Wire DPIOA Series; or
    - c) Mohawk; or
    - d) Superior Essex; or
    - e) Approved equal.
- C. Fiber Optic (non-hybrid) Cable Connectivity
  1. General Requirements:
    - a. Comply with referenced standards.
    - b. Connectors and adapters shall match the cable type indicated on the drawings.
    - c. Mid-span splices shall not be allowed, except where specifically identified on the drawings or required by code.
  2. Equipment Room Terminations – where located in a building AV equipment rack or enclosure with sufficient depth.
    - a. Fiber Enclosure with pre-terminated ST connectors to fusion-spliced pigtails:
      - 1) Belden FX UHD Enclosure with Cassettes; or
      - 2) Corning CCH Enclosure with CCH Pigtail Cassettes; or
      - 3) Leviton Opt-X Ultra Enclosure with Opt-X ST Splice Modules; or
      - 4) OCC RTC Enclosures with Splice Cassettes; or
      - 5) Approved equal.
  3. Far End Location Terminations – where rack-mounted in 10-inch-deep box, such as at camera locations, production rooms, truck dock locations, etc. (Identified within Broadcast Prewire Box Schedule.)
    - a. Fiber patch panel with ST pass-through connectors. Patch panel shall include a shallow chassis to protect the rear connectors.
      - 1) Clark Wire FB1-ST-## Series; or

- 2) Gepco FP1-xxST; or
- 3) OCC RC1U Series; or
- 4) Approved equal.
- b. Each location requires unique labeling information; either provide custom fiber patch panel or provide custom blank 1RU immediately above fiber patch panel with required labeling.
- c. Field-terminate all strands onto ST adapters. Acceptable manufacturers include:
  - 1) Belden
  - 2) Corning Unicam
  - 3) Leviton
  - 4) Approved equal.
4. Mid-Span Fiber Splice Case – where specifically identified on the drawings or required by code for transitions from non-CMP/CMR to riser- or plenum-rated cabling:
  - a. Locate splice case in a non-plenum space. All strands are to be fusion-spliced.
  - b. Manufacturer shall be: Preformed Coyote Fiber Optic Closure, with fusion splice trays.

## 2.8 CABLE & TERMINATIONS – BULK – CAMERA – HYBRID FIBER

- A. SMPTE 311M Hybrid Fiber Cable – 9.2
  1. Conforms to SMPTE 311M hybrid cable standard for HD video cameras, 9.2mm nominal outside diameter; two single-mode fiber strands, two 24AWG copper conductors, four 20 AWG copper conductors, one 16 AWG steel strength member:
  2. R; Riser rated:
    - a. Belden 7804R (single channel) or 7824R (three channel); or
    - b. Clark Wire HFCPV (single channel) or HFC3R (three channel); or
    - c. Gepco HDC920R (single channel) or HC3R (three channel); or
    - d. Lake Cable AVBSMPTE311R; or
    - e. Mohawk M96921 (single channel) or M97673 (three channel); or
    - f. OCC C-008HBAA5KR; or
    - g. Approved equal.
  3. P; Plenum rated:
    - a. Belden 7804P (single channel) or 7824P (three channel); or
    - b. Clark Wire HFCPL (single channel) or HFC3P (three channel); or
    - c. Gepco HDC920P; or
    - d. Mohawk M96924 (single channel) or M97767 (three channel); or
    - e. OCC CX008HBAA9KP; or
    - f. Approved equal.
  4. 9.2DB; Direct bury rated, water blocking tape or gel filled, when cable is exposed to moisture:
    - a. Belden 7804WB (single channel) or 7824WB (three channel); or
    - b. Clark Wire HFCDB (single channel) or HFC3DB (three channel); or
    - c. Gepco HDC920PEF; or
    - d. OCC C-008HBAA5KB; or
    - e. Approved equal.
- B. SMPTE 311M Copper Only

1. Conforms to electrical portion of SMPTE 311M hybrid cable standard for HD video cameras, for use with multi-strand single-mode fiber breakout scenarios; two 22 AWG copper conductors, two 16 AWG copper conductors:
  2. Riser rated:
    - a. Belden 7825R; or
    - b. Clark Wire CW-1622; or
    - c. Gepco HDP221; or
    - d. OCC CX005HBAE9KR; or
    - e. Approved equal.
  3. Plenum rated:
    - a. Belden 7825P; or
    - b. Clark Wire CW-1622P; or
    - c. Gepco HDP221P; or
    - d. Lake Cable AVP16/22BRD; or
    - e. OCC CX005HBAE9KP; or
    - f. Approved equal.
- C. SMPTE 304M Hybrid pigtail
1. Prefabricated with 1-meter cables to terminate in splice box, pre-terminated SC fiber connectors, multi-pin electrical breakout connector, with dust cap, with isolation plate, substitute half-meter where applicable (provide where required):
  2. Male (Socket), LEMO EDW connectors (furnish two spare pigtails in addition to those installed):
    - a. Canare FCS015A-MR with IU-FCM-SET and dust cap; or
    - b. Clark Wire X-HFC-EDW-SC-3; or
    - c. Gepco GHFBK-3-SB/SC C with dust cap; or
    - d. LEMO MDT.3K.93C.ZZZC100 (request SC in lieu of LC); or
    - e. OCC OCA-LMFR1SCPP006-3333F; or
    - f. Approved equal.
  3. Female (Plug), LEMO FXW connectors (furnish two spare pigtails in addition to those installed):
    - a. Canare FCS015A-FR with IU-FCF-SET and dust cap; or
    - b. Clark Wire X-HFC-FXW-SC-3; or
    - c. Gepco GHFBK-3-PB/SC C with dust cap; or
    - d. LEMO MXT.3K.93C.ZZZC100 (request SC in lieu of LC); or
    - e. OCC OCA-LFFR1SCPP006-3333F; or
    - f. Approved equal.
- D. SMPTE Hybrid Fiber Optic Splice Enclosure, for housing and protection of fusion splice fiber connections between terminations of permanent link fiber and SMPTE hybrid pigtail:
1. Canare FCE-# series; or
  2. Clark Wire X-HFC-SB-(#); or
  3. Gepco HSB Fusion Splice Box; or
  4. OCC SMPTE RC2U series; or
  5. Approved equal.

## 2.9 TERMINATION PANELS

---

- A. Camera
  - 1. Hybrid Fiber Camera Connector Panel; accepts Hybrid Fiber only, 2RU:
    - a. Canare COPS Series; or
    - b. Clark Wire MPAS Series; or
    - c. Clark Wire ModBox Modular Panels Series; or
    - d. Gepco HBP Series; or
    - e. OCC RC2U Series; or
    - f. Approved equal.

## 2.10 CABLES – FACTORY TERMINATED - PORTABLE

- A. Factory terminated cable assemblies in this section are approved for portable use only.
- B. Portable cable assembly quantities are identified in bold and are required to be furnished in addition to those required for system installation. Portable cable lengths are a minimum not to exceed the maximum acceptable length identified in the cable descriptions below.
- C. All cable assemblies must be factory tested and certified.
- D. Refer to equipment list for quantities and types.

## 2.11 PORTABLE ACCESSORIES

- A. SMPTE 304M Connector Alignment Removal Tool, for plug-end alignment sleeve removal (one required):
  - 1. LEMO DCS.F2.035.PN; or
  - 2. Approved equal.
- B. SMPTE 304M Cleaning Tool, for SMPTE 304M connectors and adapters (one required):
  - 1. Clark Wire FOC-CK-OCS; or
  - 2. Gepco HFCD; or
  - 3. Approved equal.
- C. ST Panel Mount Cleaning Tool, for cleaning fiber contacts (one required):
  - 1. Clark Wire FOC-CK-OC; or
  - 2. Gepco SCK-SC-250; or
  - 3. Approved equal.
- D. Cable Tester, cable tester with ability to test each individual wire in a variety of common cable types. Tests XLR, 1/8", 1/4", speakON, BNC, Ethernet. Furnish batteries for tester (one required):
  - 1. Ebtech 6-in-1 Cable Tester and Greenlee Cable Check – Data Link ID; or
  - 2. Hosa CBT-500; or
  - 3. Whirlwind MCT-9 and SC48RJ.
- E. Cable ties (thirty ties required):
  - 1. Hosa WTI-148G (pkg of 5); or
  - 2. Rip-Tie EconoWrap Slip-on 1" wide; or
  - 3. Toleeto Fasteners International Cord Lox 307-C, 1"x7".

## 2.12 STANDBY EQUIPMENT

- A. The following equipment shall be on-hand at the time of system acceptance and system first-use for possible replacement of defective equipment or for field conditions noted. Maintain

ownership of this standby equipment. However, if any item of this standby equipment is used to replace defective equipment, the installed item of standby equipment becomes Owner's property. Assume ownership of the defective equipment:

1. Panel connector / pigtail of each type (one of each type required).
- B. Allowances for overnight shipping of critical components shall be included for components essential to Owner's operation or first-use requirements.

### **PART 3 EXECUTION**

#### **3.1 GENERAL**

- A. Install in accordance with manufacturer's instructions.
- B. Comply with SVG-Section A and SVG-Section D.
- C. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for common requirements.
- D. Refer to Section 27 00 13 - SUSTAINABLE DESIGN REQUIREMENTS for sustainable requirements.

#### **3.2 INSTALLATION**

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS and Section 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO-VIDEO for physical installation requirements.
- B. Blank panels and/or vent panels shall be installed in unused rack spaces and camera connection box spaces. Ensure that air flow within the rack is maintained (i.e., cool air can enter the rack and hot air can exit the rack). Ensure that connection boxes are fully plated (i.e., no gaps to rear of box allowed).

#### **3.3 LABELING**

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for labeling requirements.
- B. Refer to broadcast plate details for additional labeling requirements.

#### **3.4 TESTING AND CERTIFICATION**

- A. At the completion of the installation, perform the following tests on the system to ensure proper installation and operation. The Cabling System shall be fully tested with all equipment on site, installed, connected, and fully operational.
- B. The completed Testing and Certification Documentation package shall include:
  1. Results of the tests detailed herein; and
  2. Digital photographs of primary systems, sub-systems and components; and
  3. List of test equipment used; and
  4. Written notice to the HENDERSON ENGINEERS that the systems have been tested and certified, along with a comprehensive report summarizing the results.
- C. All test equipment used for these tests shall be on site during the system final acceptance activities should verification of submitted measurements be required.
- D. Utilize the technical support services offered by the manufacturers of the various Cabling System components to ensure optimum performance.
- E. Tests shall include the following:
  1. Verify each device is properly grounded.



2. Verify each device has proper AC power (including AC power for associated devices such as cameras, trucks, etc.)
3. Cables are properly installed and labeled with an appropriate service loop.
4. Verify the termination for each cable is labeled and wired correctly.
5. Utilize broadcast equipment to verify acceptable performance.
6. Functional tests of all equipment and software. Functional tests include examination for hum, buzz, hiss, ghosts, hum bars, oscillation, unintended reception of other signals such as AM or FM radio, TV, CB, ham radio, cell phones, or any other unwanted signals through the systems.
7. Ensure that all equipment is on the job-site and fully operational. This includes portable (not installed) items and other loose equipment. Remove all devices from shipping or packaging containers, ready for use.
8. Audio cabling:
  - a. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS testing requirements.
9. Video cabling:
  - a. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS testing requirements.
10. SMPTE Hybrid Cable:
  - a. Clark Wire CWT-SMPTE-T
  - b. Gepco SMPTE-304TS
  - c. Use a broadcast camera for final testing.
11. Category Copper cable testing
  - a. Multipair Category 3/5e
    - 1) After terminating and splicing the cables. Test all cable pairs for continuity, ground fault, proper cross-connection, shorts and crossed pairs.
    - 2) Cable test reports: As a minimum, also provide: cable number, cable type, pair or conductor count, individual pair or conductor numbers, number of cross-connects and/or patches in each pair, results of each test for each pair or conductor, total number of serviceable pairs or conductors in cable.
  - b. 4-pair Category 5e/6/6A
    - 1) After terminating both ends of all 4-pair cables, but before any cross-connects are installed, test these cables for the following:
      - a) Wire map
      - b) Length
      - c) Insertion loss
      - d) Near-end crosstalk (NEXT) loss.
      - e) Power sum near-end crosstalk (PSNEXT)
      - f) Equal-level far-end crosstalk (ELFEXT)
      - g) Power sum equal-level far-end crosstalk (PSELFEXT)
      - h) Return loss
      - i) Propagation delay
      - j) Delay skew
    - 2) Submit the following information regarding the cable testing: cable number, cable type, pair or conductor count, individual pair or conductor numbers, results of each test for each pair and total number of serviceable pairs in cable.
      - a) In addition to the tests specified above, provide a minimum of two suitably qualified cabling technicians and copper test equipment to be present on-

site for a period of 8 hours during the Substantial Completion Review. Be prepared to conduct on-the-spot cable tests as requested. Successful equipment performance tests do not relieve the Contractor from the specified testing, repair, and documentation requirements. If more than one of these randomly tested cables do not pass, the Owner and HENDERSON ENGINEERS reserves the right to require a re-testing of 100% of the cable plant, all without additional costs to the project.

- c. Category Copper Cable Test Equipment
  - 1) Category 3/5e Cable Tester
    - a) Available Manufacturers. Contractor may submit other cable testers that meet specification requirements.
    - b) Category 3/5e UTP cable Tester
      - (1) Agilent [www.agilent.com](http://www.agilent.com)
      - (2) Fluke [www.flukenetworks.com](http://www.flukenetworks.com)
      - (3) Greenlee [www.greenlee.com](http://www.greenlee.com)
      - (4) Ideal [www.idealindustries.com](http://www.idealindustries.com)
      - (5) JDSU [www.jdsu.com](http://www.jdsu.com)
    - c) Requirements
      - (1) The field tester shall be a level II-E (Ile) or greater.
      - (2) The field tester shall meet the requirements of TIA-568 (SET).
  - 2) Category 6/6A Cable Tester
    - a) Available Manufacturers. Contractor may submit other cable testers that meet specification requirements.
    - b) Category 6 Cable Tester
      - (1) Agilent [www.agilent.com](http://www.agilent.com)
      - (2) Fluke [www.flukenetworks.com](http://www.flukenetworks.com)
      - (3) Greenlee [www.greenlee.com](http://www.greenlee.com)
      - (4) Ideal [www.idealindustries.com](http://www.idealindustries.com)
      - (5) JDSU [www.jdsu.com](http://www.jdsu.com)
    - c) Requirements
      - (1) The field tester shall be a level III or greater.
      - (2) The field tester shall meet the requirements of TIA-568 (SET).
- 12. Fiber cable testing
  - a. Post-installation testing:
    - 1) After installation of connectors, visually inspect each fiber end-face at 50X magnification. Refinish fibers with visible defects and/or striations in the core area.
    - 2) Perform end-to-end, bi-directional attenuation (loss) test for each multimode fiber strand at 850nm and 1300nm. Conduct tests in accordance with TIA-526-14, Method B and with test instrument manufacturer's printed instructions.
    - 3) Perform end-to-end, bi-directional attenuation (loss) test for each single-mode fiber strand at 1310 and 1550 wavelengths. Conduct tests in accordance with TIA-526-7, Method A.1 and with test instrument manufacturer's printed instructions.

- 4) Demonstrate that measured link loss does not exceed the “worst case” allowable loss which is defined as the sum of: the connector losses (based on the number of mated connector pairs at the TIA-568 (SET) maximum allowable loss of 0.75dB per mated pair) and the optical fiber loss (based on length and the TIA-568 (SET) maximum allowable loss (3.5dB/km @ 850nm and 1.5dB/km @1300nm for multi-mode and 1.0dB/km @1300 and 1550nm for single-mode) by more than 1.0dB.
  - 5) Strands whose measured attenuation fall outside the acceptable range shall be subject to further inspection and testing to determine the nature of the fault. At a minimum, an OTDR shall be used to: determine the true loss for each connector pair, the exact length of the fiber and to identify the presence of any core damage.
  - 6) Faults related to fiber being connectorized shall be corrected, and the fiber re-tested as described above, until acceptable attenuation measurements are recorded.
  - 7) Where defects are found to be inherent in the fiber itself: replace any cable having fewer than the manufacturer’s guaranteed number of serviceable fibers.
  - 8) Provide testing in accordance with manufacturer’s requirements for a fully-warranted cabling system(s) as required by these Contract Documents.
- b. Testing jumpers used shall remain connected at the test equipment for the entire duration of testing. If at any time the jumper becomes loose or removed, for any reason, the jumper shall be reinstalled and re-referenced. This procedure shall be documented each time it is performed to indicate date, time and who performed the procedure. This log shall accompany test reports submitted.
- c. These test results and corrective procedures are to be documented and submitted with Substantial Completion submittal.
- 1) Prior to testing, submit for review and approval copies of test report forms proposed for use.
  - 2) Each test report shall contain the following general information: Date of Preparation, Date of Test, Project Name, Contractor’s Name, Media Type, Make, Model and Serial Number of test equipment used, Date of Last Calibration and Names of Test Crew.
  - 3) Cable number, fiber count, individual fiber numbers, connector types, number of connectors/patches, calculated maximum link loss, length or run, measured link loss for each fiber.
- d. Fiber Optic Test Equipment
- 1) Optical Time Domain Reflectometer (OTDR)
    - a) Available Manufacturers. Contractor may submit other cable testers that meet specification requirements.
    - b) Optical Time Domain Reflectometer (OTDR)
      - (1) [www.agilent.com](http://www.agilent.com)
      - (2) [www.flukenetworks.com](http://www.flukenetworks.com)
      - (3) [www.idealindustries.com](http://www.idealindustries.com)
      - (4) [www.jdsu.com](http://www.jdsu.com)
    - c) Requirements
    - d) An OTDR shall be used to provide Tier Two testing, which shall provide information regarding attenuation, connector location and insertion loss,

- splice location and splice loss, and any other power loss events that may have been created during installation.
- e) The OTDR shall be utilized from both ends of the fiber strand to better isolate any potential problems.
  - f) For unterminated fiber, a "bare fiber adapter" shall be utilized.
- 2) Optical Power Measurement Meter
- a) Available Manufacturers. Contractor may submit other cable testers that meet specification requirements.
  - b) Optical Power Measurement Meter
    - (1) Agilent [www.agilent.com](http://www.agilent.com)
    - (2) Fluke [www.flukenetworks.com](http://www.flukenetworks.com)
    - (3) Ideal [www.idealindustries.com](http://www.idealindustries.com)
    - (4) JDSU [www.jdsu.com](http://www.jdsu.com)
  - c) Requirements
  - d) An Optical Loss Test Set (OLTS) shall be used to provide Tier One testing, which shall provide information regarding link attenuation, continuity, and polarity of the installed fiber optic cable.
  - e) The OLTS shall be used with the appropriate adapters to allow connectivity to the optical fiber link.
  - f) The OLTS shall meet the launch requirements of TIA-455-78.
- 3) Optical Fiber Inspection Scope (or Fiber Viewers)
- a) Available Manufacturers. Contractor may submit other cable testers that meet specification requirements.
  - b) Optical Fiber Inspection Scope
    - (1) Agilent [www.agilent.com](http://www.agilent.com)
    - (2) Fluke [www.flukenetworks.com](http://www.flukenetworks.com)
    - (3) Ideal [www.idealindustries.com](http://www.idealindustries.com)
    - (4) JDSU [www.jdsu.com](http://www.jdsu.com)
  - c) Requirements
  - d) An Optical Fiber Inspection Scope shall be utilized to examine all ends of fiber optic strands prior to splicing or termination.
  - e) The Optical Fiber Inspection Scope shall have a minimum of 400x magnification. If the cable and/or connectivity manufacturer requires greater magnification to meet their installation requirements, the more restrictive standard shall apply.
13. In addition to the tests specified above, provide a minimum of two suitably qualified cabling technicians with all test equipment to be present on-site for a period of 2 hours during the HENDERSON ENGINEERS's final acceptance review. Be prepared to conduct on-the-spot cable tests as requested. Successful equipment performance tests do no relieve the Contractor from the specified testing, repair, and documentation requirements. If more than one of these randomly tested cables do not pass, the Owner and/or HENDERSON ENGINEERS reserve the right to require a re-testing of 100% of the cable plant, all without additional costs to the project.
14. Repair or replace any defects or malfunctions found prior to the commencement of final acceptance activities by the HENDERSON ENGINEERS.

15. Contact the HENDERSON ENGINEERS should problems or concerns arise during the testing activities.
- F. Record all products used, wire numbers, connection numbers, and any changes to the systems accurately mapping the system installation, including the data network components. This information shall be used for inclusion with the system record drawings as described later in the specifications.
- G. Should the HENDERSON ENGINEERS be required to invest time performing some or all of the tests, the Contractor will compensate the HENDERSON ENGINEERS for all associated costs.

### **3.5 FINAL ACCEPTANCE**

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for Final Acceptance requirements.

### **3.6 OPERATION & MAINTENANCE (O&M) MANUALS**

- A. Refer to Section 27 41 00 - AUDIO VIDEO SYSTEMS for O&M Manual requirements with the following alterations and additions:
  1. Additionally include broadcast cabling system testing results under a separate section.

**END OF SECTION**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**TABLE OF CONTENTS**

**DIVISION 28 – SECURITY**

280500	BASIC SECURITY RQUIREMENTS
280520	BASIC SECURITY MATERIALS AND METHODS
280526	GROUNDING AND BONDING FOR SECURITY SYSTEMS
280528	SECURITY SYSTEMS PATHWAYS AND SUPPORT EQUIPMENT
281300	ACCESS CONTROL SOFTWARE AND DATABASE MANAGEMENT
281500	ACCESS CONTROL HARDWARE DEVICES
281523	INTERCOM ENTRY SYSTEM
282300	VIDEO SURVEILLANCE CAMERA SYSTEMS
284110	SECURITY CONTROL ROOM EQUIPMENT

**END OF DIVISION 28 TABLE OF CONTENTS**

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 28 05 00 - BASIC SECURITY REQUIREMENTS****PART 1 - GENERAL**

1.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 00 and Division 01 Specifications Sections, apply to this Section.

**1.2 SPECIAL NOTE**

- A. All provisions of the Division 00 and Division 01 apply to work specified in this Division.
- B. The Electronic Safety and Security drawings and specifications assign work (labor and/or materials) to be provided by the General, Electrical, Communications, Plumbing, Fire Suppression or HVAC Contractor or their sub-contractors. Understanding that the contractors for mechanical and electrical work are sub-contractors to the (General) Contractor, such assignments are not intended to restrict the Contractor in assignment of work among the sub-contractor to accommodate trade agreements and practices or the normal conduct of the construction work.

**1.3 SCOPE OF WORK – ELECTRONIC SAFETY AND SECURITY (ESS)**

- A. The scope of the Electronic Safety and Security work includes furnishing, installing, testing and warranty of all Electronic Safety and Security work and complete Electronic Safety and Security systems shown on the Electronic Safety and Security drawings and specified herein.

**1.4 ALTERNATES**

- A. Refer to the description of Alternates in Division 01 which affect the Electronic Safety and Security work.

**1.5 PERMITS AND REGULATIONS**

- A. Include payment of all permit and inspection fees applicable to the work in this Division. Furnish for the Owner a certificate of approval from the governing inspection agencies, as a condition for final payment.
- B. Work must conform to the National Electrical Code, National Electrical Safety Code and other applicable local, state and federal laws, ordinances and regulations. Where drawings or specifications exceed code requirements, the drawings and specifications shall govern. Install no work contrary to minimum legal standards.
- C. All electrical work shall be inspected and approved by the local jurisdictional authority.
- D. All electrical work shall be inspected and approved by the Alabama Division of Industrial Compliance who will issue the inspection certificate.
- E. Upon completion of work, the Electronic Safety and Security Contractor shall furnish to the consulting State Architect the certificate of inspection and approval before final payment on contract will be allowed.
- F. Final acceptance of all work will also be subject to the approval of the Owner.

**1.6 DRAWINGS AND SPECIFICATIONS**

- A. The drawings indicate the general arrangement of the work and are to be followed insofar as possible. The word "provide", as used, shall mean "furnish and install". If significant deviations from the layout are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted to the Architect for approval before proceeding with the work.
- B. Make all necessary field measurements to ensure correct fitting. Coordinate work with all other trades in such a manner as to cause a minimum of conflict or delay.

- C. The drawings and specifications shall be carefully studied during the course of bidding and construction. Any errors, omissions or discrepancies encountered shall be referred immediately to the Architect for interpretation or correction, so that misunderstandings at a later date may be avoided. The contract drawings are not intended to show every vertical or horizontal offset which may be necessary to complete the systems. Having wireways and fittings fabricated and delivered in advance of making actual measurements shall not be sufficient cause to avoid making offsets and minor changes as may be necessary to install wireways, fittings and equipment.
- D. The Architect shall reserve the right to make minor adjustment in locations of system runs and components where he considers such adjustments desirable in the interest of protecting and concealing work or presenting a better appearance where exposed. Any such changes shall be anticipated and requested sufficiently in advance as to not cause extra work, or unduly delay the work. Coordinate work in advance with all other trades and report immediately any difficulties which can be anticipated.
- E. Equipment, ductwork, piping and electronic safety and security wiring shall not be installed in the dedicated electrical space above or in the working space required around electrical switchgear, motor control centers or panelboards as identified by NEC 110.26 Spaces About Electrical Equipment – 600 Volts Nominal or Less. For equipment rated over 600 volts nominal – 110.32 Work Space About Equipment – 110.33 Entrance and Access to Work Space – 110.34 Work Space and Guarding. The Electronic Safety and Security Contractor shall caution other trades to comply with this stipulation.
- F. Where any system runs and components are so placed as to cause or contribute to a conflict, it shall be readjusted at the expense of the contractor causing such conflict. The Architect's decision shall be final in regard to the arrangement of conduit, etc., where conflict arises.
- G. Provide offsets **in** system runs, additional fittings, necessary conduit, pull boxes, conductors, switches and devices required to complete the installation, or for the proper operation of the system. Each Contractor shall exercise due and particular caution to determine that all parts of the work are made quickly and easily accessible.
- H. Should overlap of work among the trades become evident, this shall be called to the attention of the Architect. In such event, none of the trades or their suppliers shall assume that he is relieved of the work which is specified under his branch until instructions in writing are received from the Architect.

### 1.7 ASBESTOS MATERIALS

- A. Abatement, removal or encapsulation of existing materials containing asbestos is not included in the Electronic Safety and Security Contract. Necessary work of this nature will be arranged by the Owner to be done outside of this construction and remodeling project by a company regularly engaged in asbestos abatement. Such work will be scheduled and performed in advance of work in the construction and remodeling project.
- B. If, in the performance of the Electronic Safety and Security work, materials are observed which are suspected to contain asbestos, the Electronic Safety and Security Contractor shall immediately inform the Architect/Engineer who in turn will notify the Owner. Work that would expose workers to the inhalation of asbestos particles shall be terminated. Work may be resumed only after a determination has been made and unsafe materials have been removed or encapsulated and the area declared safe.

### 1.8 INSPECTION

- A. All work shall be subject to inspection of Federal, State and local agencies as may be appropriate, and of the Architect and Engineer.
- B. Final inspection certificates shall be obtained by the Contractor and given to the Owner.

**1.9 RECORD DRAWINGS**

- A. The Electronic Safety and Security Contractor shall maintain a separate set of prints of the contract documents and shall show all changes or variations, in a manner to be clearly discernible, which are made during construction. Upon completion of the work, these drawings shall be turned over to the Architect. This shall apply particularly to underground and concealed work, and to other systems where the installation varies to a degree which would justify recording the change.

**1.10 OPERATING AND MAINTENANCE MANUALS**

- A. Two copies each of operating and maintenance manuals shall be assembled for the Electronic Safety and Security work by the Contractor.
- B. All shop drawings and installation, maintenance and operating instruction pamphlets or brochures, wiring diagrams, parts list, and other information, along with warranties, shall be obtained from each manufacturer of the principal items of equipment. In addition, the Contractor shall prepare a chart listing all items of equipment which are furnished under his contract and indicating the nature of maintenance required, the recommended frequency of checking these points and the type of lubricating media or replacement material required.
- C. Standard NEMA publications on the operation and care of equipment may be furnished in lieu of manufacturer's data where the manufacturer's instructions are not available.
- D. These shall be assembled into three-ring loose leaf binders or other appropriate binding. An index and tabbed sheets to separate the sections shall be included. These shall be submitted to the Architect or Engineer for review. Upon approval, manuals shall be turned over to the Owner.
- E. O & M manuals shall contain the following information at a minimum:
  - 1. Copies of all approved shop drawings with the Engineer's stamp.
  - 2. Owner's manuals for every item of equipment when available from the manufacturer. These shall be the technical manuals provided by the manufacturer and shall not consist of generic sales brochures. Technical manuals shall provide complete specifications for the equipment as well as complete operating, maintenance, troubleshooting and product repair/replacement information. Where available only in electronic format, the contractor may provide a CD with electronic versions of Owner's manuals. CDs containing electronic versions of Owner's manuals must contain the proper software viewers for each document type.
  - 3. Electronic Safety and Security drawings updated with final as-built information.
  - 4. This shall be in the form of a complete set of Electronic Safety and Security drawings with as-built information indicated in colored pen based upon actual field conditions.
  - 5. System schematic and block diagrams for every system updated with final as-built information. These drawings shall define the exact arrangement of each system including wiring configuration, device locations and cable types.
  - 6. Rack elevations for all systems with rack mounted equipment.

**1.11 FINAL INSPECTION AND PUNCH LIST**

- A. As the time of work completion approaches, the Contractor shall survey and inspect his work and develop his own punch list to confirm that it is complete and finished. He shall then notify the Architect and request that a final inspection be made. It shall not be considered the Architect's or Engineer's obligation to perform a final inspection until the Contractor has inspected the work and so states at the time of the request for the final inspection.

- B. Requests to the Architect, Engineer or Owner for final inspection may be accompanied by a limited list of known deficiencies in completion, with appropriate explanation and schedule for completing these; this is in the interest of expediting acceptance for beneficial occupancy.
- C. The Architect and/or Engineer will inspect the work and prepare a punch list of items requiring correction, completion or verification. Corrective action shall be taken by the Contractor to the satisfaction of Architect and Engineer within 30 days of receipt of the Architect/Engineer's punch list.

#### **1.12 WARRANTY**

- A. This Contractor shall warrant all workmanship, equipment and material entering into this contract for a period of one (1) year or the period of time as per specific specification section from the date of approval of certificate of contract completion by the Owner. Refer to General Conditions. Any materials or equipment proving to be defective during this warranty period shall be made good by this Contractor without expense to the Owner.
- B. This provision is intended specifically to cover deficiencies in contract completion or performance which are not immediately discovered after systems are placed in operation. These items include, but are not limited to replacement of malfunctioning equipment and adjusting special equipment and communication systems to obtain optimum performance.
- C. This provision shall not be construed to include maintenance items such as making normally anticipated adjustments or correcting adjustment errors on the part of the Owner's personnel.
- D. Provisions of this warranty shall be considered supplementary to warranty provisions under General Conditions.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS AND EQUIPMENT**

- A. Materials and equipment furnished under this contract shall be in strict accordance with the specifications and drawings and shall be new and of best grade and quality. When two or more articles of the same material or equipment are required, they shall be of the same manufacturer.
- B. All electrical equipment and wiring shall bear the Underwriters Laboratories, Inc. label where UL labeled items are available, and shall comply with NEC (NFPA-70) and NFPA requirements.

#### **2.2 REFERENCE STANDARDS**

- A. Where standards (NFPA, NEC, ASTM, UL, etc.) are referenced in the specifications or on the drawings, the latest edition is to be used except, however, where the authority having jurisdiction has not yet adopted the latest edition, the edition so recognized shall be used.

#### **2.3 EQUIPMENT SELECTION**

- A. The selection of materials and equipment to be furnished under this contract shall be governed by the following:
  - 1. Where trade names, brands, or manufacturers of equipment or materials are listed in the specification, the exact equipment listed shall be furnished. Where more than one name is used, the Contractor shall have the option of selecting between any one of the several specified. All products shall be first quality line of manufacturers listed.
  - 2. Where the words "or approved equal" appear after a manufacturer's name, specific approval must be obtained from the Architect during the bidding period in sufficient time to be included in an addendum. The same shall apply for equipment and materials not named in the specifications, where approval is sought.

3. Where the words "equal to" appear, followed by a manufacturer's name and sometimes a model or series designation, such designation is intended to establish quality level and standard features. Equal equipment by other manufacturers will be acceptable, subject to the Engineer's approval.
- B. Substitute equipment of equal quality and capacity will be considered when the listing of such is included as a separate item of the bid. State the deduction or addition in cost to that of the specified product.
- C. Before bidding equipment, and again in the preparation of shop drawings, the Contractor and his supplier shall verify that adequate space is available for entry and installation of the item of equipment, including associated accessories. Also verify that adequate space is available for servicing of the equipment and that required NEC clearances are met.
- D. If extensive changes in conduit, equipment layout or electrical wiring and equipment are brought about by the use of equipment which is not compatible with the layout shown on the drawings, necessary changes by all other trades shall be deemed to be included in the contract.

## **2.4 SHOP DRAWINGS**

- A. Six sets of shop drawings and descriptive information shall be assembled by each Contractor of equipment and materials furnished in his contract, and submitted to the Architect and/or Engineer for review as stated in the General Conditions and Supplementary Conditions. These shall be submitted as soon as practicable and before installation and before special equipment is manufactured. Submittal information shall clearly identify the manufacturer, specific model number, approval labels, performance data, electrical characteristics, features, specified options and additional information sufficient to evidence compliance with the contract documents. Shop drawings for equipment, fixtures, devices and materials shall be labeled and identified same as on the Contract Documents. If compliance with the above criteria is not provided shop drawings will be subject to rejection and returned without review.
- B. The review of shop drawings by the Architect or Engineer shall not relieve the Electronic Safety and Security Contractor from responsibility for errors in the shop drawings. Deviations from specifications and drawing requirements shall be called to the Engineer's attention in a separate clearly stated notification at the time of submittal for the Engineer's review.

## **PART 3 - EXECUTION**

### **3.1 TESTING**

- A. As each wiring system is completed, it shall be tested for continuity and freedom from grounds.
- B. As each electrically operated system is energized, it shall be tested for function.
- C. The Contractor shall perform meager and resistance tests and special tests on any circuits or equipment when an authorized inspection agency suspects the system's integrity or when requested by the Architect or Engineer.
- D. All signaling and communications systems shall be inspected and tested by a qualified representative of the manufacturer or equipment vendor. Refer to specific section for required tests of the various systems. Submit four (4) copies of reports indicating results.
- E. Tests shall be witnessed by field representatives of the Architect or Engineer or shall be monitored by a recorder. Furnish a written record of each system test indicating date, system, test conditions, duration and results of tests. Copies of all test reports shall be included in the O&M manuals.
- F. Instruments required for tests shall be furnished by the Contractor.

**3.2 EQUIPMENT CLEANING**

- A. Before placing each system in operation, the equipment shall be thoroughly cleaned; cleaning shall be performed in accordance with equipment manufacturer's recommendations.
- B. Refer to appropriate Sections for cleaning of other equipment and systems for normal operation.

**3.3 OPERATION AND ADJUSTMENT OF EQUIPMENT**

- A. As each system is put into operation, all items of equipment included therein shall be adjusted to proper working order. This shall include balancing and adjusting voltages and currents; verifying phase rotation; setting breakers, ground fault and other relays, controllers, meters and timers; and adjusting all operating equipment.

**3.4 OPERATING DEMONSTRATION AND INSTRUCTIONS**

- A. The Contractor shall set the various systems into operation and demonstrate to the Owner and Architect that the systems function properly and that the requirements of the Contract are fulfilled.
- B. The Contractor shall provide the Owner's representatives with detailed explanations of operation and maintenance of equipment and systems. A thorough review of the operating and maintenance manuals shall be included in these instructional meetings.
- C. O & M Manuals shall be submitted, reviewed and approved prior to scheduling of demonstrations.
- D. A minimum of 24 hours shall be allowed for instructions to personnel selected by the Owner. Instructions shall include not less than the following:
  - 1. Show location of items of equipment and their purpose.
  - 2. Review binder containing instructions and equipment and systems data.
  - 3. Coordinate written and verbal instructions so that each is understood by personnel.
  - 4. Manufacturer's representatives for the various special and communication systems shall give separate instructions.
- E. A minimum of 48 hours continuous trouble-free operating time shall be acceptable to prove that the systems function properly.
- F. Note that additional time for training, operating time, etc. may be required per other specification sections and shall be included. This section only establishes minimum requirements.

**END OF SECTION 28 05 00**

**SECTION 280520 - BASIC SECURITY MATERIALS AND METHODS****PART 1 - GENERAL**

- 1.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 00 and Division 01 Specifications Sections, apply to this Section.
- 1.2 Temporary Electronic Safety and Security Services
- A. The temporary Electronic Safety and Security for construction is provided by the Electronic Safety and Security Contractor. Refer to Division 01 – General Requirements.
  - B. The use of the permanent Electronic Safety and Security system for temporary services during the latter stages of construction shall be allowed. Expedite completion of system as practicable to this end. Maintain the system during this period.
  - C. Warranty periods on equipment, materials and systems shall commence upon Owner acceptance of the building or systems. Temporary use shall not jeopardize or alter warranty requirements.
  - D. The complete temporary service shall comply with Owner Facility, OSHA and all Code requirements.

**1.3 CONTINUITY OF SERVICE**

- A. Work shall be so planned and executed as to provide reasonable continuous service of existing systems throughout the construction period. Where necessary to disrupt services for short periods of time for connection, alteration or switch-over, the Owner shall be notified in advance and outages scheduled at the Owner's reasonable convenience.
- B. Submit, on request, a written step-by-step sequence of operations proposed to accomplish this work. The outline must include tentative dates, times of day for disruption, downtime and restoration of services. Submit the outline sufficiently in advance of the proposed work to allow the Architect or Engineer to review the information with the Owner. Upon approval, final planning and the work shall be done in close coordination with the Owner.
- C. Shutdown of systems and work undertaken during shutdowns shall be bid as being done during normal working hours. If the Owner should require such work be performed outside of normal working hours, reimbursement shall be made for premium time expenses only, without mark-up.

**PART 2 - PRODUCTS****2.1 ACCESS PANELS**

- A. Ceiling and wall access panels shall be provided where indicated on the drawings, or where otherwise required to gain access to concealed junction boxes, pull boxes, devices and equipment requiring service or adjustment.
- B. All proposed access panel sizes and locations shall be approved by the Architect and Design team prior to installation.
- C. Access panels (refer to paragraph C. below for more specialized drywall ceiling access panels) shall be steel construction (except where aluminum or stainless steel is specified) with concealed hinge and door with screwdriver lock. Locks in "secured" areas of the building shall have tamperproof screws. Panels shall be 18" x 18" size unless larger panels are shown or required. Mounting frames shall be compatible with the material in which they are installed. Access panels shall be:
  - 1. Standard flush type with overlapping flange for masonry and tile walls.
  - 2. Recessed type having the door recessed to accept a drywall panel insert, for drywall ceilings and walls.

3. Standard flush type for drywall ceilings and walls.
- D. Access panels in drywall ceilings shall be glass reinforced gypsum drywall lay-in panels with flush mounting frames. Corners of panels shall be rounded. Panels shall be 18" x 18" unless larger panels are shown or required.
- E. Access panels in fire rated shaft walls and in fire rated ceilings shall be "B" label or greater to match the rating of the wall or ceiling.
- F. Materials used in plenums shall be rated for plenum use conforming to the 25/50 smoke development and flame spread restrictions.

### **PART 3 - EXECUTION**

#### **3.1 WORKMANSHIP**

- A. Materials and equipment shall be installed and supported in a first-class and workmanlike manner by mechanics skilled in their particular trades. Workmanship shall be first-class in all respects, and the Architect shall have the right to stop the work if highest quality workmanship is not maintained.
- B. Electrical work shall be performed by a licensed Electrical Contractor in accordance with requirements of the jurisdiction.
- C. Electronic Safety and Security work shall be performed by certified contractor in accordance with the respective specification and system requirements.

#### **3.2 PROTECTION**

- A. Each Contractor shall be entirely responsible for all material and equipment furnished in connection with his work. Special care shall be taken to properly protect all parts thereof from theft, damage or deterioration during the entire construction period in such a manner as may be necessary, or as directed by the Architect.
- B. The Owner's property and the property of other contractors shall be scrupulously respected at all times. Provide drop cloths and visqueen or similar barriers where dust and debris is generated, to protect adjacent areas.

#### **3.3 CUTTING AND PATCHING NEW BUILDINGS**

- A. Refer to Division 01 - General Requirements for information regarding cutting and patching.
- B. Plan the work well ahead of the general construction. Where conduits, wireways and cable trays are to pass thru walls, partitions, floors, roof or ceilings, place sleeves in these elements or arrange with the General Contractor to provide openings where sleeves are not practical. Where sleeves or openings have not been installed, saw-cut or core drill holes and patch as required for the installation of this work, or pay other trades for doing this work when so directed by the Architect. Any damage caused to the building in this work shall be repaired or rectified.
- C. All sleeves and openings not used or partially used shall be closed to prevent passage of smoke and fire.

#### **3.4 PAINTING**

- A. In addition to any painting specified for various individual items of equipment, the following painting shall be included in the Electronic Safety and Security Contract:
  1. Ferrous metal which is not factory or shop painted or galvanized and which remains exposed to view in the building including finished areas, mechanical rooms, storage rooms, and other unfinished areas shall be given a prime coat of paint and two finish coats of paint.
  2. Ferrous metal installed outside the building which is not factory or shop painted or galvanized shall be given a prime coat of paint and two finish coats of paint.



3. Equipment and materials which have been factory or shop coated (prime or finished painted or galvanized), on which the finish has been damaged or has deteriorated, shall be cleaned and refinished equal to its original condition. The entire surface shall be repainted if a uniform appearance cannot be accomplished by touch-up.
  4. Apply Z.R.C. Galviline / 221 cold galvanizing compound, or approved equal, for touch-up and repair of previously galvanized surfaces.
- B. Each backboard shall be painted with a minimum of two coats of flame retardant paint, all sides; gray enamel primer with gray matte enamel finish.
  - C. Paint, surface preparation and application shall conform to applicable portions of the Painting section of Division 01 of the Specifications. All rust must be removed before application of paint.
  - D. Finish painting is included in the General Contract except where otherwise required under remodeling work. Refer to the Cutting and Patching paragraph in this Section for finishing requirements.

### **3.5 ACCESS PANELS**

- A. Access panels shall be turned over to the General Contractor for installation.
- B. Access locations thru HVAC ductwork must be coordinated with the ductwork installer. Location of the hinged access door with latch must be coordinated in advance with the HVAC Contractor.
- C. Location of access panels shall be planned to clear ceiling lights, ceiling support grids and other obstructions so as to allow, wherever possible, full shoulder clearance beside the device to be inspected, adjusted or repaired.
- D. Panels with recessed doors are to be fitted with insert panels of drywall or, those for plaster, infilled with plaster. Caution the Installing Contractor to provide appropriate framing with drywall or plaster beading to ensure a finished appearance. Shim strips may be required to bring the insert panel flush with the plane of the door and wall / ceiling.

### **3.6 BACKBOARDS**

- A. Where shown on the drawings, backboards shall be provided for wall mounting of disconnect switches, devices and Electronic Safety and Security equipment. The Contractor may opt to mount additional groups of disconnect switches on backboards.
- B. General
  1. Backboard shall be 0.75" thick waterproof flame retardant plywood secured to structure.
  2. Each board shall be painted.
  3. Electronic Safety and Security backboards shall be normally 4 ft. x 8 ft. mounted 6" above floor where located on drawings. Where other sizes are required, they will be noted on the drawings.
- C. Each terminal cabinet for Electronic Safety and Security systems, relays, etc., shall be fitted with a full size 0.50" thick backboard for mounting terminal strips, equipment, etc.

END OF SECTION 280520

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 280526 - GROUNDING AND BONDING FOR SECURITY SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 00, and Division 01 Specifications Sections, apply to this Section.

**1.2 TECHNOLOGY GROUNDING DESCRIPTION**

- A. Provide a PRIMARY BONDING BUSBAR (PBB) in TC-01. This ground bar shall be electrically bonded to the Building Main Electrical Service Ground with a minimum insulated, #2/0, copper grounding conductor.
- B. Provide a SECONDARY BONDING BUSBAR (SBB) in each TC and at the telephone and CATV service entrance points.
- C. Provide a Telecommunications Bonding Conductor (TBC) from each SBB to a local electrical panelboard ground bus. This backbone shall consist of a minimum #6, bare copper grounding conductor. The TBC shall be bonded to the ground bars at each end. Provide a warning label attached to each Telecommunications Bonding Conductor Backbone at each end stating "WARNING: Building telecommunications grounding system. Do not remove or disconnect without prior approval from building Telecommunications Department."
- D. Provide bonding between all joints of cable tray and ladder rack. Provide bonding to all conduit sleeves. Provide bonding to all technology equipment racks and cabinets within each wiring closet. Provide bonding from the Technology grounding system to the telephone and CATV demarc equipment and protector panels. Coordinate this grounding prior to installation of telephone and CATV services.
- E. This contract shall be responsible for providing all equipment, cable tray, ladder rack, conduit and sleeve grounding in each TC to the grounding system installed under Division 26.
- F. All work shall be in compliance with NEC, Article 250 and ANSI/TIA-607.

**PART 2 - PRODUCTS****2.1 GENERAL**

- A. Grounding rods shall be copper clad, molten-welded copper to steel; unless otherwise designated, 0.625" diameter x 10 ft. long.
- B. Clamps and continuity devices shall be non-ferrous material, UL approved. Connections to ground rods and all underground connections shall be "Thermoweld" or "Cadweld".
- C. Ground conductors shall be insulated, identified by green insulation or by painting or taping green at all accessible locations and shall be connected with approved connectors and terminators to boxes, devices, equipment, etc. and to ground bars in panels.

**2.2 PRIMARY BONDING BUSBAR (PBB)**

- A. Ground bar shall be solid copper, 4" high, .25" thick, minimum 36" long with pre-drilled, 1" hole centers for anticipated large (2) hole lug count, pre-drilled, 5/8" hole centers for anticipated small (2) hole lug count and must be UL listed. Provide final length as required to accommodate grounding lug attachments.
- B. Ground bars shall be provided with insulated stand-off brackets for wall mounting providing a minimum of 2" wall clearance. Insulators shall have a minimum voltage rating of 600V and a minimum Short Time Electrical Strength of 55kVv.
- C. Manufactured by StormCopper or equal by B-Line, Andrew, Tessco Technologies, Harger.

**2.3 SECONDARY BONDING BUSBAR (SBB)**

- A. Ground bar shall be solid copper, 4" high, .25" thick, minimum 12" long with pre-drilled, 1" hole centers for anticipated large (2) hole lug count, pre-drilled, 5/8" hole centers for anticipated small (2) hole lug count and must be UL listed. Provide final length as required to accommodate grounding lug attachments.
- B. Ground bars shall be provided with insulated stand-off brackets for wall mounting providing a minimum of 2" wall clearance. Insulators shall have a minimum voltage rating of 600V and a minimum Short Time Electrical Strength of 55kVv.
- C. Bus bar and standoff assembly manufactured by StormCopper or equal by B-Line, Andrew, Tessco Technologies, Hubbell, Harger.

**2.4 TELECOMMUNICATIONS BONDING CONDUCTOR (TBC)**

- A. Insulated Conductors - Soft, annealed bare copper per ASTM B-3. Concentric, compressed stranded (class B or C Alternate ASTM B-787) per ASTM B-8, UL-83 and UL-854. Insulation Jacket: Nylon per UL-83. Insulation: High dielectric polyvinyl chloride per UL-83 and UL-854.
- B. Uninsulated Conductor: Soft, annealed bare copper per ASTM B-3. Stranded as specified herein. Overall Finish: Gray polyvinyl chloride (PVC) per UL-824.
- C. RATINGS - Cables conform to the following standards:
  - 1. UL-83 for THHN-THWN Cdrs.
  - 2. Federal Specification J-C-30B
- D. Cable as manufactured by Superior/Essex, Rome, AIWC.

**2.5 BONDING CONDUCTORS**

- A. Conductor shall be minimum #6AWG and may be either stranded or solid, insulated or bare.
- B. Cable as manufactured by Superior/Essex, Rome, AIWC.

**PART 3 - EXECUTION****3.1 GENERAL**

- A. Wiring devices shall be connected with grounding jumper from ground pole on device to grounding screw in the outlet box.
- B. The complete metal conduit system shall be used for the equipment grounding system. Conduit systems and associated fittings and terminations shall be made mechanically tight to provide a continuous electrical path to ground and shall be safely grounded at all equipment by bonding all metallic conduit to the equipment enclosures with locknuts cutting thru paint or enclosures. Bond all conduits entering primary switchgear, pad-mount transformers, unit substations, emergency generator control panel and main breaker panel, and secondary service entrance switchboard with a ground wire connecting the grounding type bushings to the equipment ground bar. Conductors shall be sized per NEC Tables 250-66 and 250-122. Bond all communications conduit systems to ground.
- C. In addition to using the conduit system for grounding, a complete auxiliary green wire equipment grounding system shall be installed, continuous from main ground, thru distribution and branch circuit panelboards and paralleling all feeders and branch circuit wiring. Grounding conductor sizes shall comply with NEC Table 250-122, minimum size shall be #12 copper except #14 on control circuits. This shall apply to all circuits rated 100 volts or more above ground potential.
- D. Connect ground terminal on wiring devices to auxiliary green wire equipment grounding system.

- E. Ground neutral of all transformers for separately derived systems. Grounds may be to the street side of the main water service, thru a set of interconnected ground rods, or to other NEC approved electrodes.
- F. Cord connected appliance frames shall be grounded to the equipment grounding system thru a green wire in the cord.
- G. A green grounding conductor shall be installed in each non-metallic conduit and all flexible conduits, including exterior underground conduits.
- H. System neutral connections shall be insulated from metal enclosures except at the neutral of the service entrance equipment and on the neutral of a separately derived system. Connections to the main switchgear enclosure shall be made by means of bonding jumpers.
- I. The building neutral shall be identified throughout with white conductors. Where there are neutral conductors from a separately derived system (such as 120/208 volt, 3 phase, 4 wire where the main building service is 277/480 volt, 3 phase, 4 wire) the neutrals of the two systems shall be separately identifiable per NEC Article 200.

### **3.2 GROUNDING/BONDING CONNECTIONS**

- A. Ground all backbone cable sheaths, shield drain wires from all voice/data horizontal cable, equipment racks and equipment to the local PBB/SBB.
- B. All grounding and bonding shall be in conformance with the National Electric Code, article 250 and as recommended by ANSI/TIA-607.
- C. All joints of all cable tray and ladder rack shall be bonded together. When bonding to painted equipment, methods shall be utilized to ensure continuity of grounding connection.
- D. Telephone, CATV Service entrance equipment, and primary protection panels shall be bonded to the technical grounding system. Coordinate with serving utilities regarding configuration of grounding connections.
- E. All connection to ground bars (SBB, PBB) shall be made using listed lugs appropriate for mounting provisions in the supplied ground bar.

### **3.3 TESTING GENERAL**

- A. The Contractor shall be responsible for testing the complete technology grounding system.
- B. No testing shall be executed until the entire system has had the Owner approved labeling scheme applied and accepted.
- C. Test reports shall be provided to indicate.
  - 1. Impedance values across each TBB from the PBB to the SBB.
  - 2. Impedance values across the TBC from the PBB to the main electrical service ground.
  - 3. Impedance values across each GE between SBB on a common floor.
- D. Tests shall be witnessed by Architect / Engineer / Owner and shall be monitored by a recorder.
- E. System testing shall be performed with final test results turned over to the Owner prior to acceptance of the system. Missing or incomplete test results will not be reviewed, and the system will not be commissioned by the Owner / Architect / Engineer.
- F. Instruments and labor required for tests shall be furnished by the Contractor. All system test equipment shall be approved by the Owner/ Architect / Engineer prior to application.
- G. Instruments required for tests shall be furnished by the Contractor.

**3.4 LABELING**

- A. The Contractor shall be responsible for labeling all telecommunications grounding equipment, cable, etc. in accordance with the guidelines as described herein.
- B. Each SECONDARY BONDING BUSBAR shall be provided with a warning label to read:
  - 1. "WARNING: Building telecommunications grounding system. Do not remove or disconnect without prior approval from building Telecommunications Department."
- C. Each Telecommunications Bonding Conductor to be provided with a label indicating source and destination ground bars.

**3.5 AS-BUILT DOCUMENTATION**

- A. Refer to Section 27 05 00 for submittal requirements.
- B. Copies of all approved shop drawings with the Engineer's stamp.
- C. Copy of all test reports.
- D. Technology drawings updated with final as-Built information. This shall be in the form of a complete set of Technology drawings with as-built information indicated in colored pen based upon actual field conditions.
- E. System schematic and block diagrams for technology grounding system updated with final as-built information. These drawings shall define the exact arrangement of each system including wiring configuration, device locations and cable types.

**END OF SECTION 280526**

**SECTION 280528 - SECURITY SYSTEMS PATHWAYS AND SUPPORT EQUIPMENT****PART 1 - GENERAL**

- 1.1 Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
- 1.2 Source Limitations: Obtain cable trays and components from single manufacturer.
- 1.3 Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
- 1.4 Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
- 1.5 Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
- 1.6 Concentrated Load: A load applied at midpoint of span and centerline of tray.
- 1.7 Load and Safety Factors: Applicable to both side rails and rung capacities.

**PART 2 - PRODUCTS****2.1 CABLE MANAGEMENT SYSTEM**

- A. Provide pre-manufactured cable supports as manufactured by Panduit, Caddy, Mineralac or Rayco. Cable supports shall be secured to building structure through threaded rod, beam clamps or other UL approved supports as required by site conditions. Components shall provide a minimum cable support point spacing of 60".
- B. Cable management devices must be sized to accommodate 100% spare capacity of the final installed cable base.
- C. Cable management system support components shall be designed with wide support surfaces that do not cause cables to be bend, crushed or otherwise deformed when installed within component loading parameters. Cable management system shall meet UL standards and be UL labeled. Utilizing elements of the building's structure such as beams, joists, etc. to hang cable from will not be acceptable.
- D. Bridle rings shall not be acceptable.
- E. Refer to Section 270528 "Pathways for Communications" for back boxes, etc.

**PART 3 - EXECUTION****3.1 GENERAL INSTALLATION**

- A. Refer to "TN" drawings for pathway types, locations and routing.
- B. Cable pathways shall provide the following minimum clearances:
  1. Motors and transformers – 4 ft.
  2. Conduit and cable used for electrical power distribution – 1 ft.
  3. Fluorescent lighting – 5 inches.
  4. Power lines up to 5 kV – 5 inches.
  5. Power lines over 5 kV. – 24 inches.

- C. Backboards and cabinets shall be installed for Electronic Safety and Security in TRs and rooms/spaces to support Electronic Safety and Security equipment and wiring. Coordinate locations of backboards and cabinets with the Owner prior to installation.
- D. Restore fire rating and smoke stoppage integrity where all wireways, raceways and cable trays pierce walls, floors and ceilings by sealing with approved means.
- E. Provide necessary pathways in areas that have exposed structure or plastered ceilings to provide a wiring path for cables from area above suspended ceilings to respective backboards.
- F. No non-metallic or combustible materials shall be installed in ceiling or other plenums used for circulating room air used for heating, ventilation or cooling.

### **3.2 CONDUIT SYSTEMS**

- A. No section of conduit shall be longer than 100 feet between pulling points.
- B. No more than two 90 degree bends in a section of conduit between pulling points.
- C. Each section of conduit shall be labeled for length, destination closet and origination closet.
- D. Refer to EIA/TIA 569-A and Section 270528 "Pathways for Communications" for specific conduit and pull box requirements.
- E. Conduit and wiring above accessible ceilings shall be run as high as possible, above piping and ductwork, so as to not interfere with mechanical trades, access to mechanical and electrical devices and to allow freedom to remove ceiling panels.
- F. Provide a No. 12 gauge pull wire or nylon pull cord in each empty conduit run.

### **3.3 WIREWAYS**

- A. Wireways shall be supported with factory made hangers designed expressly for this purpose and 0.375" diameter solid hanger rods approximately 5 ft. on center or approved strap hangers for surface mounting.

### **3.4 CABLE MANAGEMENT SYSTEM**

- A. The drawings do not indicate specific routes for cables. The Electronic Safety and Security Contractor is responsible for developing all cabling routes utilizing existing cable management pathways and systems or providing supplemental management pathways and systems so that all structured cabling adhere to specific codes and standards specifically developed for the installation of such cables. Where the use of existing cable management systems and pathways would cause the structured cable system to violate specific codes and standards regarding cable lengths, environments, proximity to EMI and RF noise sources, etc., the Electronic Safety and Security Contractor shall be responsible for developing alternative pathways and shall include all labor and material for doing so within the scope of this work.
- B. In areas where there is not an installed raceway system (conduits or cable tray) and a cable support system is required, this contract shall be responsible for providing a cable management system. Where cables are installed open wired through the use of cable management systems, they shall be installed such that there is a minimum sag of 4 inches for every 4 foot of horizontal run. Cable pathways shall provide the following minimum clearances:
  - 1. Motors and transformers – 4'.
  - 2. Conduit and cable use for electrical power distribution – 1'.
  - 3. Fluorescent lighting – 5".
  - 4. Power lines up to 2kVA – 5".
  - 5. Power lines over 5kVA – 24" cable management system shall be secured to building structure utilizing manufactured approved methods and hardware.



- C. Cable management system support components shall be designed with wide support surfaces that do not cause cables to be bent, crushed or otherwise deformed when installed within component loading parameters. Cable management system shall meet UL standards and be UL labeled. Utilizing elements of the building's structure such as beams, joists, etc. to hang cable from will not be acceptable.

### **3.5 IDENTIFICATION / LABELING**

- A. All continuous Electronic Safety and Security pathways such as conduit, cable tray, etc. shall be labeled to indicate origination and destination. Label shall be applied every 50' wherever accessible or subject to administration. Coordinate label information with Owner.
- B. Label shall consist of mechanically printed, permanent adhesive label, applied to cleaned / prepped area of raceway.

### **3.6 AS-BUILT DOCUMENTATION**

- A. Provide a complete set of architectural floor plan drawings indicating final communications pathway systems with accurate "as-built" locations to show the actual route for the communications systems pathways.
- B. Drawings shall indicate each pathway type and provide sizing information such as conduit/innerduct diameter, cable tray width, cable management ring size, etc.
- C. Component Service Manuals: Include information for testing, repair, troubleshooting, assembly, disassembly, and required / recommended maintenance intervals for all types of pathways.

### **3.7 FIRESTOPPING**

- A. Restore fire rating and smoke stoppage integrity where all wireways, raceways and cable trays pierce walls, floors and ceilings by sealing with approved means.
- B. Refer to Division 26/27 for firestopping requirements.
- C. Note: When using cable tray and tray rated cables in industrial establishments, coordinate any specific fire ratings / protection with Owner and Plumbing Designer – Factory Mutual, Industrial Risk Insurers (IRI) and ISO may require added fire rating requirements such as special cable insulation or foaming open cables in cable trays. Also, be aware of spaces above ceilings being used for air plenums.

**END OF SECTION 280528**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 281300 - ACCESS CONTROL SOFTWARE AND DATABASE MANAGEMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Security access central-control station.
  - 2. One or more security access networked workstations.
  - 3. Security access operating system and application software.
  - 4. Security access controllers connected to high-speed electronic-data transmission network.
- B. Related Requirements:
  - 1. Section 281500 "Access Control Hardware Devices" for access control system hardware, such as keypads, card readers, and biometric identity devices.

**1.3 DEFINITIONS**

- A. Credential: Data assigned to an entity and used to identify that entity.
- B. Central Station: Central station shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring. Central station shall control system networks to interconnect all system components, including workstations and field-installed controllers.
- C. DTS: Digital Termination Service. A microwave-based, line-of-sight communication provided directly to the end user.
- D. Identifier: A credential card; keypad personal identification number; or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- E. Location: A Location on the network having a workstation-to-controller communications link, with additional controllers at the Location connected to the workstation-to-controller link with a TIA 485-A communications loop. Where this term is presented with an initial capital letter, this definition applies.
- F. Workstation: Personal computer. Applies to the central station, workstations, and file servers.
- G. RAS: Remote access services.
- H. RF: Radio frequency.
- I. ROM: Read-only memory. ROM data are maintained through losses of power.
- J. TCP/IP: Transport control protocol/Internet protocol.

- K. TWAIN: Technology without an Interesting Name. A programming interface that lets a graphics application, such as an image editing program or desktop publishing program, activate a scanner, frame grabber, or other image-capturing device.
- L. WMP: Windows media player.
- M. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.
- N. WYSIWYG: What You See Is What You Get. Text and graphics appear on the screen the same as they will in print.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings. Test and evaluation data presented in Product Data shall comply with SIA.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Diagrams for cable management system.
  - 2. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in both Parts 2 and 3.
  - 3. Wiring Diagrams. For power, signal, and control wiring. Show typical wiring schematics including the following:
    - a. Workstation outlets, jacks, and jack assemblies.
    - b. Patch cords.
    - c. Patch panels.
  - 4. Cable Administration Drawings: As specified in "Identification" Article.
  - 5. Battery and charger calculations for central station, workstations, and controllers.
- C. Product Schedules.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Workstation operating system documentation.
  - 2. Workstation installation and operating documentation, manuals, and software for the workstation and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each workstation.
  - 3. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on USB, cloud media of the hard-copy submittal.
  - 4. System installation and setup guides with data forms to plan and record options and setup decisions.

**1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Laser Printers for Badge Printing: Three toner cassettes and one replacement drum unit.
  - 2. Credential card blanks, ready for printing. Include enough credential cards for all personnel to be enrolled at the site plus an extra 50 percent for future use.
  - 3. Fuses of all kinds, power and electronic, equal to 10 percent of amount installed for each size used, but no fewer than three units.

**1.7 QUALITY ASSURANCE**

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
  - 1. Cable installer must have on staff an RCDD certified by Building Industry Consulting Service International.
  - 2. Installer must be certified by manufacturer.
- B. Source Limitations: Obtain controllers, Identifier readers, and all software through one source from single manufacturer.

**1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Central Station, Workstations, and Controllers:
  - 1. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F, and not more than 80 percent relative humidity, noncondensing.
  - 2. Open each container; verify contents against packing list; and file copy of packing list, complete with container identification, for inclusion in operation and maintenance data.
  - 3. Mark packing list with the same designations assigned to materials and equipment for recording in the system labeling schedules that are generated by software specified in "Cable and Asset Management Software" Article.
  - 4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

**1.9 PROJECT CONDITIONS**

- A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
  - 1. Control Station: Rated for continuous operation in ambient conditions of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.
  - 2. Indoor, Controlled Environment: NEMA 250, Type 1 enclosure. System components, except the central-station control unit, installed in temperature-controlled indoor environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.
  - 3. Indoor, Uncontrolled Environment: NEMA 250, Type 3R, Type 4 enclosures. System components installed in non-temperature-controlled indoor environments shall be rated for continuous operation in ambient conditions of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.

4. Outdoor Environment: NEMA 250, NEMA 250, Type 3, Type 4 enclosures. System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 85 mph.
5. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
6. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X enclosures.

## **PART 2 - PRODUCTS**

### **2.1 ACCESS CONTROL SOFTWARE**

- A. Lenel (Basis of Design)
- B. Genetec
- C. Honeywell
- D. Tyco
- E. Or Equal

### **2.2 DESCRIPTION**

- A. Security Access System: Workstation-based central station, one or more networked workstation-based workstations, and field-installed controllers, connected by a high-speed electronic-data transmission network.
- B. System Software: Based on 64-bit, central-station, workstation operating system, server operating system, and application software. Software shall have the following capabilities:
  1. Multiuser and multitasking to allow for independent activities and monitoring to occur simultaneously at different workstations.
  2. Graphical user interface to show pull-down menus and a menu-tree format that complies with interface guidelines of the operating system.
  3. System license for the entire system including capability for future additions that are within the indicated system size limits specified in this Section.
  4. Open-architecture system that allows importing and exporting of data and interfacing with other systems that are compatible with operating system.
  5. Password-protected operator login and access.
  6. Open-database-connectivity compliant.
- C. Network connecting the central station and workstations shall be a LAN using TCP/IP with a capacity of connecting up to 99 workstations. System shall be portable across multiple communication platforms without changing system software (including web-based, mobile and thick client).
- D. Network(s) connecting workstations and controllers shall consist of one or more of the following:
  1. Local area, IEEE 802.3 Gigabit-Ethernet, star topology network based on TCP/IP.

2. Local area, IEEE 802.11 compatible wireless mesh network, based on TCP/IP.
3. Direct-connected, RS-232 cable from the COM port of the central station to the first controller, then RS-485 cable to interconnect the remaining controllers at that Location.

### 2.3 OPERATION

- A. Security access system shall use a single database for access-control and credential-creation functions.
- B. Distributed Processing: A fully distributed processing system.
  1. Access-control information, including time, date, valid codes, access levels, and similar data, shall be downloaded to controllers so each controller can make access-control decisions.
  2. Intermediate controllers for access control are prohibited.
  3. In the event that communications with the central controller are lost, controllers shall automatically buffer event transactions until communications are restored, at which time buffered events shall be uploaded to the central station.
- C. Number of Locations:
  1. Support at least 32,000 separate Locations using a single workstation with combinations of direct-connect, or TCP/IP LAN connections to each Location.
  2. Each Location shall have its own database and history in the central station.
  3. Locations may be combined to share a common database.
- D. Data Capacity:
  1. 130 different card-reader formats.
  2. 999 comments.
  3. 48 graphic file types for importing maps.
- E. Location Capacity:
  1. 1024 reader-controlled doors.
  2. 50,000 total-access credentials.
  3. 2048 supervised alarm inputs.
  4. 2048 programmable outputs.
  5. 32,000 custom action messages per Location to instruct operator on action required when alarm is received.
- F. System Network Requirements:
  1. System components shall be interconnected and shall provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
  2. Communication shall not require operator initiation or response and shall return to normal after partial- or total-network interruption such as power loss or transient upset.
  3. System shall automatically annunciate communication failures to the operator and shall identify the communications link that has experienced a partial or total failure.

4. Communications controller may be used as an interface between the central-station display systems and the field device network. Communications controller shall provide functions required to attain the specified network communications performance.
- G. Central station shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring. Central station shall control system networks to interconnect all system components, including workstations and field-installed controllers.
- H. Field equipment shall include controllers, sensors, and controls.
1. Controllers shall serve as an interface between the central station and sensors and controls.
  2. Data exchange between the central station and the controllers shall include down-line transmission of commands, software, and databases to controllers.
  3. The up-line data exchange from the controller to the central station shall include status data such as intrusion alarms, status reports, and entry-control records.
  4. Controllers are classified as alarm-annunciation or entry-control type.
- I. System Response to Alarms:
1. Field device network shall provide a system end-to-end response time of one second(s) or less for every device connected to the system.
  2. Alarms shall be annunciated at the central station within one second of the alarm occurring at a controller or at a device controlled by a local controller, and within 100 ms if the alarm occurs at the central station.
  3. Alarm and status changes shall be displayed within 100 ms after receipt of data by the central station.
  4. All graphics shall be displayed, including graphics-generated map displays, on the console monitor within five seconds of alarm receipt at the security console.
  5. This response time shall be maintained during system heavy load.
- J. False-Alarm Reduction: The design of the central station and controllers shall contain features to reduce false alarms. Equipment and software shall comply with SIA CP-01.
- K. Error Detection:
1. Use a cyclic code method to detect single- and double-bit errors, burst errors of eight bits or fewer, and at least 99 percent of all other multibit and burst errors between controllers and the central station.
  2. Interactive or product error-detection codes alone will not be acceptable.
  3. A message shall be in error if one bit is received incorrectly.
  4. Retransmit messages with detected errors.
  5. Allow for an operator-assigned two-digit decimal number to each communications link representing the number of retransmission attempts.
  6. Central station shall print a communication failure alarm message when the number of consecutive retransmission attempts equals the assigned quantity.
  7. Monitor the frequency of data transmission failure for display and logging.
- L. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.
- M. Door Hardware Interface:



1. Comply with requirements in Section 087100 "Door Hardware" and Section 087111 "Door Hardware (Descriptive Specification)" for door hardware required to be monitored or controlled by the security access system.
2. Electrical characteristics of controllers shall match the signal and power requirements of door hardware.

## **2.4 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70, "National Electrical Code."
- C. Comply with UL 294.

## **2.5 APPLICATION SOFTWARE**

- A. System Software: Based on 64-bit, Microsoft Windows central-station and workstation operating system and application software.
  1. Multiuser multitasking shall allow independent activities and monitoring to occur simultaneously at different workstations.
  2. Graphical user interface shall show pull-down menus and a menu-tree format.
  3. Capability for future additions within the indicated system size limits.
  4. Open architecture that allows importing and exporting of data and interfacing with other systems that are compatible with operating system.
  5. Password-protected operator login and access.
  6. Accessible through mobile and web browser.
- B. Peer Computer Control Software: Detect a failure of a central computer and cause the other central computer to assume control of all system functions without interruption of operation. Both central computers shall have drivers to support this mode of operation.
- C. Application Software: Interface between the alarm annunciation and entry-control controllers to monitor sensors and DTS links, operate displays, report alarms, generate reports, and help train system operators.
  1. Reside at the central station, workstations, and controllers as required to perform specified functions.
  2. Operate and manage peripheral devices.
  3. Manage files for disk I/O, including creating, deleting, and copying files; and automatically maintain a directory of all files, including size and location of each sequential and random-ordered record.
  4. Import custom icons into graphics to represent alarms and I/O devices.
  5. Globally link I/O so that any I/O can link to any other I/O within the same Location without requiring interaction with the host workstation. This operation shall be at the controller.
  6. Globally code I/O links so that any access-granted event can link to any I/O with the same Location without requiring interaction with the host workstation. This operation shall be at the controller.
  7. Messages from workstation to controllers and controllers to controllers shall be on a polled network that utilizes check summing and acknowledgment of each message.

Communication shall be automatically verified, buffered, and retransmitted if message is not acknowledged.

8. Selectable poll frequency and message time-out settings shall handle bandwidth and latency issues for TCP/IP, RF, and other workstation-to-controller communications methods by changing the polling frequency and the amount of time the system waits for a response.
9. Automatic and encrypted backups for database and history backups shall be automatically stored at the central-control workstation and encrypted with a nine-character alphanumeric password that must be used to restore or read data contained in backup.
10. Operator audit trail for recording and reporting all changes made to database and system software.
11. Support network protocol and topology, TCP/IP, Novel Netware, Digital Path works, Banyan Vines, LAN/WAN, and RAS.

D. Workstation Software:

1. Password levels shall be individually customized at each workstation to allow or disallow operator access to program functions for each Location.
2. Workstation event filtering shall allow user to define events and alarms that will be displayed at each workstation. If an alarm is unacknowledged (not handled by another workstation) for a preset amount of time, the alarm will automatically appear on the filtered workstation.

E. Controller Software:

1. Controllers shall operate as autonomous, intelligent processing units.
  - a. Controllers shall make decisions about access control, alarm monitoring, linking functions, and door-locking schedules for their operation, independent of other system components.
  - b. Controllers shall be part of a fully distributed processing-control network.
  - c. The portion of the database associated with a controller, and consisting of parameters, constraints, and the latest value or status of points connected to that controller, shall be maintained in the controller.
2. The following functions shall be fully implemented and operational within each controller:
  - a. Monitoring inputs.
  - b. Controlling outputs.
  - c. Automatically reporting alarms to the central station.
  - d. Reporting of sensor and output status to the central station on request.
  - e. Maintaining real time, automatically updated by the central station at least once a day.
  - f. Communicating with the central station.
  - g. Executing controller resident programs.
  - h. Diagnosing.
  - i. Downloading and uploading data to and from the central station.

3. Controller Operations at a Location:
  - a. Up to 64 controllers connected to TIA 485-A communications loop. Globally operating I/O linking and anti-passback functions between controllers within the same Location without central-station or workstation intervention. Linking and anti-passback shall remain fully functional within the same Location even when the central station or workstations are off-line.
  - b. In the event of communication failure between the central station and a Location, there shall be no degradation in operations at the controllers at that Location. Controllers at each Location shall be connected to a memory buffer with a capacity to store up to 10,000 events; there shall be no loss of transactions in system history files until the buffer overflows.
  - c. Buffered events shall be handled in a first-in-first-out mode of operation.
4. Individual Controller Operation:
  - a. Controllers shall transmit alarms, status changes, and other data to the central station when communications circuits are operable. If communications are not available, controllers shall function in a stand-alone mode; operational data, including the status and alarm data normally transmitted to the central station, shall be stored for later transmission to the central station. Storage capacity for the latest 1024 events shall be provided at each controller.
  - b. Card-reader ports of a controller shall be custom configurable for at least 120 different card-reader or keypad formats. Multiple reader or keypad formats may be used simultaneously at different controllers or within the same controller.
  - c. Controllers shall provide a response to card readers or keypad entries in less than 0.25 seconds, regardless of system size.
  - d. Controllers that are reset, or powered up from a nonpowered state, shall automatically request a parameter download and reboot to their proper working state. This shall happen without any operator intervention.
  - e. Initial Startup: When controllers are brought on-line, database parameters shall be automatically downloaded to them. After initial download is completed, only database changes shall be downloaded to each controller.
  - f. On failure for any reason, controllers shall perform an orderly shutdown and force controller outputs to a predetermined failure-mode state, consistent with the failure modes shown and the associated control device.
  - g. After power is restored, following a power failure, startup software shall initiate self-test diagnostic routines, after which controllers shall resume normal operation.
  - h. After controller failure, if the database and application software are no longer resident, controllers shall not restart but shall remain in the failure mode until repaired. If database and application programs are resident, controllers shall immediately resume operation. If not, software shall be restored automatically from the central station.
5. Communications Monitoring:
  - a. System shall monitor and report status of TIA 485-A communications loop of each Location.

- b. Communication status window shall display which controllers are currently communicating, a total count of missed polls since midnight, and which controller last missed a poll.
    - c. Communication status window shall show the type of CPU, the type of I/O board, and the amount of RAM for each controller.
  6. Operating systems shall include a real-time clock function that maintains seconds, minutes, hours, day, date, and month. The real-time clock shall be automatically synchronized with the central station at least once a day to plus or minus 10 seconds. The time synchronization shall be automatic, without operator action and without requiring system shutdown.
- F. Workstation-to-Controller Communications:
  1. Central-station or workstation communications shall use the following:
    - a. Direct connection using data ports of the workstation.
    - b. TCP/IP LAN interface cards.
  2. Each data port used for communications shall be individually configurable for "direct communications," "modem communications incoming and outgoing," or "modem communications incoming only," or as an ASCII output port. Serial ports shall have adjustable data transmission rates and shall be selectable under program control.
  3. TCP/IP network interface card (NIC) shall have an option to set the poll-frequency and message-response time-out settings.
  4. Workstation-to-controller and controller-to-controller communications (direct, or TCP/IP) shall use a polled-communication protocol that checks sum and acknowledges each message. All communications in this subparagraph shall be verified and buffered, and retransmitted if not acknowledged.
- G. Direct TCP/IP Workstation-to-Controller Communications:
  1. Communication software on the workstation shall supervise the workstation-to-controller communications link.
  2. Loss of communications to any controller shall result in an alarm at all workstations running the communication software.
  3. When communications are restored, all buffered events shall automatically upload to the workstation, and any database changes shall be automatically sent to the controller.
- H. Broadband Workstation-to-Controller Communications:
  1. Communication software on the workstation shall supervise the workstation-to-controller communications link during dial-up modem connect times.
  2. Communication software shall be programmable to routinely poll each of the remote dial-up or cable modem Locations, collecting event logs and verifying phone lines at operator-selectable time intervals for each Location.
  3. System shall be programmable for dialing and connecting to all dial-up or cable modem Locations and for retrieving the accrued history transactions on an automatic basis as often as once every 10 minutes and up to once every 60 minutes.
  4. Failure to communicate to a dial-up Location three times in a row shall result in an alarm at the workstation.

5. Time offset capabilities shall be present so that Locations in a different geographical time zone than the host workstation will be set to, and maintained at, the proper local time. This feature shall allow for geographical time zones that are ahead of or behind the host workstation.
  6. The controller connected to a dial-up or cable modem shall automatically buffer all normal transactions until its buffer reaches 80 percent of capacity. When the transaction buffer reaches 80 percent, the controller shall automatically initiate a call to the central station and upload all transactions.
  7. Alarms shall be reported immediately.
  8. Dial-up or cable modems shall be provided by manufacturer of the system. Modems used at the controller shall be powered by the controller. Power to the modem shall include battery backup if the controller is so equipped.
- I. Controller-to-Controller Communications:
1. TIA 485-A, four-wire, point-to-point, regenerative (repeater) communications network methodology.
  2. TIA 485-A communications signal shall be regenerated at each controller.
- J. Database Downloads:
1. All data transmissions from workstations to a Location, and between controllers at a Location, shall include a complete database checksum to check the integrity of the transmission. If the data checksum does not match, a full data download shall be automatically retransmitted.
  2. If a controller is reset for any reason, it shall automatically request and receive a database download from the workstation. The download shall restore data stored at the controller to their normal working state and shall take place with no operator intervention.
- K. Operator Interface:
1. Inputs in system shall have two icon representations, one for the normal state and one for the abnormal state.
  2. When viewing and controlling inputs, displayed icons shall automatically change to the proper icon to display the current system state in real time. Icons shall also display the input's state, whether armed or bypassed, and if the input is in the armed or bypassed state due to a time zone or a manual command.
  3. Outputs in system shall have two icon representations, one for the secure (locked) state and one for the open (unlocked) state.
  4. Icons displaying status of the I/O points shall be constantly updated to show their current real-time condition without prompting by the operator.
  5. The operator shall be able to scroll the list of I/Os and press the appropriate toolbar button, or right click, to command the system to perform the desired function.
  6. Graphic maps or drawings containing inputs, outputs, and override groups shall include the following:
    - a. Database to import and store full-color maps or drawings and allow for input, output, and override group icons to be placed on maps.
    - b. Maps to provide real-time display animation and allow for control of points assigned to them.

- c. System to allow inputs, outputs, and override groups to be placed on different maps.
  - d. Software to allow changing the order or priority in which maps will be displayed.
- 7. Override Groups Containing I/Os:
  - a. System shall incorporate override groups that provide the operator with the status and control over user-defined "sets" of I/Os with a single icon.
  - b. Icon shall change automatically to show the live summary status of points in that group.
  - c. Override group icon shall provide a method to manually control or set to time-zone points in the group.
  - d. Override group icon shall allow the expanding of the group to show icons representing the live status for each point in the group, individual control over each point, and the ability to compress the individual icons back into one summary icon.
- 8. Schedule Overrides of I/Os and Override Groups:
  - a. To accommodate temporary schedule changes that do not fall within the holiday parameters, the operator shall have the ability to override schedules individually for each input, output, or override group.
  - b. Each schedule shall be composed of a minimum of two dates with separate times for each date.
  - c. The first time and date shall be assigned the override state that the point shall advance to when the time and date become current.
  - d. The second time and date shall be assigned the state that the point shall return to when the time and date become current.
- 9. Copy command in database shall allow for like data to be copied and then edited for specific requirements, to reduce redundant data entry.
- L. Operator Access Control:
  - 1. Control operator access to system controls through three password-protected operator levels. System operators and managers with appropriate password clearances shall be able to change operator levels for operators.
  - 2. Three successive attempts by an operator to execute functions beyond their defined level during a 24-hour period shall initiate a software tamper alarm.
  - 3. A minimum of 1024 unique user accounts shall be available with the system software. System shall display the operator's name or initials in the console's first field. System shall print the operator's name or initials, action, date, and time on the system printer at login and logoff.
  - 4. The password shall not be displayed or printed.
  - 5. Each password shall be definable and assignable for the following:
    - a. Selected commands to be usable.
    - b. Access to system software.
    - c. Access to application software.
    - d. Individual zones that are to be accessed.

- e. Access to database.

M. Operator Commands:

1. Command Input: Plain-language words and acronyms shall allow operators to use the system without extensive training or data-processing backgrounds. System prompts shall be a word, a phrase, or an acronym.
2. Command inputs shall be acknowledged and processing shall start in not less than one second.
3. Tasks that are executed by operator's commands shall include the following:
  - a. Acknowledge Alarms: Used to acknowledge that the operator has observed the alarm message.
  - b. Place Zone in Access: Used to remotely disable intrusion-alarm circuits emanating from a specific zone. System shall be structured so that console operator cannot disable tamper circuits.
  - c. Place Zone in Secure: Used to remotely activate intrusion-alarm circuits emanating from a specific zone.
  - d. System Test: Allows the operator to initiate a system-wide operational test.
  - e. Zone Test: Allows the operator to initiate an operational test for a specific zone.
  - f. Print reports.
  - g. Change Operator: Used for changing operators.
  - h. Security Lighting Controls: Allows the operator to remotely turn on or turn off security lights.
  - i. Display Graphics: Used to show any graphic displays implemented in the system. Graphic displays shall be completed within 20 seconds from time of operator command.
  - j. Run system tests.
  - k. Generate and format reports.
  - l. Request help with the system operation.
    - 1) Include in main menus.
    - 2) Provide unique, descriptive, context-sensitive help for selections and functions with the press of one function key.
    - 3) Provide navigation to specific topic from within the first help window.
    - 4) Help shall be accessible outside the application program.
  - m. Entry-Control Commands:
    - 1) Lock (secure) or unlock (open) each controlled entry and exit up to four times a day through time-zone programming.
    - 2) Arm or disarm each monitored input up to four times a day through time-zone programming.
    - 3) Enable or disable readers or keypads up to two times a day through time-zone programming.

- 4) Enable or disable cards or codes up to four times a day per entry point through access-level programming.
4. Command Input Errors: Show operator input assistance when a command cannot be executed because of operator input errors. Assistance screen shall use plain-language words and phrases to explain why the command cannot be executed. Error responses that require an operator to look up a code in a manual or other document are not acceptable. Conditions causing operator assistance messages include the following:
    - a. Command entered is incorrect or incomplete.
    - b. Operator is restricted from using that command.
    - c. Command addresses a point that is disabled or out of service.
    - d. Command addresses a point that does not exist.
    - e. Command is outside the system's capacity.
- N. Alarms:
1. System Setup:
    - a. Assign manual and automatic responses to incoming-point status change or alarms.
    - b. Automatically respond to input with a link to other inputs, outputs, or operator-response plans; unique sound with use of WAV files; and maps or images that graphically represent the point location.
    - c. Sixty-character message field for each alarm.
    - d. Operator-response-action messages shall allow message length of at least 65,000 characters, with database storage capacity of up to 32,000 messages. Setup shall assign messages to access point other alarm originating device.
    - e. Secondary messages shall be assignable by the operator for printing to provide further information and shall be editable by the operator.
    - f. Allow 25 secondary messages with a field of four lines of 60 characters each.
    - g. Store the most recent 1000 alarms for recall by the operator using the report generator.
  2. Software Tamper:
    - a. Annunciate a tamper alarm when unauthorized changes to system database files are attempted. Three consecutive unsuccessful attempts to log onto system shall generate a software tamper alarm.
    - b. Annunciate a software tamper alarm when an operator or other individual makes three consecutive unsuccessful attempts to invoke functions beyond the authorization level.
    - c. Maintain a transcript file of the last 5000 commands entered at each central station to serve as an audit trail. System shall not allow write access to system transcript files by any person, regardless of their authorization level.
    - d. Allow only acknowledgment of software tamper alarms.
  3. Read access to system transcript files shall be reserved for operators with the highest password authorization level available in system.



4. Animated Response Graphics: Highlight alarms with flashing icons on graphic maps; display and constantly update the current status of alarm inputs and outputs in real time through animated icons.
  5. Multimedia Alarm Annunciation: WAV files to be associated with alarm events for audio annunciation or instructions.
  6. Alarm Handling: Each input may be configured so that an alarm cannot be cleared unless it has returned to normal, with options of requiring the operator to enter a comment about disposition of alarm. Allow operator to silence alarm sound when alarm is acknowledged.
  7. Alarm Automation Interface: High-level interface to central-station alarm automation software systems. Allows input alarms to be passed to and handled by automation systems in the same manner as burglar alarms, using a TIA 232-F ASCII interface.
  8. CCTV Alarm Interface: Allow commands to be sent to CCTV systems during alarms (or input change of state) through serial ports.
  9. Camera Control: Provides operator ability to select and control cameras from graphic maps.
- O. Alarm Monitoring: Monitor sensors, controllers, and DTS circuits and notify operators of an alarm condition. Display higher-priority alarms first and, within alarm priorities, display the oldest unacknowledged alarm first. Operator acknowledgment of one alarm shall not be considered acknowledgment of other alarms nor shall it inhibit reporting of subsequent alarms.
1. Displayed alarm data shall include type of alarm, location of alarm, and secondary alarm messages.
  2. Printed alarm data shall include type of alarm, location of alarm, date and time (to nearest second) of occurrence, and operator responses.
  3. Maps shall automatically display the alarm condition for each input assigned to that map if that option is selected for that input location.
  4. Alarms initiate a status of "pending" and require the following two handling steps by operators:
    - a. First Operator Step: "Acknowledged." This action shall silence sounds associated with the alarm. The alarm remains in the system "Acknowledged" but "Un-Resolved."
    - b. Second Operator Step: Operators enter the resolution or operator comment, giving the disposition of the alarm event. The alarm shall then clear.
  5. Each workstation shall display the total pending alarms and total unresolved alarms.
  6. Each alarm point shall be programmable to disallow the resolution of alarms until the alarm point has returned to its normal state.
  7. Alarms shall transmit to the central station in real time except for allowing connection time for dial-up locations.
  8. Alarms shall be displayed and managed from a minimum of four different windows.
    - a. Input Status Window: Overlay status icon with a large red blinking icon. Selecting the icon will acknowledge the alarm.
    - b. History Log Transaction Window: Display name, time, and date in red text. Selecting red text will acknowledge the alarm.
    - c. Alarm Log Transaction Window: Display name, time, and date in red. Selecting red text will acknowledge the alarm.

- d. Graphic Map Display: Display a steady colored icon representing each alarm input location. Change icon to flashing red when the alarm occurs. Change icon from flashing red to steady red when the alarm is acknowledged.
9. Once an alarm is acknowledged, the operator shall be prompted to enter comments about the nature of the alarm and actions taken. Operator's comments may be manually entered or selected from a programmed predefined list, or a combination of both.
  10. For locations where there are regular alarm occurrences, provide programmed comments. Selecting that comment shall clear the alarm.
  11. The time and name of the operator who acknowledged and resolved the alarm shall be recorded in the database.
  12. Identical alarms from the same alarm point shall be acknowledged at the same time the operator acknowledges the first alarm. Identical alarms shall be resolved when the first alarm is resolved.
  13. Alarm functions shall have priority over downloading, retrieving, and updating database from workstations and controllers.
  14. When a reader-controlled output (relay) is opened, the corresponding alarm point shall be automatically bypassed.
- P. Monitor Display: Display text and graphic maps that include zone status integrated into the display. Colors are used for the various components and current data. Colors shall be uniform throughout the system.
1. Color Code:
    - a. FLASHING RED: Alerts operator that a zone has gone into an alarm or that primary power has failed.
    - b. STEADY RED: Alerts operator that a zone is in alarm and alarm has been acknowledged.
    - c. YELLOW: Advises operator that a zone is in access.
    - d. GREEN: Indicates that a zone is secure and that power is on.
  2. Graphics:
    - a. Support 32,000 graphic display maps and allow import of maps from a minimum of 16 standard formats from another drawing or graphics program.
    - b. Allow I/O to be placed on graphic maps by the drag-and-drop method.
    - c. Operators shall be able to view the inputs, outputs, and the point's name by moving the mouse cursor over the point on the graphic map.
    - d. Inputs or outputs may be placed on multiple graphic maps. The operator shall be able to toggle to view graphic maps associated with I/Os.
    - e. Each graphic map shall have a display-order sequence number associated with it to provide a predetermined order when toggled to different views.
    - f. Camera icons shall have the ability to be placed on graphic maps that, when selected by an operator, will open a video window, display the camera associated with that icon, and provide pan-tilt-zoom control.
    - g. Input, output, or camera placed on a map shall allow the ability to arm or bypass an input, open or secure an output, or control the pan-tilt-zoom function of the selected camera.

- Q. System test software enables operators to initiate a test of the entire system or of a particular portion of the system.
1. Test Report: The results of each test shall be stored for future display or printout. The report shall document the operational status of system components.
- R. Report-Generator Software: Include commands to generate reports for displaying, printing, and storing on disk and tape. Reports shall be stored by type, date, and time. Report printing shall be the lowest-priority activity. Report-generation mode shall be operator selectable but set up initially as periodic, automatic, or on request. Include time and date printed and the name of operator generating the report. Report formats may be configured by operators.
1. Automatic Printing: Setup shall specify, modify, or inhibit the report to be generated; the time the initial report is to be generated; the time interval between reports; the end of the period; and the default printer.
  2. Printing on Request: An operator may request a printout of any report.
  3. Alarm Reports: Reporting shall be automatic as initially set up. Include alarms recorded by system over the selected time and information about the type of alarm (such as door alarm, intrusion alarm, tamper alarm, etc.), the type of sensor, the location, the time, and the action taken.
  4. Access and Secure Reports: Document zones placed in access, the time placed in access, and the time placed in secure mode.
  5. Custom Reports: Reports tailored to exact requirements of who, what, when, and where. As an option, custom report formats may be stored for future printing.
  6. Automatic History Reports: Named, saved, and scheduled for automatic generation.
  7. Cardholder Reports: Include data, or selected parts of the data, as well as the ability to be sorted by name, card number, imprinted number, or by any of the user-defined fields.
  8. Cardholder by Reader Reports: Based on who has access to a specific reader or group of readers by selecting the readers from a list.
  9. Cardholder by Access-Level Reports: Display everyone that has been assigned to the specified access level.
  10. Who Is "In" (Muster) Report:
    - a. Emergency Muster Report: One-click operation on toolbar launches report.
    - b. Cardholder Report. Contain a count of persons who are "In" at a selected Location and a detailed listing of name, date, and time of last use, sorted by the last reader used or by the group assignment.
  11. Panel Labels Reports: Printout of control-panel field documentation including the actual location of equipment, programming parameters, and wiring identification. Maintain system installation data within system database so that data are available on-site at all times.
  12. Activity and Alarm On-Line Printing: Activity printers for use at workstations; prints all events, or alarms only.
  13. History Reports: Custom reports that allow the operator to select any date, time, event type, device, output, input, operator, Location, name, or cardholder to be included or excluded from the report.
    - a. Initially store history on the hard disk of the host workstation.

- b. Permit viewing of the history on workstations or print history to any system printer.
  - c. The report shall be definable by a range of dates and times with the ability to have a daily start and stop time over a given date range.
  - d. Each report shall depict the date, time, event type, event description, and device; or I/O name, cardholder group assignment, and cardholder name or code number.
  - e. Each line of a printed report shall be numbered to ensure that the integrity of the report has not been compromised.
  - f. Total number of lines of the report shall be given at the end of the report. If the report is run for a single event such as "Alarms," the total shall reflect how many alarms occurred during that period.
14. Reports shall have the following four options:
- a. View on screen.
  - b. Print to system printer. Include automatic print spooling and "Print To" options if more than one printer is connected to the system.
  - c. "Save to File" with full path statement.
  - d. System shall have the ability to produce a report indicating status of system inputs and outputs or of inputs and outputs that are abnormal, out of time zone, manually overridden, not reporting, or in alarm.
15. Custom Code List Subroutine: Allow the access codes of system to be sorted and printed according to the following criteria:
- a. Active, inactive, or future activate or deactivate.
  - b. Code number, name, or imprinted card number.
  - c. Group, Location access levels.
  - d. Start and stop code range.
  - e. Codes that have not been used since a selectable number of days.
  - f. In, out, or either status.
  - g. Codes with trace designation.
16. The reports of system database shall allow options so that every data field may be printed.
17. The reports of system database shall be constructed so that the actual position of the printed data shall closely match the position of the data on the data-entry windows.
- S. Anti-Passback:
- 1. System shall have global and local anti-passback features, selectable by Location. System shall support hard and soft anti-passback.
  - 2. Hard Anti-Passback: Once a credential holder is granted access through a reader with one type of designation (IN or OUT), the credential holder may not pass through that type of reader designation until the credential holder passes through a reader of opposite designation.
  - 3. Soft Anti-Passback: Should a violation of the proper IN or OUT sequence occur, access shall be granted, but a unique alarm shall be transmitted to the control station, reporting

the credential holder and the door involved in the violation. A separate report may be run on this event.

4. Timed Anti-Passback: A controller capability that prevents an access code from being used twice at the same device (door) within a user-defined amount of time.
5. Provide four separate zones per Location that can operate without requiring interaction with the host workstation (done at controller). Each reader shall be assignable to one or all four anti-passback zones. In addition, each anti-passback reader can be further designated as "Hard," "Soft," or "Timed" in each of the four anti-passback zones. The four anti-passback zones shall operate independently.
6. The anti-passback schemes shall be definable for each individual door.
7. The Master Access Level shall override anti-passback.
8. System shall have the ability to forgive (or reset) an individual credential holder or the entire credential-holder population anti-passback status to a neutral status.

T. Visitor Assignment:

1. Provide for and allow an operator to be restricted to only working with visitors. The visitor badging subsystem shall assign credentials and enroll visitors. Allow only those access levels that have been designated as approved for visitors.
2. Provide an automated log of visitor name, time and doors accessed, and name of person contacted.
3. Allow a visitor designation to be assigned to a credential holder.
4. Security access system shall be able to restrict the access levels that may be assigned to credentials issued to visitors.
5. Allow operator to recall visitors' credential-holder file once a visitor is enrolled in the system.
6. The operator may designate any reader as one that deactivates the credential after use at that reader. The history log shall show the return of the credential.
7. System shall have the ability to use the visitor designation in searches and reports. Reports shall be able to print all or any visitor activity.

U. Time and Attendance:

1. Time and attendance reporting shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length designated in the report.
2. Shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length designated in the report.
3. System software setup shall allow designation of selected access-control readers as time and attendance hardware to gather the clock-in and clock-out times of the users at these readers.
  - a. Reports shall show in and out times for each day, total time in for each day, and a total time in for period specified by the user.
  - b. Allow the operator to view and print the reports, or save the reports to a file.
  - c. Alphabetically sort reports on the person's last name, by Location or location group. Include all credential holders or optionally select individual credential holders for the report.

- V. Training Software: Enables operators to practice system operation, including alarm acknowledgment, alarm assessment, response force deployment, and response force communications. System shall continue normal operation during training exercises and shall terminate exercises when an alarm signal is received at the console.
- W. Entry-Control Enrollment Software: Database management functions that allow operators to add, delete, and modify access data as needed.
1. The enrollment station shall not have alarm response or acknowledgment functions.
  2. Provide multiple, password-protected access levels. Database management and modification functions shall require a higher operator access level than personnel enrollment functions.
  3. The program shall provide means to disable the enrollment station when it is unattended, to prevent unauthorized use.
  4. The program shall provide a method to enter personnel identifying information into the entry-control database files through enrollment stations. In the case of personnel identity-verification subsystems, this shall include biometric data. Allow entry of personnel identifying information into the system database using menu selections and data fields. The data field names shall be customized during setup to suit user and site needs. Personnel identity-verification subsystems selected for use with the system shall fully support the enrollment function and shall be compatible with the entry-control database files.
  5. Cardholder Data: Provide 99 user-defined fields. System shall have the ability to run searches and reports using any combination of these fields. Each user-defined field shall be configurable, using any combination of the following features:
    - a. MASK: Determines a specific format with which data must comply.
    - b. REQUIRED: Operator is required to enter data into field before saving.
    - c. UNIQUE: Data entered must be unique.
    - d. DEACTIVATE DATE: Data entered will be evaluated as an additional deactivate date for all cards assigned to this cardholder.
    - e. NAME ID: Data entered will be considered a unique ID for the cardholder.
  6. Personnel Search Engine: A report generator with capabilities such as search by last name, first name, group, or any predetermined user-defined data field; by codes not used in definable number of days; by skills; or by seven other methods.
  7. Multiple Deactivate Dates for Cards: User-defined fields to be configured as additional stop dates to deactivate any cards assigned to the cardholder.
  8. Batch card printing.
  9. Default card data can be programmed to speed data entry for sites where most card data are similar.
  10. Enhanced ASCII File Import Utility: Allows the importing of cardholder data and images.
  11. Card Expire Function: Allows readers to be configured to deactivate cards when a card is used at selected devices.

**2.6 SYSTEM DATABASE**

- A. Database and database management software shall define and modify each point in database using operator commands. Definition shall include parameters and constraints associated with each system device.
- B. Database Operations:
  - 1. System data management shall be in a hierarchical menu-tree format, with navigation through expandable menu branches and manipulated with use of menus and icons in a main menu and system toolbar.
  - 2. Navigational Aids:
    - a. Toolbar icons for add, delete, copy, print, capture image, activate, deactivate, and muster report.
    - b. Point and click feature to facilitate data manipulation.
    - c. Next and previous command buttons visible when editing database fields to facilitate navigation from one record to the next.
    - d. Copy command and copy tool in the toolbar to copy data from one record to create a new similar record.
  - 3. Data entry shall be automatically checked for duplicate and illegal data and shall be verified for valid format.
  - 4. System shall generate a memo or note field for each item that is stored in database, allowing the storing of information about any defining characteristics of the item. Memo field is used for noting the purpose for which the item was entered, reasons for changes that were made, and the like.
- C. File Management:
  - 1. File management shall include database backup and restoration system, allowing selection of storage media.
  - 2. Operations shall be both manual and automatic modes. The number of automatic sequential backups before the oldest backup will be overwritten; FIFO mode shall be operator selectable.
  - 3. Backup program shall provide manual operation from any workstation on the LAN and shall operate while system remains operational.
- D. Operator Passwords:
  - 1. Support up to 32,000 individual system operators, each with a unique password.
  - 2. One to eight alphanumeric characters.
  - 3. Allow passwords to be case sensitive.
  - 4. Passwords shall not be displayed when entered.
  - 5. Passwords shall have unique and customizable password profile, and allow several operators to share a password profile. Include the following features in the password profile:
    - a. Predetermine the highest-level password profile for access to all functions and areas of program.

- b. Allow or disallow operator access to any program operation, including the functions of View, Add, Edit, and Delete.
    - c. Restrict doors to which an operator can assign access.
  6. Operators shall use a user name and password to log on to system. This user name and password shall be used to access database areas and programs as determined by the associated profile.
  7. Make provision to allow the operator to log off without fully exiting program. User may be logged off but program will remain running while displaying the login window for the next operator.
- E. Access Card/Code Operation and Management: Access authorization shall be by card, by a manually entered code (PIN), or by a combination of both (card plus PIN).
  1. Access authorization shall verify the facility code first, the card or card-and-PIN validation second, and the access level (time of day, day of week, date), anti-passback status, and number of uses last.
  2. Use data-entry windows to view, edit, and issue access levels. Access-authorization entry-management system shall maintain and coordinate all access levels to prevent duplication or the incorrect creation of levels.
  3. Allow assignment of multiple cards/codes to a cardholder.
  4. Allow assignment of up to four access levels for each Location to a cardholder. Each access level may contain any combination of doors.
  5. Each door may be assigned four time zones.
  6. Access codes may be up to 11 digits in length.
  7. Software shall allow the grouping of locations so cardholder data can be shared by all locations in the group.
  8. Visitor Access: Issue a visitor badge for data tracking or photo ID purposes without assigning that person a card or code.
  9. Cardholder Tracing: Allow for selection of cardholder for tracing. Make a special audible and visible annunciation at control station when a selected card or code is used at a designated code reader. Annunciation shall include an automatic display of the cardholder image.
  10. Allow each cardholder to be given either an unlimited number of uses or a number from one to 9999 that regulates the number of times the card can be used before it is automatically deactivated.
  11. Provide for cards and codes to be activated and deactivated manually or automatically by date. Provide for multiple deactivate dates to be preprogrammed.
- F. Security Access Integration:
  1. Photo ID badging and photo verification shall use the same database as the security access and may query data from cardholder, group, and other personal information to build a custom ID badge.
  2. Automatic or manual image recall and manual access based on photo verification shall also be a means of access verification and entry.
  3. System shall allow sorting of cardholders together by group or other characteristic for a fast and efficient method of reporting on, and enabling or disabling, cards or codes.
- G. Key control and tracking shall be an integrated function of cardholder data.



1. Provide the ability to store information about which conventional metal keys are issued and to whom, along with key construction information.
  2. Reports shall be designed to list everyone who possesses a specified key.
- H. Facility Codes: System shall accommodate up to 2048 facility codes per Location, with the option of allowing facility codes to work at all doors or only at particular doors.
- I. Operator Comments:
1. With the press of one appropriate button on the toolbar, the user shall be permitted to enter operator comments into the history at any time.
  2. Automatic prompting of operator comment shall occur before the resolution of each alarm.
  3. Operator comments shall be recorded by time, date, and operator number.
  4. Comments shall be sorted and viewed through reports and history.
  5. The operator may enter comments in two ways; either or both may be used:
    - a. Manually entered through keyboard data entry (typed), up to 65,000 characters per each alarm.
    - b. Predefined and stored in database for retrieval on request.
  6. System shall have a minimum of 999 predefined operator comments with up to 30 characters per comment.
- J. Group:
1. Group names may be used to sort cardholders into groups that allow the operator to determine the tenant, vendor, contractor, department, division, or any other designation of a group to which the person belongs.
  2. System software shall have the capacity to assign one of 32,000 group names to an access authorization.
  3. Make provision in software to deactivate and reactivate all access authorizations assigned to a particular group.
  4. Allow sorting of history reports and code list printouts by group name.
- K. Time Zones:
1. Each zone consists of a start and stop time for seven days of the week and three holiday schedules. A time zone is assigned to inputs, outputs, or access levels to determine when an input shall automatically arm or disarm, when an output automatically opens or secures, or when access authorization assigned to an access level will be denied or granted.
  2. Up to four time zones may be assigned to inputs and outputs to allow up to four arm or disarm periods per day or four lock or unlock periods per day; up to three holiday override schedules may be assigned to a time zone.
  3. Data-entry window shall display a dynamically linked bar graph showing active and inactive times for each day and holiday, as start and stop times are entered or edited.
  4. System shall have the capacity for multiple time zones for each Location.
- L. Holidays:

1. Three different holiday schedules may be assigned to a time zone. Holiday schedule consists of date in format MM/DD/YYYY and a description. When the holiday date matches the current date of the time zone, the holiday schedule replaces the time-zone schedule for that 24-hour period.
2. System shall have the capacity for 32,000 holidays.
3. Three separate holiday schedules may be applied to a time zone.
4. Holidays have an option to be designated as occurring on the designated date each year. These holidays remain in the system and will not be purged.
5. Holidays not designated to occur each year shall be automatically purged from the database after the date expires.

M. Access Levels:

1. System shall allow for the creation of up to 32,000 access levels.
2. One level shall be predefined as the Master Access Level. The Master Access Level shall work at all doors at all times and override any anti-passback.
3. System shall allow for access to be restricted to any area by reader and by time. Access levels shall determine when and where an Identifier is authorized.
4. System shall be able to create multiple door and time-zone combinations under the same access level so that an Identifier may be valid during different time periods at different readers even if the readers are on the same controller.

N. User-Defined Fields:

1. System shall provide a minimum of 99 user-defined fields, each with up to 50 characters, for specific information about each credential holder.
2. System shall accommodate a title for each field; field length shall be 20 characters.
3. A "Required" option may be applied to each user-defined field that, when selected, forces the operator to enter data in the user-defined field before the credential can be saved.
4. A "Unique" option may be applied to each user-defined field that, when selected, will not allow duplicate data from different credential holders to be entered.
5. Data format option may be assigned to each user-defined field that will require the data to be entered with certain character types in specific spots in the field entry window.
6. A user-defined field, if selected, will define the field as a deactivate date. The selection shall automatically cause the data to be formatted with the windows MM/DD/YYYY date format. The credential of the holder will be deactivated on that date.
7. A search function shall allow any one user-defined field or combination of user-defined fields to be searched to find the appropriate cardholder. The search function shall include a search for a character string.
8. System shall have the ability to print cardholders based on and organized by the user-defined fields.

O. Code Tracing:

1. System shall perform code tracing selectable by cardholder and by reader.
2. Any code may be designated as a "traced code" with no limit to how many codes can be traced.
3. Any reader may be designated as a "trace reader" with no limit to which or how many readers can be used for code tracing.

4. When a traced code is used at a trace reader, the access-granted message that usually appears on the monitor window of the central station shall be highlighted with a different color than regular messages. A short singular beep shall occur at the same time the highlighted message is displayed on the window.
5. The traced cardholder image (if image exists) shall appear on workstations when used at a trace reader.

## 2.7 SURGE AND TAMPER PROTECTION

- A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.
  1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."
  2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.
- B. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station control-unit alarm display shall identify tamper alarms and indicate locations.

## 2.8 CENTRAL-STATION HARDWARE

- A. Central-Station Computer: Standard workstation of modular design.
- B. Redundant Central Computer: One identical redundant central computer, connected in a hot standby, peer configuration. This computer shall automatically maintain its own copies of system software, application software, and data files. System transactions and other activities that alter system data files shall be updated to system files of redundant computer in near real time. If central computer fails, redundant computer shall assume control immediately and automatically.
- C. Desktop Workstations:
  1. Performance Requirements:
    - a. Performance requirements may dictate equipment exceeding minimum requirements indicated.
    - b. Capable of running Microsoft Windows.
    - c. Energy Star compliant.
    - d. Processor:
      - 1) Minimum Speed: 5.3GHz.
      - 2) Cores: Quad.
      - 3) Series: Core i7.
    - e. RAM:
      - 1) Capacity: 8 GB.

- 2) Speed and Type: 1333 MHz.
- f. Primary Hard Drive:
- 1) Media: Solid state.
  - 2) Number of Hard Drives: One.
  - 3) Capacity: 1TB.
  - 4) Minimum Average Seek Time: 3700/s
  - 5) Cache Buffer Size: 4GB.
- g. Expansion slots: Minimum of 4, 64 bit.
- h. Video Card:
- 1) Capable of supporting four monitors.
  - 2) Resolution: 8K(4320p) pixels minimum for each monitor.
  - 3) RAM: 8 GB.
  - 4) On-Board Memory Speed: 16GHz.
  - 5) On-Board Memory Data Width: 16 gigabytes bit.
- i. Sound Card:
- 1) At least 128 voice wavetable synthesis.
  - 2) Capable of delivering three-dimensional sound effects.
  - 3) High-resolution 16-bit stereo digital audio recording and playback with user-selectable sample rates up to 48,000 Hz.
- j. Network Interface Card: Include card with connection, as applicable.
- 1) 10-100-1000 base TX Ethernet with RJ45 connector port.
  - 2) 100 base FX Ethernet with SC or ST port.
- k. Wireless Ethernet, 802.11 a/b/g/n.
- l. Optical Modem: Full duplex link for connection to optical fiber cable provided.
- m. I/O Ports:
- 1) Two USB 3.0 ports on front panel, six on back panel, and three internal on motherboard.
  - 2) One serial port.
  - 3) One parallel port.
  - 4) Two PS/2 ports.
  - 5) One RJ-45.
  - 6) One stereo line-in and line-out on back panel.
  - 7) One microphone and headphone connector on front panel.
  - 8) One IEEE 1394 on front and back panel with workstation I-e card.

- 9) One ESATA port on back panel.
- n. Battery: Life of at least three years to maintain system clock/calendar and ROM, as a minimum.
2. Keyboard:
  - a. 101 key enhanced keyboard.
  - b. Full upper- and lowercase ASCII keyset, numeric keypad, dedicated cursor control keypad, and 12 programmable function keys.
  - c. Wireless operation within up to 72 inches in front of workstation.
3. Pointing Device:
  - a. Either a two- or three-button mouse.
  - b. Wireless operation within up to 72 inches in front of workstation.
4. PTZ Joystick Controller
5. Flat Panel Display Monitor:
  - a. Number of Displays: Eight.
  - b. Display Support: Desk mounted, adjustable bracket capable of supporting number of monitors specified above with integral power and display cable organization.
  - c. Color display with 43" diagonal viewable area.
  - d. Aspect Ratio: 16 to 9.
  - e. Resolution: 1920 by 4K pixels at 60 Hz with pixel size of 0.277 mm or smaller.
  - f. Digital input signal.
  - g. Response Time: 5 ms.
  - h. Dynamic Contrast Ratio: 50000 to 1.
  - i. Brightness: 250 cd/sq.
  - j. Energy Star compliant.
  - k. Antiglare display.
6. Speakers:
  - a. Two, with individual controls for volume, bass and treble.
  - b. Signal to Noise Ratio: At least 65 dB.
  - c. Power: At least 4 W per speaker/channel.
  - d. Magnetic shielding to prevent distortion on the video monitor.
7. I/O Cabling: Include applicable cabling to connect I/O devices.
8. Software:
  - a. Factory installed operating system.
- D. Servers:

1. Description: x86 based computer used for client-server computing.
  2. Mounting: Rack, blade.
  3. Power: dual power supply, minimum 300 W.
  4. Performance Requirements:
    - a. Performance requirements may dictate equipment exceeding minimum requirements indicated.
    - b. Energy Star compliant.
  5. Processor:
    - a. Minimum Speed: 5.3GHz,
    - b. Cores: Quad.
    - c. Series: Core i7.
  6. RAM:
    - a. Capacity: 1TB.
    - b. Speed and Type: 1333 MGz.
  7. Drive Bays: Eight at 2.5 inches (65 mm) or eight at 3.5 inches (90 mm).
  8. Network Interface: Dual port Gigabit Ethernet
  9. Color, flat-screen display with 23" diagonal viewable area.
  10. KVM.
  11. Next-day on-site warranty for two year period following Substantial Completion.
  12. Servers shall include the following:
    - a. Full-feature backup server (server and backup minimum requirement).
    - b. Software licenses.
    - c. Cable installation between server(s) and network.
  13. Web Server:
    - a. If required to be separate, include Web server hardware and software to match, except backup server is not required.
    - b. Firewalls between server Web and networks.
    - c. Password protection for access to server from Web server.
    - d. Cable installation between the server(s) and building Ethernet network.
  14. Power each server through a dedicated UPS unit.
- E. Printers:
1. Color Laser Printer:
    - a. 1200 by 1200 dots per inch resolution black and white, 1200 by 1200 dots per inch resolution black and white and color.

- b. First sheet printed within 10 seconds.
  - c. 5-20 page per minute rated print speed at best quality mode.
  - d. Print buffer with at least 512 MB of RAM, expandable to at least one GB.
  - e. Complies with Energy Star requirements.
  - f. Capable of handling letter- and legal-size paper and overhead transparencies.
  - g. Two paper trays; one tray with 500 sheet capacity, and one tray with 250 sheet capacity.
  - h. Two-sided printing.
  - i. At least 500 page toner/cartridge capacity.
2. Color Inkjet Printer:
- a. Inkjet technology with true four-color printing (black, cyan, magenta, and yellow).
  - b. Print quality of 1200 by 600 dots per inch with black on inkjet paper and 4800 by 1200 dots per inch color printing on premium photo paper.
  - c. Rated speed of 5-20 pages per minute printing black and white in normal mode and 5-20 pages per minute printing color in normal mode.
  - d. Two paper trays; one tray with 500 sheet capacity, and one tray with 250 sheet capacity.
  - e. Capable of handling letter- and legal-size paper and overhead transparencies.
  - f. Duplex printing (printing on both sides of paper).

## 2.9 FIXED MAP DISPLAY

- A. A fixed map display shall show layout of the protected facilities. Zones corresponding to those monitored by the system shall be highlighted on the display. Status of each zone shall be displayed using digital displays as required within each designated zone. A digital display test switch shall be provided on the map display.

## 2.10 CONTROLLERS

- A. Controllers: Intelligent peripheral control unit, complying with UL 294, that stores time, date, valid codes, access levels, and similar data downloaded from the central station or workstation for controlling its operation.
- B. Subject to compliance with requirements in this article, manufacturers may use multipurpose controllers.
- C. Battery Backup: Sealed, lead acid; sized to provide run time during a power outage of 90 minutes, complying with UL 924.
- D. Alarm Annunciation Controller:
  - 1. The controller shall automatically restore communication within 10 seconds after an interruption with the field device network.
    - a. Inputs: Monitor dry contacts for changes of state that reflect alarm conditions. Provides at least eight alarm inputs, which are suitable for wiring as normally open or normally closed contacts for alarm conditions.
    - b. Alarm-Line Supervision:

- 1) Supervise the alarm lines by monitoring each circuit for changes or disturbances in the signal by monitoring for abnormal open, grounded, or shorted conditions using dc change measurements. System shall initiate an alarm in response to an abnormal current, which is a dc change of 10 percent or more for longer than 500 ms.
      - 2) Transmit alarm-line-supervision alarm to the central station during the next interrogation cycle after the abnormal current condition.
    - c. Outputs: Managed by central-station software.
  2. Auxiliary Equipment Power: A GFI service outlet inside the controller enclosure and all power shall be hard-wired.
- E. Entry-Control Controller:
  1. Function: Provide local entry-control functions including one- and two-way communications with access-control devices such as card readers, keypads, biometric personnel identity-verification devices, door strikes, magnetic latches, gate and door operators, and exit push buttons.
    - a. Operate as a stand-alone portal controller using the downloaded database during periods of communication loss between the controller and the field-device network.
    - b. Accept information generated by the entry-control devices; automatically process this information to determine valid identification of the individual present at the portal:
      - 1) On authentication of the credentials or information presented, check privileges of the identified individual, allowing only those actions granted as privileges.
      - 2) Privileges shall include, but are not limited to, time of day control, day of week control, group control, and visitor escort control.
    - c. Maintain a date-, time-, and Location-stamped record of each transaction. A transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.
  2. Inputs:
    - a. Data from entry-control devices; use this input to change modes between access and secure.
    - b. Database downloads and updates from the central station that include enrollment and privilege information.
  3. Outputs:
    - a. Indicate success or failure of attempts to use entry-control devices and make comparisons of presented information with stored identification information.
    - b. Grant or deny entry by sending control signals to portal-control devices.
    - c. Maintain a date-, time-, and Location-stamped record of each transaction and transmit transaction records to the central station.



- d. Door Prop Alarm: If a portal is held open for longer than time listed in a schedule] alarm sounds.
- 4. With power supplies sufficient to power at voltage and frequency required for field devices and portal-control devices.
- 5. Data Line Problems: For periods of loss of communication with the central station, or when data transmission is degraded and generating continuous checksum errors, the controller shall continue to control entry by accepting identifying information, making authentication decisions, checking privileges, and controlling portal-control devices.
  - a. Store up to 1000 transactions during periods of communication loss between the controller and access-control devices for subsequent upload to the central station on restoration of communication.
- 6. Controller Power: NFPA 70, Class II power-supply transformer, with 12- or 24-V ac secondary, backup battery and charger.
  - a. Backup Battery: Valve-regulated, recombinant-sealed, lead-acid battery; spill proof. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
  - b. Backup Power-Supply Capacity: Five minutes of battery supply. Submit battery and charger calculations.
  - c. Power Monitoring: Provide manual, dynamic battery-load test, initiated and monitored at the control center; with automatic disconnection of the controller when battery voltage drops below controller limits. Report by using local controller-mounted digital displays and by communicating status to central station. Indicate normal power on and battery charger on trickle charge. Indicate and report the following:
    - 1) Trouble Alarm: Normal power-off load assumed by battery.
    - 2) Trouble Alarm: Low battery.
    - 3) Alarm: Power off.

## 2.11 SECONDARY ALARM ANNUNCIATOR

- A. Secondary Alarm Annunciation Site: A workstation with limited I/O capacity, consisting of a secondary alarm annunciation workstation to allow the operator to duplicate functions of the main operator interface and to show system status changes.

## 2.12 ENROLLMENT CENTER

- A. Equipment for enrolling personnel into, and removing personnel from, system database, using a dedicated desktop workstation
  - 1. Include equipment to enroll selected biometric credentials.
- B. Enrollment equipment shall support encoding of credential cards including cryptographic and other internal security checks as required for system.
  - 1. Allow only authorized entry-control enrollment personnel to access the enrollment equipment using passwords.

2. Include enrollment-subsystem configuration controls and electronic diagnostic aids for subsystem setup and troubleshooting with the central station.
  3. Enrollment-station records printer shall meet requirements of the report printer.
- C. Entry-Control Enrollment Software:
1. Shall include database management functions for the system, and shall allow an operator to change and modify the data entered in the system as needed.
  2. Software shall not have alarm response or acknowledgment functions as a programmable function.
  3. Multiple, password-protected access levels shall be provided at the enrollment station.
  4. Database management and modification functions shall require a higher operator-access level than personnel enrollment functions.
  5. Software shall provide a means for disabling the enrollment station when it is unattended, to prevent unauthorized use.
  6. Software shall provide a method to enter personnel identifying information into the entry-control database files through enrollment stations to include a credential unit in use at the installation.
  7. In the case of personnel identity-verification subsystems, this data shall include biometric data.
  8. Software shall allow entry of this data into the system database files through the use of simple menu selections and data fields. The data field names shall be customized to suit user and site needs.
  9. Personnel identity-verification subsystems selected for use with the system shall fully support the enrollment function and shall be compatible with the entry-control database files.
- D. System Capacity: Number of badges shall be limited only by hard disk space. Badge templates and images shall be in color, supporting the maximum color capability of workstation operating system.
- E. Badge Configuration:
1. Software for badge template creation shall include a template consisting of background and predetermined locations of photographs, text objects and data fields for text, and bar-code and biometric information. Include automatic sizing of data fields placed on a badge to compensate for names, which may otherwise be too large to fit in the area designated.
  2. Allow different badge templates to be used for each department, tenant, or visitor.
  3. As a setup option, templates shall be automatically selected for the badge, based on the group to which the credential holder is assigned. Allow the operator to override the automatic template selection and use a template chosen by the operator for creating a badge.
  4. Setup shall determine which graphics and credential-holder information will be displayed and where on the card it will be placed. All data in the security access system, such as name, code, group, access level, and any of the 99 user-defined fields, shall be selectable, with the ability to place them anywhere on the card.
  5. System shall include an importing, filing, and recall system of stored images and shapes that can be placed on the badge.
  6. Allow multiple images on the same badge, including, but not limited to, bar codes, digital photos, and signatures.

7. Support transparent backgrounds so that image is only surrounded by the intended background and not by its immediate background.
- F. Photo Imaging: Integral to security access.
1. Import images from bitmap file formats, digital cameras, TWAIN cameras, or scanners. Allow image cropping and editing, WYSIWYG badge-building application, and badge print-preview and printing capabilities.
  2. System shall support multiple images stored for each credential holder, including signatures, portrait views, and profile views.
- G. Text Objects: Badge configuration shall provide for creation of custom text as an object, allowing font selection, typing, scaling, and formatting of the text object. Formatting options shall include changing font, font size, text flow, and text alignment; bending or curving the text object into a circle or semicircle; applying 3-D effects; and applying predefined effects such as tilt, extrusion, or beveling. Text shall be placed and optionally automatically centered within any region of the badge layout.
- H. Badges and Credential Cards:
1. Badges are credential cards that do not contain data to be read by card readers.
  2. Credential cards shall store uniquely coded data used by card readers as an Identifier.
    - a. Proximity Cards: Use proximity detection without physical contact with the reader for proper operation.
  3. Allow entry-control card to be modified by lamination or direct print process during the enrollment process for use as a picture and identification badge without reduction of readability. The design shall allow for the addition of at least one slot or hole to accommodate the attachment of a clip for affixing the credential card to the type of badge holder used at the site.
    - a. Card Size and Dimensional Stability: Standard size, 2-1/8 by 3-3/8 inches; dimensionally stable so that an undamaged card with deformations resulting from normal use shall be readable by the card reader.
    - b. Card Material: Abrasion resistant, nonflammable, and nontoxic; and impervious to solar radiation and effects of ultraviolet light.
    - c. Card Construction: Core and laminate or monolithic construction. Lettering, logos, and other markings shall be hot stamped into the credential material or direct printed.
      - 1) Incorporate phosphorous ink]as a security enhancement.
      - 2) Furnish equipment for on-site assembly and lamination of credential cards.
    - d. Card Durability and Maintainability: Designed and constructed to yield a useful lifetime of at least five years or 5000 insertions or swipes, whichever results in a longer period of time. Allow credential cards to be cleaned by wiping with a sponge or cloth wetted with soap and water.
- I. Card-Making Equipment: Consisting of a workstation, video camera, video-imaging equipment, and a printer.
1. Camera: NTSC color standard, RGB video output, 470 lines minimum horizontal resolution, and automatic white balance with full rated output under illumination of 0.5 fc (5 lx).

2. Video Imaging: Live-image capture software and hardware and a digital signature capture pad.
3. Standard workstation, modified as follows:
  - a. Redundant workstation is not required.
  - b. Printer is not required.
  - c. UPS is not required.
  - d. Sound card is not required.
4. Printer: Dye-sublimation resin thermal transfer, 300 dpi resolution, 16.7 million colors, accepting cards ranging in size from 2.1 by 3 inches to 2.6 by 3.7 inches and having card thickness ranging from 0.020 to 0.060 inch. Printer shall have options for encoding magnetic stripe using tracks 1, 2, and 3. Throughput shall be not less than 60 seconds per card.

### **2.13 DOOR AND GATE HARDWARE INTERFACE**

- A. Exit Device with Alarm: Operation of the exit device shall generate an alarm and annunciate a local alarm. Exit device and alarm contacts are specified in Section 087100 "Door Hardware."
- B. Exit Alarm: Operation of a monitored door shall generate an alarm. Exit devices and alarm contacts are specified in Section 087100 "Door Hardware."
- C. Electric Door Strikes: Use end-of-line resistors to provide power-line supervision. Signal switches shall transmit data to controller to indicate when the bolt is not engaged and the strike mechanism is unlocked, and they shall report a forced entry. Power and signal shall be from the controller. Electric strikes are specified in Section 087100 "Door Hardware."
- D. Electromagnetic Locks: End-of-line resistors shall provide power-line supervision. Lock status sensing signal shall positively indicate door is secure. Power and signal shall be from the controller. Electromagnetic locks are specified in Section 087100 "Door Hardware."
- E. Vehicle Gate Operator: Interface electrical operation of gate with controls in this Section. Vehicle gate operators shall be connected, monitored, and controlled by the security access controllers. Vehicle gate and accessories are specified in Section 323113 "Chain Link Fences and Gates."

### **2.14 FIELD-PROCESSING SOFTWARE**

- A. Operating System:
  1. Local processors shall contain an operating system that controls and schedules that local processor's activities in real time.
  2. Local processor shall maintain a point database in its memory that includes parameters, constraints, and the latest value or status of all points connected to that local processor.
  3. Execution of local processor application programs shall utilize the data in memory resident files.
  4. Operating system shall include a real-time clock function that maintains the seconds, minutes, hours, date, and month, including day of the week.
  5. Local processor real-time clock shall be automatically synchronized with the central station at least once per day to plus or minus 10 seconds (the time synchronization shall be accomplished automatically, without operator action and without requiring system shutdown).

**B. Startup Software:**

1. Causes automatic commencement of operation without human intervention, including startup of all connected I/O functions.
2. Local processor restart program based on detection of power failure at the local processor shall be included in the local processor software.
3. Initiates operation of self-test diagnostic routines.
4. Upon failure of the local processor, if the database and application software are no longer resident, the local processor shall not restart and systems shall remain in the failure mode indicated until the necessary repairs are made.
5. If the database and application programs are resident, the local processor shall immediately resume operation.

**C. Operating Mode:**

1. Local processors shall control and monitor inputs and outputs as specified, independent of communications with the central station or designated workstations.
2. Alarms, status changes, and other data shall be transmitted to the central station or designated workstations when communications circuits are operable.
3. If communications are not available, each local processor shall function in a stand-alone mode and operational data, including the status and alarm data normally transmitted to the central station or designated workstations, shall be stored for later transmission to the central station or designated workstations.
4. Storage for the latest 4000 events shall be provided at local processors, as a minimum.
5. Local processors shall accept software downloaded from the central station.
6. Panel shall support flash ROM technology to accomplish firmware downloads from a central location.

**D. Failure Mode:** Upon failure for any reason, each local processor shall perform an orderly shutdown and force all local processor outputs to a predetermined (failure-mode) state, consistent with the failure modes shown and the associated control device.**E. Functions:**

1. Monitoring of inputs.
2. Control of outputs.
3. Reporting of alarms automatically to the central station.
4. Reporting of sensor and output status to central station upon request.
5. Maintenance of real time, automatically updated by the central station at least once a day.
6. Communication with the central station.
7. Execution of local processor resident programs.
8. Diagnostics.
9. Download and upload data to and from the central station.

**2.15 FIELD-PROCESSING HARDWARE****A. Alarm Annunciation Local Processor:**

1. Respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station, and change outputs based on commands received from the central station.
  2. Local processor shall also automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs.
  3. Local processor inputs shall monitor dry contacts for changes of state that reflect alarm conditions.
  4. Local processor shall have at least eight alarm inputs which allow wiring contacts as normally open or normally closed for alarm conditions; and shall provide line supervision for each input by monitoring each input for abnormal open, grounded, or shorted conditions using dc current change measurements.
  5. Local processor shall report line supervision alarms to the central station.
  6. Alarms shall be reported for any condition that remains abnormal at an input for longer than 500 milliseconds.
  7. Alarm condition shall be transmitted to the central computer during the next interrogation cycle.
  8. Local processor outputs shall reflect the state of commands issued by the central station.
  9. Outputs shall be a form C contact and shall include normally open and normally closed contacts.
  10. Local processor shall have at least four command outputs.
  11. Local processor shall be able to communicate with the central station via RS-485 or TCP/IP as a minimum.
- B. Processor Power Supply:
1. Local processor and sensors shall be powered from an uninterruptible power source.
  2. Uninterruptible power source shall provide eight hours of battery back-up power in the event of primary power failure and shall automatically fully recharge the batteries within 12 hours after primary power is restored.
  3. If the facility is without an emergency generator, the uninterruptible power source shall provide 24 hours of battery backup power.
  4. There shall be no equipment malfunctions or perturbations or loss of data during the switch from primary to battery power and vice versa.
  5. Batteries shall be sealed, non-outgassing type.
  6. Power supply shall be equipped with an indicator for ac input power and an indicator for dc output power.
  7. Loss of primary power shall be reported to the central station as an alarm.
- C. Auxiliary Equipment Power: A GFI service outlet shall be furnished inside the local processor's enclosure.
- D. Entry-Control Local Processor:
1. Entry-control local processor shall respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station, and change outputs based on commands received from the central station.

2. Local processor shall also automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs.
3. Entry-control local processor shall provide local entry-control functions including communicating with field devices such as card readers, keypads, biometric personnel identity-verification devices, door strikes, magnetic latches, gate and door operators, and exit push buttons.
4. Processor shall also accept data from entry-control field devices as well as database downloads and updates from the central station that include enrollment and privilege information.
5. Processor shall send indications of successful or failed attempts to use entry-control field devices and shall make comparisons of presented information with stored identification information.
6. Processor shall grant or deny entry by sending control signals to portal-control devices and mask intrusion-alarm annunciation from sensors stimulated by authorized entries.
7. Entry-control local processor shall use inputs from entry-control devices to change modes between access and secure.
8. Local processor shall maintain a date-time- and location-stamped record of each transaction and transmit transaction records to the central station.
9. Processor shall operate as a stand-alone portal controller using the downloaded database during periods of communication loss between the local processor and the central station.
10. Processor shall store a minimum of 4000 transactions during periods of communication loss between the local processor and the central station for subsequent upload to the central station upon restoration of communication.
11. Local processor inputs shall monitor dry contacts for changes of state that reflect alarm conditions.
12. Local processor shall have at least eight alarm inputs which allow wiring contacts as normally open or normally closed for alarm conditions; and shall also provide line supervision for each input by monitoring each input for abnormal open, grounded, or shorted conditions using dc current change measurements.
13. Local processor shall report line supervision alarms to the central station.
14. Alarms shall be reported for any condition that remains abnormal at an input for longer than 500 ms.
15. Alarm condition shall be transmitted to the central station during the next interrogation cycle.
16. Entry-control local processor shall include the necessary software drivers to communicate with entry-control field devices. Information generated by the entry-control field devices shall be accepted by the local processor and automatically processed to determine valid identification of the individual present at the portal.
17. Upon authentication of the credentials or information presented, the local processor shall automatically check privileges of the identified individual, allowing only those actions granted as privileges.
18. Privileges shall include, but are not limited to, time of day control, day of week control, group control, and visitor escort control. The local processor shall maintain a date-time- and location-stamped record of each transaction.

19. Transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.
20. Local processor outputs shall reflect the state of commands issued by the central station.
21. Outputs shall be a form C contact and shall include normally open and normally closed contacts.
22. Local processor shall have at least four addressable outputs.
23. The entry-control local processor shall also provide control outputs to portal-control devices.
24. Local processor shall be able to communicate with the central station via RS-485 or TCP/IP as a minimum.
25. The system manufacturer shall provide strategies for downloading database information for panel configurations and cardholder data to minimize the required download time when using IP connectivity.

## **2.16 FLOOR-SELECT ELEVATOR CONTROL**

- A. Elevator access control shall be integral to security access.
  1. System shall be capable of providing full elevator security and control through dedicated controllers without relying on the control-station host workstation for elevator control decisions.
  2. Access-control system shall enable and disable car calls on each floor and floor-select buttons in each elevator car, restricting passengers' access to the floors where they have been given access.
  3. System setup shall, through programming, automatically and individually secure and unsecure each floor-select button of a car by time and day. Each floor-select button within a car shall be separately controlled so that some floors may be secure while others remain unsecure.
  4. When a floor-select button is secure, it shall require the passenger to use his or her access code and gain access to that floor before the floor-select button will operate. The passenger's credential shall determine which car call and floor-select buttons are to be enabled, restricting access to floors unless authorized by the system's access code database. Floor-select button shall be enabled only in the car where the credential holder is the passenger.
- B. Security access system shall record which call button is pressed, along with credential and time information.
  1. System controller shall record elevator access data.
  2. The controller shall reset all additional call buttons that may have been enabled by the user's credential.
  3. The floor-select elevator control shall allow for manual override from a workstation workstation either by individual floor or by cab.

## **2.17 REAL-TIME GUARD TOUR**

- A. Guard tour module shall provide the ability to plan, track, and route tours. Module shall input an alarm during tour if guard fails to make a station. Tours can be programmed for sequential or random tour-station order.



1. Guard tour setup shall define specific routes or tours for the guard to take, with time restrictions in which to reach every predefined tour station.
  2. Guard tour activity shall be automatically logged to the central-station workstation's hard drive.
  3. If the guard is early or late to a tour station, a unique alarm per station shall appear at the central station to indicate the time and station.
  4. Guard tour setup shall allow the tours to be executed sequentially or in a random order with an overall time limit set for the entire tour instead of individual times for each tour station.
  5. Setup shall allow recording of predefined responses that will display for the operator at the control station should a "Failed to Check In" alarm occur.
- B. Guard tour module shall allow proprietary direct-connected systems to use security access-control hardware to perform guard tour management in real time.
- C. A tour station is a physical location where a guard shall go and perform an action indicating that he or she has arrived. This action, performed at the tour station, shall be one of 13 different events with any combination of station types within the same tour. An event at a tour station shall be one of the following types:
1. Access Granted.
  2. Access Denied Code.
  3. Access Denied Card plus PIN.
  4. Access Denied Time Zone.
  5. Access Denied Level.
  6. Access Denied Facility.
  7. Access Denied Code Timer.
  8. Access Denied Anti-Passback.
  9. Access Granted Passback Violation.
  10. Alarm.
  11. Restored.
  12. Input Normal.
  13. Input Abnormal.
- D. Guard tour and other system features shall operate simultaneously with no interference.
- E. Guard Tour Module Capacity: 999 possible guard tour definitions with each tour having up to 99 tour stations. System shall allow all 999 tours to be running at the same time.

## **2.18 VIDEO AND CAMERA CONTROL**

- A. Control station or designated workstation displays live video from a CCTV source.
1. Control Buttons: On the display window, with separate control buttons to represent Left, Right, Up, Down, Zoom In, Zoom Out, Scan, and a minimum of two custom-command auxiliary controls.
  2. Provide at least seven icons to represent different types of cameras, with ability to import custom icons. Provide option for display of icons on graphic maps to represent their physical location.

3. Provide the alarm-handling window with a command button that will display the camera associated with the alarm point.
- B. Display mouse-selectable icons representing each camera source, to select source to be displayed. For CCTV sources that are connected to a video switcher, control station shall automatically send control commands through a COM port to display the requested camera when the camera icon is selected.
- C. Allow cameras with preset positioning to be defined by displaying a different icon for each of the presets. Provide control with Next and Previous buttons to allow operator to cycle quickly through the preset positions.

## **2.19 TRANSFORMERS**

- A. NFPA 70, Class II control transformers, NRTL listed. Transformers for security access-control system shall not be shared with any other system.

## **2.20 CABLE AND ASSET MANAGEMENT SOFTWARE**

- A. Computer-based cable and asset management system, with fully integrated database and graphic capabilities, complying with requirements in TIA 606-B.
  1. Document physical characteristics by recording the network, asset, user, TIA details, device configurations, and exact connections between equipment and cabling.
    - a. Manage the physical layer of security system.
    - b. List device configurations.
    - c. List and display circuit connections.
    - d. Record firestopping data.
    - e. Record grounding and bonding connections and test data.
  2. Information shall be presented in database view, schematic plans, or technical drawings.
    - a. Microsoft Visio Technical Drawing shall be used as drawing and schematic plans software. Drawing symbols, system layout, and design shall comply with SIA/IAPSC AG-01.
  3. System shall interface with the following testing and recording devices:
    - a. Direct-upload tests from circuit testing instrument into the workstation.
    - b. Direct-download circuit labeling into labeling printer.
- B. Software shall be designed for the same version as security access system's central station and workstations and shall be installed on the designated workstation, using a hard drive dedicated only to this management function.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

- B. Examine roughing-in for LAN and control cable conduit systems to workstations, controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Comply with recommendations in SIA CP-01.
- B. Comply with TIA 606-B, "Administration Standard for Commercial Telecommunications Infrastructure."
- C. Product Schedules: Obtain detailed product schedules from manufacturer of access-control system or develop product schedules to suit Project. Fill in all data available from Project plans and specifications and publish as Product Schedules for review and approval.
  - 1. Record setup data for control station and workstations.
  - 2. For each Location, record setup of controller features and access requirements.
  - 3. Propose start and stop times for time zones and holidays, and match up access levels for doors.
  - 4. Set up groups, facility codes, linking, and list inputs and outputs for each controller.
  - 5. Assign action message names and compose messages.
  - 6. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
  - 7. Prepare and install alarm graphic maps.
  - 8. Develop user-defined fields.
  - 9. Develop screen layout formats.
  - 10. Propose setups for guard tours and key control.
  - 11. Discuss badge layout options; design badges.
  - 12. Complete system diagnostics and operation verification.
  - 13. Prepare a specific plan for system testing, startup, and demonstration.
  - 14. Develop acceptance test concept and, on approval, develop specifics of the test.
  - 15. Develop cable and asset-management system details; input data from construction documents. Include system schematics and Visio Technical Drawings in electronic format.
- D. In meetings with Architect and Owner, present Product Schedules and review, adjust, and prepare final setup documents. Use approved, final Product Schedules to set up system software.

### **3.3 IDENTIFICATION**

- A. In addition to requirements in this article, comply with applicable requirements in Section 270553 "Identification for Communications Systems" and with TIA 606-B.
- B. Using software specified in "Cable and Asset Management Software" Article, develop cable administration drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with the same designation. Use logical and systematic designations for facility's architectural arrangement.

- C. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
  - 1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.
- D. At completion, cable and asset management software shall reflect as-built conditions.

### **3.4 SYSTEM SOFTWARE AND HARDWARE**

- A. Develop, install, and test software and hardware, and perform database tests for the complete and proper operation of systems involved. Assign software license to Owner.

### **3.5 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to supervise and assist with startup service.
  - 1. Complete installation and startup checks according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.
  - 2. Enroll and prepare badges and access cards for Owner's operators, management, and security personnel.

### **3.6 PROTECTION**

- A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured with an activated burglar alarm and access-control system reporting to a central station complying with UL 1610, "Central-Station Burglar-Alarm Units," during periods when a qualified operator in the employ of Contractor is not present.

### **3.7 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain security access system. See Section 017900 "Demonstration and Training."
- B. Develop separate training modules for the following:
  - 1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
  - 2. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
  - 3. Security personnel.
  - 4. Hardware maintenance personnel.
  - 5. Corporate management.

**END OF SECTION 281300**

**SECTION 281500 - ACCESS CONTROL HARDWARE DEVICES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Card readers, credential cards, and keypads
  - 2. Cables
  - 3. Transformers
- B. Related Requirements:
  - 1. Section 281300 "Access Control System Software and Database Management" for control and monitoring applications, workstations, and interfaces.

**1.3 DEFINITIONS**

- A. Credential: Data assigned to an entity and used to identify that entity.
- B. DTS: Digital Termination Service. A microwave-based, line-of-sight communication provided directly to the end user.
- C. Identifier: A credential card; keypad personal identification number; or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- D. Location: A Location on the network having a PC-to-controller communications link, with additional controllers at the Location connected to the PC-to-controller link with a TIA 485-A communications loop. Where this term is presented with an initial capital letter, this definition applies.
- E. PC: Personal computer. Applies to the central station, workstations, and file servers.
- F. RAS: Remote access services.
- G. RF: Radio frequency.
- H. ROM: Read-only memory. ROM data is maintained through losses of power.
- I. TCP/IP: Transport control protocol/Internet protocol.
- J. TWAIN: Technology without an Interesting Name. A programming interface that lets a graphics application, such as an image editing program or desktop publishing program, activate a scanner, frame grabber, or other image-capturing device.
- K. WMP: Windows media player.
- L. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.

- M. WYSIWYG: What You See Is What You Get. Text and graphics appear on the screen the same as they will in print.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings. Test and evaluation data presented in Product Data shall comply with SIA BIO-01.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Diagrams for cable management system.
  - 2. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.
  - 3. Wiring Diagrams. For power, signal, and control wiring. Show typical wiring schematics including the following:
    - a. Workstation outlets, jacks, and jack assemblies.
    - b. Patch cords.
    - c. Patch panels.
  - 4. Cable Administration Drawings: As specified in "Identification" Article.
  - 5. Battery and charger calculations for central station, workstations, and controllers.
- C. Product Schedules.
- D. Samples: For workstation outlets, jacks, jack assemblies, and faceplates. For each exposed product and for each color and texture specified.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on USB media of the hard-copy submittal.
  - 2. System installation and setup guides with data forms to plan and record options and setup decisions.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Credential card blanks, ready for printing. Include enough credential cards for all personnel to be enrolled at the site plus an extra 50 percent for future use.

2. Fuses of all kinds, power and electronic, equal to 10 percent of amount installed for each size used, but no fewer than three units.

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
  1. Cable installer must have on staff an RCDD certified by Building Industry Consulting Service International.
  2. Contractor to be certified by manufacturer
- B. Source Limitations: Obtain central station, workstations, controllers, Identifier readers, and all software through one source from single manufacturer.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F and not more than 80 percent relative humidity, noncondensing.
- B. Open each container; verify contents against packing list; and file copy of packing list, complete with container identification, for inclusion in operation and maintenance data.
- C. Mark packing list with the same designations assigned to materials and equipment for recording in the system labeling schedules that are generated by software specified in "Cable and Asset Management Software" Article.
- D. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

## 1.10 PROJECT CONDITIONS

- A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
  1. Control Station: Rated for continuous operation in ambient conditions of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.
  2. Indoor, Controlled Environment: NEMA 250, Type 1 enclosure. System components, except the central-station control unit, installed in temperature-controlled indoor environments shall be rated for continuous operation in ambient conditions of 36 to 85 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.
  3. Indoor, Uncontrolled Environment: NEMA 250, Type 3R, Type 4 enclosures. System components installed in non-temperature-controlled indoor environments shall be rated for continuous operation in ambient conditions of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.
  4. Outdoor Environment: NEMA 250, NEMA 250, Type 3R, Type 4 enclosures. System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 85 mph.
  5. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.

6. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X enclosures.

## **PART 2 - PRODUCTS**

### **2.1 OPERATION**

- A. Security access system hardware shall use a single database for access-control and credential-creation functions.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70, "National Electrical Code."
- C. Comply with SIA DC-03.

### **2.3 CARD READERS, CREDENTIAL CARDS, AND KEYPADS**

- A. Card-Reader Power: Powered from its associated controller, including its standby power source, and shall not dissipate more than 5 W.
- B. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the controller. Response time shall be 800 ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.
- C. Enclosure: Suitable for surface, semi-flush, pedestal, or weatherproof mounting. Mounting types shall additionally be suitable for installation in the following locations:
  1. Indoors, controlled environment.
  2. Indoors, uncontrolled environment.
  3. Outdoors, with built-in heaters or other cold-weather equipment to extend the operating temperature range as needed for operation at the site.
- D. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.
- E. Touch-Plate and Proximity Readers:
  1. Active-detection proximity card readers shall provide power to compatible credential cards through magnetic induction and shall receive and decode a unique identification code number transmitted from the credential card.
  2. Passive-detection proximity card readers shall use a swept-frequency, RF field generator to read the resonant frequencies of tuned circuits laminated into compatible credential cards. The resonant frequencies read shall constitute a unique identification code number.
  3. The card reader shall read proximity cards in a range from direct contact to at least 6 inches from the reader.
- F. Keypads:
  1. Entry-control keypads shall use a unique combination of alphanumeric and other symbols as an Identifier.
  2. Keypads shall contain an integral alphanumeric/special symbols keyboard with symbols arranged in ascending ASCII-code ordinal sequence.
  3. Communication protocol shall be compatible with the local processor.



- G. Keypad Display:
1. Keypads shall include a digital visual indicator and shall provide visible and audible status indications and user prompts.
  2. Display shall indicate power on or off and whether user passage requests have been accepted or rejected.
  3. Design of the keypad display or keypad enclosure shall limit viewing angles of the keypad as follows:
    - a. Maximum Horizontal Viewing Angle: Plus or minus 5 degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display.
    - b. Maximum Vertical Viewing Angle: Plus or minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.
- H. Keypad Response Time:
1. The keypad shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 ms or less from the time the last alphanumeric symbol is entered until a response signal is generated.
- I. Keypad Power:
1. The keypad shall be powered from the source as shown and shall not dissipate more than 150 W.
- J. Keypad Mounting Method:
1. Keypads shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.
- K. Keypad Duress Codes:
1. Keypads shall provide a means for users to indicate a duress situation by entering a special code.
- L. Keypad and Wiegand-Swipe-Reader Combination: Designed to require an entry on the keypad before presenting the credential card.
1. Keypad: Allow the entry of four alphanumeric characters that are associated with a specific credential. Keypads shall contain an integral alphanumeric/special symbol keyboard with symbols arranged in ascending ASCII-code ordinal sequence. Keypad display or enclosure shall limit viewing angles of the keypad as follows:
    - a. Maximum Horizontal Viewing Angle: Plus or minus 5 degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display.
    - b. Maximum Vertical Viewing Angle: Plus or minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.
  2. Wiegand Swipe Reader: Set up for 26-bit data cards to generate a unique card identification code. Comply with SIA AC-01.
- M. Communication Protocol: Compatible with local processor.
- N. Touch-Plate and Contactless Card Reader: The reader shall have "flash" download capability to accommodate card format changes. The card reader shall have capability of transmitting data to security control panel and shall comply with ISO/IEC 7816.
- O. Credential Card Modification: Entry-control cards shall be able to be modified by lamination direct print process during the enrollment process without reduction of readability. The design of

the credential cards shall allow for the addition of at least one slot or hole to accommodate the attachment of a clip for affixing the credential card to the badge holder used at the site.

- P. Card Size and Dimensional Stability: Credential cards shall be 2-1/8 by 3-3/8 inches. The credential card material shall be dimensionally stable so that an undamaged card with deformations resulting from normal use shall be readable by the card reader.
- Q. Card Material: Abrasion resistant, nonflammable, nontoxic, and impervious to solar radiation and effects of ultraviolet light.
- R. Card Construction:
  - 1. Core and laminate or monolithic construction.
  - 2. Lettering, logos, and other markings shall be hot stamped into the credential material or direct printed.
  - 3. Incorporate phosphorous ink as a security enhancement.
  - 4. Furnish equipment for on-site assembly and lamination of credential cards.

## 2.4 BIOMETRIC IDENTITY-VERIFICATION EQUIPMENT

- A. Biometric identity-verification templates shall be stored as part of system database files and used as a comparative base by the identity-verification equipment to generate an appropriate signal to the associated controller.
- B. Eye Retina Scanner: Designed to incorporate positive measures to establish that the eye retina being scanned by the device belongs to a living human being.
  - 1. Retina scan device shall provide a means that does not require facial contact with the device for enrollees to align their eye for identification. A manual push button shall be provided to initiate the scan process when the enrollee's eye is aligned in front of the device.
  - 2. The efficiency and accuracy of scanner shall not be affected by contact lenses.
  - 3. Storage space for each eye template shall not exceed 512 8-bit bytes.
  - 4. Light-emitting source used for retina scans may not use light levels exceeding 20 percent of the maximum safe level established in the American Conference of Governmental Industrial Hygienists limit values.
  - 5. Template Update: Eye scanner shall not automatically update an enrollee's template. Significant changes in an individual's eye shall require re-enrollment.
  - 6. Scan acceptance tolerance or template match criteria shall be under system manager/operator control. Eye scanner shall determine when multiple attempts are needed for retina verification and shall automatically prompt the enrollee for additional attempts up to a maximum of three. Three failed attempts shall generate an entry-control alarm.
  - 7. Average Verification Time: Eye scanner shall respond to passage requests by generating an entry request signal to the controller. The verification time shall be 1.5 seconds or less from the moment eye scanner initiates the scan process until eye scanner generates a response signal.
  - 8. Modes: Eye scanner shall provide an enrollment mode, a recognition mode, and a code/credential verification mode.
    - a. In the enrollment mode, eye scanner shall create an eye template for new personnel and enter the template into the system database file created for that person. Template information shall be compatible with system application software.

- b. In the recognition mode, eye scanner shall allow passage when the eye scan data from the verification attempt match an eye template stored in database files.
    - c. In the code/credential verification mode, eye scanner shall allow passage when the eye scan data from the verification attempt match the eye scan template associated with the identification code entered into a keypad, or they match the eye scan template associated with credential card data read by a card reader.
  9. Reports: Eye scanner shall create and store template match scores for all transactions involving eye retinal scans. Template match scores shall be stored in the matching personnel data file used for report generation.
  10. Power: Scanner shall be powered from its associated controller, requiring not more than 45W.
  11. Enclosure: Eye scanners shall be available with enclosures that are suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:
    - a. Indoors, controlled environment.
  12. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off and whether user passage requests have been accepted or rejected.
- C. Hand Geometry: Use unique human hand measurements to identify authorized, enrolled personnel. The design of this device shall incorporate positive measures to establish that the hand being measured by the device belongs to a living human being.
  1. The user's hand shall remain in full view of the user at all times. The scan process of the hand geometry device shall make three-dimensional measurements of the size and shape of the subject's hand. Scanning shall start automatically once the user's hand is properly positioned by the alignment system.
  2. Hand geometry device shall be able to use either left or right hand for enrollment and verification.
  3. Storage space for each hand template shall not exceed 50 8-bit bytes.
  4. Template Update and Acceptance Tolerances: Hand geometry devices shall not automatically update a user's profile. Significant changes in an individual's hand geometry shall require re-enrollment. Hand geometry devices shall provide an adjustable acceptance tolerance or template match criteria under system manager/operator control. Hand geometry device shall determine when multiple attempts are needed for hand geometry verification and shall automatically prompt the user for additional attempts up to a maximum of three. Three failed attempts shall generate an entry-control alarm.
  5. Average Verification Time: Hand geometry device shall respond to passage requests by generating an entry request signal to the controller. The verification time shall be 1.5 seconds or less from the moment hand geometry device initiates the scan process until hand geometry device generates a response signal.
  6. Modes: Hand geometry device shall provide an enrollment mode, a recognition mode, and a code/credential verification mode.
    - a. In the enrollment mode, hand geometry device shall create a hand template for new personnel and enter the template into the system database file created for that person. Template information shall be compatible with system application software.



- b. In the recognition mode, fingerprint analysis scanner shall allow passage when the fingerprint data from the verification attempt match a fingerprint template stored in database files.
    - c. In the code/credential verification mode, fingerprint analysis scanner shall allow passage when the fingerprint data from the verification attempt match the fingerprint template associated with the identification code entered into a keypad, or they match the fingerprint template associated with credential card data read by a card reader.
  6. Reports: Fingerprint analysis device shall create and store pattern match scores for all transactions involving fingerprint scans. Template match scores shall be stored in the matching personnel data file used for report generation.
  7. Power: Fingerprint analysis scanner shall be powered from its associated controller, requiring not more than 45W.
  8. Enclosure: Scanners shall be available with enclosures that are suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:
    - a. Indoors, controlled environment.
  9. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off and whether user passage requests have been accepted or rejected.
- E. Iris Scan Device: Use the unique patterns found in the iris of the human eye to identify authorized, enrolled personnel. The device shall use ambient light to capture an image of the iris of a person for identification. The resulting video image shall be compared against a stored template that was captured during the enrollment process. When the presented image is sufficiently similar to the stored image template, then the device shall authenticate the presenting individual as identified. The threshold of similarity shall be adjustable.
  1. The efficiency and accuracy of the device shall not be affected by contact lenses or eyeglasses.
  2. Iris scan device shall provide a means that does not require facial contact with the device for enrollees to align their eye for identification. A manual push button shall be provided to initiate the scan process when the user's eye is aligned in front of the device.
  3. The device shall include adjustments to accommodate differences in enrollee height.
  4. Template Update: Iris scanners shall not automatically update an enrollee's template. Significant changes in an individual's eye shall require re-enrollment.
  5. Scan acceptance tolerance or template match criteria shall be under system manager/operator control. Iris scanner shall determine when multiple attempts are needed for iris verification and shall automatically prompt the user for additional attempts up to a maximum of three. Three failed attempts shall generate an entry-control alarm.
  6. Average Verification Time: Iris scanner shall respond to passage requests by generating an entry request signal to the controller. The verification time shall be 1.5 seconds or less from the moment iris scanner initiates the scan process until iris scanner generates a response signal.
  7. Modes: Iris scanner shall provide an enrollment mode, a recognition mode, and a code/credential verification mode.

- a. In the enrollment mode, iris scanner shall create an iris template for new personnel and enter the template into the system database file created for that person. Template information shall be compatible with system application software.
  - b. In the recognition mode, iris scanner shall allow passage when the iris scan data from the verification attempt match an iris template stored in database files.
  - c. In the code/credential verification mode, iris scanner shall allow passage when the iris scan data from the verification attempt match the iris scan template associated with the identification code entered into a keypad, or they match the iris scan template associated with credential card data read by a card reader.
8. Reports: Iris imaging shall create and store template match scores for all transactions involving iris scans. Template match scores shall be stored in the matching personnel data file used for report generation.
  9. Power: Iris scanner shall be powered from its associated controller, requiring not more than 45W.
  10. Enclosure: Eye scanners shall be available with enclosures that are suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:
    - a. Indoors, controlled environment.
  11. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off and whether user passage requests have been accepted or rejected.

## **2.5 PUSH-BUTTON SWITCHES**

- A. Push-Button Switches: Momentary-contact back-lighted push buttons with stainless steel switch enclosures.
- B. Electrical Ratings:
  1. Minimum continuous current rating of 10-A at 120-V ac or 5-A at 240-V ac.
  2. Contacts that will make 720 VA at 60-A and that will break at 720 VA at 10-A.
- C. Enclosures: Flush or surface mounting. Push buttons shall be suitable for flush mounting in the switch enclosures.
- D. Enclosures shall additionally be suitable for installation in the following locations:
  1. Indoors, controlled environment.
- E. Power: Push-button switches shall be powered from their associated controller, using dc control.

## **2.6 CABLES**

- A. General Cable Requirements: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and as recommended by system manufacturer for integration requirement.
- B. PVC-Jacketed, TIA 485-A Cables:
  1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
  2. PVC insulation.

3. Unshielded.
  4. PVC jacket.
  5. NFPA 70 Type: Type CM.
  6. Flame Resistance: Comply with UL 1581.
- C. Plenum-Rated TIA 485-A Cables:
1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
  2. Fluorinated ethylene propylene insulation.
  3. Unshielded.
  4. Fluorinated ethylene propylene jacket.
  5. NFPA 70 Type: Type CMP
  6. Flame Resistance: NFPA 262, Flame Test.
- D. Multiconductor, PVC, Reader and Wiegand Keypad Cables:
- E. Paired, PVC, Reader and Wiegand Keypad Cables:
1. Three pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, individual aluminum-foil/polyester-tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
  2. NFPA 70, Type CM.
  3. Flame Resistance: UL 1581 vertical tray.
- F. Paired, PVC, Reader and Wiegand Keypad Cables:
1. Three pairs, twisted, No. 20 AWG, stranded (7x28) tinned copper conductors, polyethylene (polyolefin) insulation, individual aluminum-foil/polyester-tape shielded pairs each with No. 22 AWG, stranded (19x34) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
  2. NFPA 70, Type CM.
  3. Flame Resistance: UL 1581 vertical tray.
- G. Paired, Plenum-Type, Reader and Wiegand Keypad Cables:
1. Three pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, individual aluminum-foil/polypropylene-tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and fluorinated-ethylene-propylene jacket.
  2. NFPA 70, Type CMP.
  3. Flame Resistance: NFPA 262 flame test.
- H. Multiconductor, Plenum-Type, Reader and Wiegand Keypad Cables:
1. Six conductors, No. 20 AWG, stranded (7x28) tinned copper conductors, fluorinated-ethylene-propylene insulation, overall aluminum-foil/polyester-tape shield with 100 percent shield coverage plus tinned copper braid shield with 85 percent shield coverage, and fluorinated-ethylene-propylene jacket.
  2. NFPA 70, Type CMP.

3. Flame Resistance: NFPA 262 flame test.
- I. LAN Cabling:
  1. Comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

## 2.7 TRANSFORMERS

- A. NFPA 70, Class II control transformers, NRTL listed. Transformers for security access-control system shall not be shared with any other system.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN and control cable conduit systems to PCs, controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Comply with recommendations in SIA CP-01.
- B. Comply with TIA 606-B, "Administration Standard for Commercial Telecommunications Infrastructure."
- C. Product Schedules: Obtain detailed product schedules from manufacturer of access-control system or develop product schedules to suit Project. Fill in all data available from Project plans and specifications and publish as Product Schedules for review and approval.
- D. In meetings with Architect and Owner, present Product Schedules and review, adjust, and prepare final setup documents. Use approved, final Product Schedules to set up system software.

### 3.3 CABLING

- A. Comply with NECA 1, "Good Workmanship in Electrical Construction."
- B. Install cables and wiring according to requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental airspaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
- D. Install LAN cables using techniques, practices, and methods that are consistent with Category 5e rating of components and optical fiber rating of components, and that ensure Category 6 and optical fiber performance of completed and linked signal paths, end to end.
- E. Boxes and enclosures containing security-system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered accessible. Junction boxes and



small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.

- F. Install end-of-line resistors at the field device location and not at the controller or panel location.

### **3.4 CABLE APPLICATION**

- A. Comply with TIA 569-D, "Commercial Building Standard for Telecommunications Pathways and Spaces."
- B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.
- C. TIA 232-F Cabling: Install at a maximum distance of 50 ft. between terminations.
- D. TIA 485-A Cabling: Install at a maximum distance of 4000 ft. between terminations.
- E. Card Readers and Keypads:
  - 1. Install number of conductor pairs recommended by manufacturer for the functions specified.
  - 2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from controller to the reader is 250 ft., and install No. 20 AWG wire if maximum distance is 500 ft..
  - 3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the controller.
  - 4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.
- F. Install minimum No. 16 AWG cable from controller to electrically powered locks. Do not exceed 500 ft. between terminations.
- G. Install minimum No. 18 AWG ac power wire from transformer to controller, with a maximum distance of 25 ft. between terminations.

### **3.5 GROUNDING**

- A. Comply with Section 270526 "Grounding and Bonding for Communications Systems."
- B. Comply with IEEE 1100, "Recommended Practice for Power and Grounding Electronic Equipment."
- C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- D. Bond shields and drain conductors to ground at only one point in each circuit.
- E. Signal Ground:
  - 1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
  - 2. Bus: Mount on wall of main equipment room with standoff insulators.
  - 3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

### **3.6 INSTALLATION**

- A. Install card readers, keypads, push buttons, and biometric readers.

**3.7 IDENTIFICATION**

- A. In addition to requirements in this article, comply with applicable requirements in Section 270553 "Identification for Communications Systems" and with TIA 606-B.
- B. Using software specified in "Cable and Asset Management Software" Article, develop cable administration drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with the same designation. Use logical and systematic designations for facility's architectural arrangement.
- C. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
  - 1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.
- D. At completion, cable and asset management software shall reflect as-built conditions.

**3.8 SYSTEM SOFTWARE AND HARDWARE**

- A. Develop, install, and test software and hardware, and perform database tests for the complete and proper operation of systems involved. Assign software license to Owner.

**3.9 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use tester approved for type and kind of installed cable. Test for faulty connectors, splices, and terminations. Test according to TIA 568-C.1, "Commercial Building Telecommunications Cabling Standards - Part 1: General Requirements." Link performance for balanced twisted-pair cables must comply with minimum criteria in TIA 568-C.1.
  - 2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power-supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
  - 3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.
- C. Devices and circuits will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

**3.10 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to supervise and assist with startup service.
  - 1. Complete installation and startup checks according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.
  - 2. Enroll and prepare badges and access cards for Owner's operators, management, and security personnel.

**3.11 DEMONSTRATION**

- A. Train Owner's representative to adjust, operate, and maintain security access system. See Section 017900 "Demonstration and Training."
- B. Develop separate training modules for the following:
  - 1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
  - 2. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
  - 3. Security personnel.
  - 4. Hardware maintenance personnel.
  - 5. Corporate management.

**END OF SECTION 281500**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 281523 - INTERCOM ENTRY SYSTEMS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Digital audio intercom entry systems.
  - 2. Digital audio-video intercom entry systems.
- B. Related Requirements:
  - 1. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Coordination Meeting(s): For intercom entry system. Conduct meeting(s) before start of installation.
  - 1. Attendees: Installers, fabricators, representatives of manufacturers, representatives from telecommunications, owner's security representatives, IT representatives, and administrators for field tests and inspections. Notify Architect, construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.

**1.3 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Digital audio intercom entry systems.
  - 2. Digital audio-video intercom entry systems.
- B. Shop Drawings:
  - 1. Project general notes.
  - 2. Device layout.
  - 3. Block diagram and cable/conduit routing.
  - 4. System communications details.
  - 5. System mounting details.
  - 6. Secondary power calculations.
- C. Certificates:
  - 1. Manufacturers certification.
- D. Field Quality-Control Submittals:
  - 1. Field quality-control reports.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Installation and startup instructions for intercom entry systems.
  2. Manufacturer's recommended tests and inspections for intercom entry systems.
- B. Sample warranties.
- 1.5 CLOSEOUT SUBMITTALS**
- A. Maintenance Contracts:
1. Software and firmware service agreement.
- B. Warranty documentation.
- 1.6 MAINTENANCE MATERIAL SUBMITTALS**
- A. Special Tools: Furnish to Owner proprietary equipment, keys, and software required to operate, maintain, repair, adjust, or implement future changes to intercom entry system, that are packaged with protective covering for storage on-site and identified with labels describing contents.
- 1.7 WARRANTY**
- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed intercom entry system perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.
1. Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.
- B. Special Manufacturer Extended Warranty: Manufacturer warrants that intercom entry system perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.
1. Extended-Warranty Period: Three years from date of Substantial Completion; coverage for labor, materials, and equipment.

## **PART 2 - PRODUCTS**

### **2.1 DIGITAL AUDIO INTERCOM ENTRY SYSTEMS**

- A. Description: This category covers digital audio intercom entry systems, together with controls and accessories for use with such operators, and similar devices.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aiphone Corporation IX.
  2. Stentofon; a brand of Zenitel USA.
- C. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
  2. Listing Criteria: UL CCN ALVY; including UL 294.
- D. Options:
1. Operating Temperature: Minus 29 to plus 150 deg F .

2. Input Power: 12 or 24 V(dc) or POE
  3. Connectivity: Hardwired.
  4. Minimum Ring Voltage: 25 V(ac rms).
  5. Maximum Ring Voltage: 90 V(ac rms).
  6. Speaker Volume: Approximately 62 dB maximum at 1 m.
  7. Materials: Stainless steel.
  8. Finishes: Brushed stainless steel.
  9. Climate: outdoor.
  10. Mounting: Devices must be wall flush mounted.
  11. Push-to-talk button.
- E. Accessories:
1. Recessed back box.
  2. External keypad.
  3. Mounting adaptor plate.
  4. Mullion mounting bracket.
  5. Desk stand.

## 2.2 DIGITAL AUDIO-VIDEO INTERCOM ENTRY SYSTEMS

- A. Description: This category covers digital audio-video intercom entry systems, together with controls and accessories for use with such operators, and similar devices.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aiphone Corporation IX.
  2. Stentofon; a brand of Zenitel USA.
- C. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
  2. Listing Criteria: UL CCN ALVY; including UL 294.
- D. Options:
1. Operating Temperature: Minus 29 to plus 150 deg F.
  2. Input Power: 12 to 24 V(dc) or POE.
  3. Connectivity: Hardwired.
  4. Minimum Ring Voltage: 25 V(ac rms).
  5. Maximum Ring Voltage: 90 V(ac rms).
  6. Speaker Volume: Approximately 62 dB maximum at 1 m.
  7. Materials: Stainless steel.

8. Finishes: Brushed stainless steel.
9. Climate: outdoor.
10. Mounting: Devices must be wall flush mounted.
11. Video Camera:
  - a. Display: 7 inch full-color touchscreen.
  - b. Camera Input Power: 12 V(dc) adapter.
  - c. Camera Field of View: 80 degrees horizontal, 60 degrees vertical, and 100 degrees diagonal.
  - d. Camera Tilt/Swivel Adjustment: Vertical plus-or-minus 20 degrees; horizontal plus-or-minus 30 degrees.

E. Accessories:

1. Recessed back box.
2. External keypad.
3. Mounting adaptor plate.
4. Mullion mounting bracket.
5. Desk stand.

### 2.3 INTERCOM CLIENT FOR COMMAND STATION

- A. Provide a client for the intercom end stations in the Command station. Client shall be capable of both audio and video. 3<sup>rd</sup> party clients are acceptable and may be necessary.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
1. Hardwired System:
    - a. Cable Type: Unshielded Cat.6.
    - b. Maximum Power-over-Ethernet Cable Length: 300 ft.

### 3.2 FIELD QUALITY CONTROL

- A. Testing Preparation:
1. Schedule installation date with owner representative.
- B. Field tests and inspections must be witnessed by the owner's representative.
- C. Tests and Inspections:
1. Perform manufacturer's recommended tests and inspections.
- D. Nonconforming Work:
1. The system will be considered defective if it does not pass tests and inspections.
  2. Remove and replace defective units and retest.



- E. Collect, assemble, and submit test and inspection reports.
- F. Manufacturer Services:
  - 1. Engage factory-authorized service representative to support field tests and inspections.

### **3.3 SYSTEM STARTUP**

- A. Factory-authorized trained representative to perform to perform startup service.
  - 1. Complete installation and startup check in accordance with manufacturer's published instructions.

### **3.4 PROTECTION**

- A. After installation, protect intercom entry system from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

### **3.5 MAINTENANCE**

- A. Software and Firmware Service Agreement:
  - 1. Technical Support: Beginning at Substantial Completion, verify that the software and firmware service agreement include software and firmware support for one years.
  - 2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software and firmware upgrades that become available within one year from the date of Substantial Completion.
    - a. Upgrade Notice: No fewer than 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.
  - 3. Upgrade Reports: Prepare a report after each update, documenting upgrades installed.

**END OF SECTION 281523**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 282300 - VIDEO SURVEILLANCE****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. These specifications outline the acceptable characteristics for materials and equipment and define, in general terms, the configuration of the security system technologies to be installed and made fully operational by the selected Security System Contractor (Contractor) of the Video Management System.
- B. Contractor shall have total "turn-key" responsibility (except where noted) for ensuring the system is installed complete and functional, consistent with the manufacturer's specifications and that all applicable fire, electrical, and building codes and standards are met. Where required by the various codes, the vendor is responsible to obtain the necessary approval(s) of the Authority Having Jurisdiction (AHJ).
- C. Section includes a video surveillance system consisting of cameras and mounts, connected to a Hanwha Vision WAVE Video Management System video servers, software, monitors, and workstations.
- D. Contractor shall provide all necessary camera infrastructure needs to include conduit, network, data drops, pathways and other supporting system infrastructure.
- E. Reference project drawings for camera type locations to include "edge" specific recording cameras.
- F. Reference project drawings for all server recording device locations.
- G. Any aspect of these specifications, or future addendum, which appears to the Contractor to fall outside applicable codes or standards, shall immediately be brought to the attention of the Owner.

**1.3 GENERAL REQUIREMENTS**

- A. The specified camera product shall be an open video platform designed for use in any video application.
- B. Contractors shall provide all necessary channel licensing, related plugins, third-party applications and other project required integrations for the for the VMS.
- C. Contractor shall provide all necessary network drops and conduit pathways to each camera location. Camera locations located on the exterior of the facility shall have appropriate surge protection in place for each device.
- D. System cameras shall be minimally ONVIF profile S and/or T compliant, have a 5-year manufacturer guarantee, utilize both H.265 and H.264 compression and be appropriately IP (ingress protection) and IK (vandal resistance) rated for the environment.

**1.4 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Minimum of ten (10) years experience manufacturing similar products. Basis of Design for all video camera products is Hanwha Vision America.
- B. System Integrator and Installer Qualifications: Minimum three (3) year experience installing similar products. Installers shall be trained and certified as an authorized dealer by the Manufacturer to install, integrate, test, and commission the system.

1. Installer working on this project must possess a valid Professional certificate from the equipment manufacturer verifying completion of Installation and Service Training.
  2. Installer must provide the resume and copy of the certification of the technician assigned to the project.
- C. Installing contractor shall provide at least three (3) examples of projects of similar size and scope to include:
1. Project name
  2. Project locations
  3. Project description
  4. Contact name, email address and phone number
- D. Complete product and technical data specification sheets that include all material and equipment shall be provided by the System Integrator and be available freely online.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### **1.5 CLOSEOUT SUBMITTALS**

- A. After project completion, the contractor shall provide additional project close out submittals required.
- B. Operation and Maintenance Data: For cameras, power supplies, network recorders (server/storage), to include in emergency, operation, and maintenance manuals.
- C. Lists of spare parts and replacement components recommended to be stored at the site for ready access (if applicable).
- D. Complete hardcopy printout and electronic copy from the system cameras manufacturer Device Manager which outlines system and camera configuration, includes camera model number, IP address, and MAC address, static camera image FOV at the time of installation and other system settings.
- E. As-built drawings on facility floor plans showing camera installed location, wiring and cable routes, termination points, riser and connection diagrams, schematics and other system drawings.

### **1.6 DISCLOSURE OF NON-CONFORMING EQUIPMENT**

- A. Project owner desires to make an informed decision regarding the Contractor's proposed project approach, mobilization, staging and overall implementation schedule of tasks.
- B. Contractor is required to disclose, separate from any cut or advertising sheets, any functional, operational or electrical requirements of these specifications that they are not able to perform, and/or which fall outside the scope of their quotation.
- C. The form of this disclosure shall be by letter clearly identifying these noncompliant items and describing how the Contractor intends to address these issues.
- D. Absent such disclosure, Contractors shall be responsible for ensuring that their systems will fully operate as outlined in these specifications without additional cost to the owner or other parties.
- E. Contractor may elect to provide an alternate design approach if cost savings could be realized. This approach shall be clearly outlined within their submittal and should not consider any sacrifice of system functionality or capacity.

**1.7 ONGOING SUPPORT AND WARRANTY**

- A. The Contractor shall warrant all components and installation for a period of one (1) year after the date of final acceptance by the Owner. The contractor warranty shall cover the replacement of all components, including labor.
  - 1. Alternately, the contractor shall provide for an additional two (2) years of warranty, for a total of three (3) total years that shall cover the replacement of all components to include labor.
- B. The product manufacturer shall provide a limited one five (5) year warranty with a one (1) year advanced replacement for the video products such as cameras, to be free of defects in material and workmanship, at no additional cost to the owner.
- C. Response time shall be four (4) hours for major failures and 8 hours or next business day for minor failures. A major failure shall be defined as a malfunction resulting in the loss of two or more video outlets and/or system server/storage failure or errors.
- D. The Contractor shall employ and respond with factory trained technical service personnel for service and maintenance of the system should service be required. The Contractor shall instruct the Owner's technical personnel in the operation, care and maintenance of the system.

**1.8 DEFINITIONS**

- A. AGC Auto Gain Control
- B. AI Artificial Intelligence
- C. AES Advanced Encryption Standard
- D. API Application Programming Interface
- E. ARP Address Resolution Protocol
- F. AWB Auto White Balance
- G. BLC Back light compensation
- H. CBR Constant Bit Rate
- I. COTS Commercial Off The Shelf
- J. CVBS Composite Video Blanking and Sync
- K. DHCP Dynamic Host Configuration Protocol
- L. DNR Digital Noise Reduction
- M. DNS Domain Name Server
- N. DDNS Dynamic Domain Name Server
- O. DSCP Differentiated Services Code Point
- P. FOV Field of View (of the camera)
- Q. fps frames per second
- R. FTP File Transfer Protocol
- S. GOV Group of Video
- T. GUI Graphical User Interface
- U. HD High Definition
- V. HTTP Hypertext Transfer Protocol
- W. HTTPS Secure HTTP
- X. ICMP Internet Control Message Protocol

Y.	IGMP	Internet Group Management Protocol
Z.	IP	Internet Protocol
AA.	IR	Infrared
BB.	JPEG	Joint Photographic Experts Group
CC.	LAN	Local Area Network
DD.	LED	Light Emitting Diode
EE.	LDC	Lens Distortion Correction
FF.	LLDP	Link Layer Discovery Protocol
GG.	LPR	License Plate Recognition
HH.	MJPEG	Motion JPEG
II.	MP	Megapixel
JJ.	MPEG	Moving Pictures Experts Group
KK.	NAS	Network Attached Storage
LL.	NTP	Network Time Protocol
MM.	NVR	Network Video Recorder
NN.	PIM-SM	Protocol Independent Multicast-Sparse Mode
OO.	PoE	Power over Ethernet
PP.	PPPoE	Point to Point Protocol over Ethernet
QQ.	QoS	Quality of Service
RR.	RTP	Real-Time Transport Protocol
SS.	RTCP	Real-Time Control Protocol
TT.	RTSP	Real-Time Streaming Protocol
UU.	SDK	Software Development Kit
VV.	SFP	Small Form Factor Pluggable
WW.	SMTP	Simple Mail Transfer Protocol
XX.	SNMP	Simple Network Management Protocol
YY.	SSDR	Super Smart Dynamic Range
ZZ.	SSNR	Super Smart Noise Reduction
AAA.	SSL	Secure Sockets Layer
BBB.	TCP	Transmission Control Protocol
CCC.	UDP	User Datagram Protocol
DDD.	UPnP	Universal Plug and Play
EEE.	VBR	Variable Bit Rate
FFF.	VMS	Video Management System
GGG.	WDR	Wide Dynamic Range

## 1.9 REFERENCE STANDARDS

- A. Abbreviations

1. Network - IEEE
    - a) 802.3 Ethernet Standards
    - b) 802.1x Port-based Network Access Control
    - c) IPv4 IP addressing version 4
    - d) IPv6 IP addressing version 6
    - e) QoS Quality of Service
  2. Video
    - a) ISO / IEC 23008-2:2013, MPEG-H Part2 (ITU H.265, HEVC)
    - b) ISO / IEC 14496-10, MPEG-4 Part 10 (ITU H.264)
    - c) ISO / IEC 10918 – JPEG
    - d) ONVIF – Profiles S, G, T
  3. EMC & Safety
    - a) FCC 47 CFR Part 15 Subpart B
    - b) ANSI C63.4-2014 Class A
    - c) IC Regulation ICES-003:2016
    - d) ANSI C63.4-2014 Class A
    - e) CE EMC-Directive 2014/30/EU
    - f) EN 55032:2015 Class A
    - g) EN 50130-4:2011+A1:2014
    - h) VCCI-CISPR 32: Class A
    - i) AS/NZS CISPR32:2015 Class A
    - j) UL listed
    - k) CE EN 50581:2012 (hazardous substances)
  4. Safety
    - a) UL listed
    - b) CE EN 50581:2012 (hazardous substances)
  5. Ingress Protection and Vandal Resistance
    - a) ANSI / IEC60529 – Degrees of Protection Provided by Enclosures – IP52
    - b) IEC EN 62262 - Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts: IK10
    - c) IEC 60068-2-75: IK10
- B. Definitions
1. GOV (Group of Video object planes) - A set of video frames for H.264 and H.265 compression, indicating a collection of frames from the initial I-Frame (key frame) to the next I-Frame. GOV consists of 2 kinds of frames: I-Frame and P-Frame.
  2. Dynamic GOV – Dynamic assignment of GOV length based on the complexity of the scene to efficiently manage bitrate of the video stream and reduce the storage required.

3. Multi-exposure wide dynamic range - Operation which automatically adjusts shutter speed to provide a wide range between dark and light areas visible at the same time, preventing backlighting issues. Long exposure is used for dark areas and a short exposure is used in light areas.
4. Dynamic fps – Dynamic assignment of fps (frames per seconds) based on the movement of object(s) in the scene to efficiently manage bitrate of the video stream and reduce the storage required.
5. Smart Codec – Smart Codec that controls quantization parameter and dynamic fps in H.265 and H.264 to efficiently manage bitrate of the video stream and reduce the storage required.
6. WiseStream II – Technology that controls quantization parameter, fps, and GOV length in H.265 and H.264 to efficiently manage bitrate of the video stream and reduce the storage required.
7. WiseStream III - Technology that controls quantization parameter, fps, and GOV length to manage bitrate of the video stream and reduce the storage required based on AI analytic events.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. All equipment and materials used shall be standard components that are regularly manufactured and used in the manufacturer's system.
- B. All systems and components shall have been thoroughly tested and proven in actual use.
- C. Basis of design for camera products are from Hanwha Vision America or approved equal.
- D. Multi-sensor camera devices shall have only one network drop and one camera license on the VMS platform.
- E. All camera system firmware shall be of the latest version and have the selected camera(s) driver installed.
- F. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.
- G. Provide a letter from the product manufacturer stating that all products provided shall meet the National Defense Authorization Act (NDAA) compliancy requirements which addresses the prohibited use of certain video surveillance telecommunications services, equipment and components manufactured by specific vendors.

### **2.2 STANDARD CAMERAS**

- A. See the Camera Schedule in the Evaluations. If cameras are scheduled on Drawings, revise camera characteristics accordingly.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Hanwha (Basis of Design)
  2. Avigilon
  3. Axis
  4. Bosch

### **2.3 NETWORK VIDEO RECORDING AND MANAGEMENT SYSTEM (NVRMS) – OPERATING**



**SYSTEM (SOFTWARE)**

- A. Manufacturers
  - 1. Hanwha – Basis of Design
  - 2. Avigilon
  - 3. Genetec
  - 4. Milestone

**2.4 CAMERA DEVICE MANAGER**

- A. Provide and install the selected camera system Device Manager to manage the video surveillance devices in network including IP cameras, encoders, decoders, NVRs and DVRs by enabling users to remotely configure multiple devices simultaneously.
- B. The software shall support backing up and restoring configuration data from multiple cameras. Backup file name shall include model number, IP address, and MAC address, and shall be user editable. Backup and restore shall be performed in parallel or sequential mode, and at a user desired relative or absolute time. The software shall support restoring a single configuration to multiple devices.
- C. The software shall support setting camera image menu adjustments including SDR, white balance, backlight compensation, exposure, day/night, special, & OSD. Image adjustments shall be performed and displayed on a selected camera immediately, and to other selected cameras per model upon selection.

**2.5 CAMERA INTELLIGENCE AND ANALYTICS**

- A. Cameras shall have a suite of integral intelligent operations and analytic functions at no additional cost to the end-user using the integrated edge-analytics built into each camera models as outlined in product specifications noted.
- B. Contractor shall provide necessary software updates to the VMS and any necessary software plugins for the selected manufacturers cameras and/or VMS.
- C. Camera analytic configuration shall be based on the owner and project requirements outlined in Section 3.
- D. The Contractor shall verify that the use of third-party analytics (if applicable) follows all manufacturer recommendations for pixel-density, camera angle and position.
- E. The Contractor shall follow all manufacturer recommendations for License Plate Recognition relative to pixel-density, camera angle and position.

**2.6 CAMERA SOFTWARE**

- A. The camera shall have a built in web server which supports browser-based configuration using Internet Explorer, Google Chrome, Mozilla Firefox, and Apple Safari from a PC or Mac.
- B. The web viewer shall provide a monitoring screen which displays live camera video and simultaneously provides same-screen access to the following functions:
  - 1. Live view window size
  - 2. Resolution setting
  - 3. Image (snapshot) capture
  - 4. Manual recording to SD or NAS
  - 5. Audio/microphone control

6. Access recorded data playback and camera configuration menus
7. Digital PTZ
- C. The web viewer shall provide a playback screen which provides access to the following functions:
  1. Recorded data search using date and time range
  2. Recorded data search using event type
  3. Play a recorded video by event triggering
  4. Set resolution
  5. Play audio if present
  6. Generate a backup copy of saved video data
- D. The web viewer shall provide a setup screen which provides access to the following configuration settings and functions in the camera:
  1. Digital video profile to include compression type, maximum or target bit rate, frame rate, multicast parameters, crop encoding area
  2. User profile to include password, access level, authentication
  3. Date and time
  4. Network settings and IP version
    - a) DDNS
    - b) SSL/TLS, including certificate management
    - c) 802.1x authentication
    - d) Quality of Service settings
    - e) SNMP to include version selection and settings
    - f) Auto configuration
  5. Video setup
    - a) Flip / mirror mode
    - b) Video output type
    - c) Privacy zone
  6. Audio setup to include source, audio codec type, gain, and bit rate
  7. Camera settings to include image preset, sensor frame capture, dynamic range, white balance, back light, exposure, day/night operation, on-screen display, IR illumination, sharpness, contrast, color level, lens distortion correction.
  8. Event detection setup to include notification parameters, recording rules, time schedule, tamper protection, motion detection, event triggers
  9. System function to include reboot, upgrade, check system and event logs, application (SDK) management
  10. View profile information
- E. Client requirements
  1. Recommend Browser: Chrome
  2. Acceptable Browser: Chrome, Safari, Firefox, MS Edge (chromium based)
  3. Acceptable Operating Systems: Windows, MAC, Android, iOS, Chrome

4. Verified Environment:
  - a) Windows 10 : Google chrome version 80 above, Firefox version 72 above, MS Edge version 83 above
  - b) Mac 10.13/14: Safari version 11.0.1 above

F. Decoding performance in web viewer depends on CPU/GPU performance of user

## 2.7 ACCESSORIES

- A. Provide and install all necessary mounting accessories to include caps, housings, mounts, brackets, pendants, etc. as necessary for the environment to accommodate field of views required by the owner.
- B. Install power supplies and other auxiliary components at control stations unless otherwise indicated.

## 2.8 CAMERA TYPES

- A. Camera Type 1
  1. 4MP x 4 AI IR Multi-directional Dome (indoor/outdoor)
- B. Camera Type 2
  1. 6MP x 2 AI IR Multi-directional Dome
- C. Camera Type 3
  1. 4K AI IR Vandal Dome
- D. Camera Type 4
  1. 4K x 4 AI IR PTRZ + 2MP 40x PTZ
- E. Camera Type 5
  1. 10MP High Resolution Bullet

## 2.9 CAMERA TYPE 1 – 4MP x 4 AI IR Multi-directional Dome

- A. Must meet or exceed the operating characteristics of the Hanwha Vision America PNM-C16083RVQ.
  1. Provide necessary mounts, pendant caps and and other appurtenances based on the individual camera mounting location referenced in project drawings and camera equipment matrix.
- B. GENERAL DESCRIPTION
  1. Video Compression and Transmission – The camera shall have the following properties relating to the video signals it produces.
    - a) H.265, H.264 and MJPEG compression, each derived from a dedicated encoder and capable of being streamed independently and simultaneously
    - b) H.265 and H.264 – frame rates to 30/25 fps (60Hz/50Hz)
    - c) MJPEG – frame rates to 30/25 fps (60Hz/50Hz) @4MP Max. 5fps
  2. The camera shall be able to configure up to 10 independent video stream profiles with differing encoding, quality, frame rate, resolution, and bit rate settings.
  3. Resolution selections
    - a) 2592x1520, 1920x1080, 1280x1024, 1280x960, 1280x720, 1024x768, 800x600, 800x448, 720x576, 720x480, 640x480, 640x360, 320x240

4. Simultaneous unicast access by up to 10 users
  5. Multicast or unicast capable
  6. Dynamic DNS (DDNS) support.
  7. WiseStream and Dynamic GOV to efficiently manage bitrate of the video stream.
- C. Camera – The camera device shall have the following physical and performance properties:
1. The camera shall be able to produce clear images in highly contrast scenes with multi-exposure wide dynamic range.
  2. IP66, IK10, NEMA4X, NEMA-TS 2(2.2.8, 2.2.9) rated for protection against impacts.
  3. Auto day/night operation with removable IR cut filter
    - a) Low light level operation to 0.075 lux (color) and 0 lux (black and white)
  4. 2D and 3D digital noise reduction
  5. Integral IR illumination, providing effective visibility of up to 20m(with HPoE) at 0 Lux when activated in Black & White mode.
  6. 6 privacy masking regions with polygonal.
  7. The camera shall provide video display on smart phone (iPhone, Android) to adjust viewing angle, rotation and focus.
- D. Intelligence and Analytics – The camera shall have a suite of integral intelligent operations and analytic functions to include:
1. Motion detection with 8 definable detection areas with 8 point polygonal zones, and minimum/maximum object size.
  2. Detection of logical events of specified conditions from the camera's video
    - a) Classified object type:
      2. Person
      3. Vehicle
    - a) Attributes
      4. Vehicle Type: car/bus/truck/motorcycle/bicycle
    - a) Support BestShot
    - b) Analytics events based on AI engine
      1. Object detection
      2. Virtual line(Crossing/Direction)
      3. Virtual area(Loitering/Intrusion/Enter/Exit)
    - a) Analytics events
      1. Defocus detection
      2. Motion detection
      3. Tampering
      4. Audio detection
      5. Sound classification
      6. Virtual area(Appear/Disappear)

- E. Interoperability – The camera shall be ONVIF Profile S and T compliant.
- F. The camera shall possess the following further characteristics:
  - 1. Built-in web server, accessed via standard browsers including Internet Explorer, Firefox, Chrome & Safari
  - 2. Micro SD/SDHC/SDXC memory card and NAS recording options, with configurable pre-alarm and post-alarm recording intervals
  - 3. Bi-directional audio
  - 4. Alarms and notifications
    - a) alarm notification triggers:
      - 1. Analytics
      - 2. Network disconnect
      - 3. Alarm input with NW I/O Box
      - 4. App event
      - 5. Time schedule
      - 6. MQTT subscription
    - b) available notification means upon trigger:
      - 1. File upload(image): e-mail/FTP
      - 2. Notification: e-mail
      - 3. Recording: SD/SDHC/SDXC or NAS recording at event triggers
      - 4. Alarm output
      - 5. Handover: PTZ preset, send message by HTTP/HTTPS/TCP
      - 6. Audio clip playback
      - 7. MQTT: publication
- G. Pixel Counter available in the plug-in web viewer.
- H. HPoE capable
- I. IP66, NEMA4X, IK10
- J. This device has been verified using STP cable. The use of appropriate GND grounding and STP cable is recommended to effectively protect your product and property from transient voltage, thunder stroke, communication interruption.

## 2.10 CAMERA TYPE 2 – 6MP x 2 AI IR Multi-directional Dome

- A. Must meet or exceed the operating characteristics of the Hanwha Vision America PNM-C12083RVD.
  - 1. Provide necessary mounts, pendant caps and and other appurtenances based on the individual camera mounting location referenced in project drawings and camera equipment matrix.
- B. GENERAL DESCRIPTION
  - 1. Video Compression and Transmission – The camera shall have the following properties relating to the video signals it produces.
    - a) H.265, H.264 and MJPEG compression, each derived from a dedicated encoder and capable of being streamed independently and simultaneously

- b) H.265 and H.264 – frame rates to 15fps
- c) MJPEG – frame rates to 15fps
- 2. The camera shall be able to configure up to 5 independent video stream per channel with differing encoding, quality, frame rate, resolution, and bit rate settings.
- 3. Resolution selections
  - a) 3328 x 1872, 3072 x 1728, 2592 x 1944, 2688 x 1520, 1920x1080, 1600 x 1200, 1280x1024, 1280x960, 1280x720, 1024x768, 800x600, 800x448, 720x576, 720x480, 640x480, 640x360, 320x240
- 4. Simultaneous unicast access by up to 10 users
- 5. Multicast or unicast capable
- 6. Dynamic DNS (DDNS) support.
- 7. WiseStream and Dynamic GOV to efficiently manage bitrate of the video stream.
- C. Camera – The camera device shall have the following physical and performance properties:
  - 1. IP66, IK10, NEMA4X rated for protection against impacts
  - 2. Auto day/night operation with removable IR cut filter
  - 3. 2D and 3D digital noise reduction
  - 4. Integral IR illumination, providing effective visibility of 25m(65.62ft) based on scene at 0 Lux when activated in Black & White mode
  - 5. 6 privacy masking regions utilizing quadrangle
- D. Intelligence and Analytics – The camera shall have a suite of integral intelligent operations and analytic functions to include:
  - 1. Motion detection with eight definable detection areas, minimum / maximum object size definition and a learning algorithm that ignores false alarms such as trees and waves on water.
  - 2. Detection of logical events of specified conditions from the camera's video input
    - a) Classified object type : Person / Face / Vehicle / License plate
    - b) Attributes: Vehicle (Type: car / bus / truck / motorcycle / bicycle)
    - c) Analytics events based on AI engine: Object detection, Virtual line (Crossing / Direction), Virtual area (Loitering / Intrusion / Enter / Exit)
    - d) Analytics events: Defocus detection, Motion detection, Tampering, Fog detection, Shock detection, Virtual area (Appear / Disappear) \*Support Audio detection, Sound classification via optional SPM-4210 I/O box
- E. Interoperability – The camera shall be ONVIF Profile S / T compliant.
- F. The camera shall possess the following further characteristics:
  - 1. Built-in web server, accessed via standard browsers including MS Edge, Firefox, Chrome and Safari
  - 2. Micro SD/SDHC/SDXC memory card and NAS recording options, with configurable pre-alarm and post-alarm recording intervals
  - 3. Alarms and notifications
    - a) alarm notification triggers:
      - 1. alarm input via optional SPM-4210 I/O box

2. video analytics
3. network disconnect
- b) available notification means upon trigger:
  1. file upload via FTP and e-mail
  2. notification via e-mail
  3. record to local storage (SD/SDHC/SDXC card)
  4. Handover(PTZ Preset, Send message by HTTP/HTTPS/TCP)
  5. Alarm output via optional SPM-4210 I/O box

G. Pixel Counter available in the plug-in web viewer.

H. POE+ capable

## 2.11 CAMERA TYPE 3 – 4K AI IR Vandal Dome

A. Must meet or exceed the operating characteristics of the Hanwha Vision America – QNV-C9083R.

1. Provide necessary mounts, pendant caps and and other appurtenances based on the individual camera mounting location referenced in project drawings and camera equipment matrix.

### B. GENERAL DESCRIPTION

1. Video Compression and Transmission – The camera shall have the following properties relating to the video signals it produces.
  - a) H.265, H.264 and MJPEG compression, each derived from a dedicated encoder and capable of being streamed independently and simultaneously.
  - b) H.265 and H.264 – Max. 30/25fps (60Hz/50Hz) at all resolution
  - c) MJPEG – Max. 30fps(@8MP Max. 5fps)
2. The camera shall be able to configure up to 10 independent video stream profiles with differing encoding, quality, frame rate, resolution, and bit rate settings.
3. The camera shall be able to configure various resolution selections.
  - a) 16:9 aspect ratio: 3840x2160, 3328x1872, 3072x1728, 2688x1520, 1920x1080, 1280x720, 800x448, 640x360
  - b) 4:3 aspect ratio: 2592x1944, 1600x1200, 1280x960, 1024x768, 800x600, 640x480, 320x240
  - c) 5:4 aspect ratio: 1280x1024, 720x576
  - d) 3:2 aspect ratio: 720x480
4. The camera shall support unicast video streaming up to 20 users.
5. The camera shall support multicast video streaming.
6. The camera shall be able to configure Dynamic DNS (DDNS). DDNS shall be provided with no additional cost by the manufacturer.
7. The camera shall provide WiseStream II, Dynamic GOV and Dynamic fps to efficiently manage bit rate of the video stream and reduce storage.
8. The camera shall provide WiseNR II that working based on AI engine for reduce noise and blur on image.

- C. Camera – The camera device shall have the following physical and performance properties:
1. IP66, IK10 rated for protection against impacts
  2. True day/night operation with removable IR cut filter
  3. The camera shall be able to produce clear images in highly contrast scenes with multi-exposure wide dynamic range up to 120dB.
  4. The camera shall support digital noise reduction using both 2D and 3D noise reduction technology.
  5. The camera shall be able to configure 32 privacy masking areas with 4 points quadrangle zones.
  6. The camera shall provide video display on smart phone (iPhone, Android) to adjust viewing angle, rotation and focus.
- D. Intelligence and Analytics – The camera shall have a suite of intelligent analytic functions.
1. Analytics
    - a) Analytics events based on AI engine(Person, Vehicle)
    - b) Motion detection
    - c) Object detection: Person/Vehicle(Car/Bus/Truck/Motorcycle/Bicycle)
    - d) Virtual line(Crossing/Direction)
    - e) Virtual area(Loitering/Intrusion/Enter/Exit)
  2. Analytics events
    - a) Defocus detection
    - b) Tampering
    - c) Virtual area(Appear/Disappear)
  3. Motion detection with 8 definable detection areas with 8 point polygonal zones, and minimum/maximum object size
  4. Defocus detection that event can be created when defocus of the camera lens is detected
  5. Tampering detection that event can be created when the screen is blocked or the camera position is changed
  6. Classified object types are Person and Vehicle.
    - a) Attribute support Vehicle Type(car/bus/truck/motorcycle/bicycle)
    - b) Camera supports DetectionShot
- E. Interoperability – The camera shall be ONVIF Profile S, G, T and M compliant.
- F. The camera shall possess the following further characteristics:
1. Built-in web server, accessed via non-plugin browsers including Google Chrome, IE11, MS Edge, Mozilla Firefox and Apple Safari.
  2. Micro SD/SDHC/SDXC memory card with configurable pre-alarm and post-alarm recording intervals
  3. NAS recording option with configurable pre-alarm and post-alarm recording intervals
  4. Alarms and notifications
    - a) alarm notification triggers:



1. Alarm input
  2. Motion detection
  3. Video analytics
  4. Network disconnect
- b) available notification means upon trigger:
1. File Upload via FTP and E-mail
  2. Notification via E-mail
  3. Local storage (SD / SDHC / SDXC) or NAS recording at event triggers
  4. Alarm output
  5. Handover(PTZ preset, Send message by HTTP/HTTPS/TCP)
  6. Audio clip playback

G. Pixel Counter available in the web viewer.

H. PoE capable including heater by PoE

I. IP66, IK10 capable

## 2.12 CAMERA TYPE 4 – 4K x 4 AI IR PTRZ + 2MP 40x PTZ Multi-directional Dome

A. Must meet or exceed the operating characteristics of the Hanwha Vision America PNM-C34404RQPZ.

1. Provide necessary mounts, pendant caps and and other appurtenances based on the individual camera mounting location referenced in project drawings and camera equipment matrix.

B. GENERAL DESCRIPTION

1. 120dB WDR
2. 4.25~170mm (Optical 40x) lens
3. PTZ Auto Tracking, SmartZoom to Preset / IVA Trigger
4. 4-Channels @ 4K/8MP with motorized PTRZ for easy installation and remote adjustment of the entire FoV, 3.3~5.7mm (FoV H: 109°~56°, V: 55°~31°)
5. 15FPS AI ON, 20FPS AI OFF
6. 2MP @ 60FPS PTZ with 40x zoom
7. IR viewable [4CH] length 20m (65ft) / [PTZ] WiseIR 200m (656ft)
8. H.265, H.264, MJPEG triple codec
9. Analytics events based on AI engine: Object detection [Person/Vehicle (Car/Bus/Truck/Motorcycle/Bicycle)], IVA (Virtual line/Area, Enter/Exit, Loitering, direction, intrusion), Appear/Disappear
10. I/O Box compatibility
11. TPM with FIPS 140-2 level 2
12. Micro SD card 512GB x2
13. IP66, IK10, NEMA4X
14. Operating Temperature: -40°C~+50°C(-40°F~+122°F)
15. HPoE (injector included)

16. Hard-coated dome bubble

### **2.13 CAMERA TYPE 5 –10MP High Resolution Bullet**

- A. Must meet or exceed the operating characteristics of the Axis Q1808-LE.
  1. Provide necessary housing, mounts, pendant caps and and other appurtenances based on the individual camera mounting location referenced in project drawings and camera equipment matrix.
  2. This camera is an “edge” recording camera. Reference locations on project drawings.
- B. GENERAL DESCRIPTION
  1. Video Compression and Transmission – The camera shall have the following properties relating to the video signals it produces.
  2. 4/3” progressive scan RGB CMOS
  3. Pixel size 4.63 µm
  4. Varifocal, 12-48 mm, F1.7-4.0
  5. Horizontal field of view: 90°–21°
  6. Vertical field of view: 49°–12°
  7. Minimum focus distance: 1.5 m (4.9 ft)
  8. Remote zoom and focus, P-Iris control
  9. Day and night Automatically removable IR-cut filter in day mode and IR-pass filter 800–900 nm in night mode
  10. Minimum illumination: Q1808–LE: Color: 0.02 lux at 50 IRE, F1.7; B/W: 0.004 lux at 50 IRE, F1.7; 0 lux with IR illumination on
  11. Shutter speed With WDR: 1/22000 s to 2 s in 4K; With WDR: 1/25500 s to 2 s in 3712x2784; Without WDR: 1/45500 s to 2 s
  12. Camera angle adjustment: Pan ±180°, tilt 0 to -90°, roll -90 to 270

### **2.14 VIDEO MANAGEMENT SYSTEM**

- A. Video Management System shall meet or exceed the operating characteristics of Hanwha WAVE, utilizing the most current version of software.
- B. VMS shall consist of a standard COTS server/storage solution for the recording and retention of security video for use in both real-time and forensically for investigative purposes.
- C. The specified product shall be an open video platform designed for use in any video application.
- D. The specified software shall be a one-time license cost per channel and include, free of charge, any and all software updates, API or SDKs necessary to integrate 3rd party devices and systems.
- E. Lifetime software upgrades shall be provided by the Manufacturer without cost and without the need for an annual maintenance agreement or ongoing licensing costs.
- F. The specified Video Management solution's architecture should include Desktop, Server, Mobile, and Cloud applications.

### **2.15 VIDEO SERVERS (reference locations based on project drawings)**

- A. Servers shall minimally have the following characteristics:
  1. 2U rack-mountable.
  2. Professional licenses for all camera channels.

3. JBOD Configuration.
4. 470 Mbps recording B/W, 14 HDD Bay (3.5").
5. Intel Xeon Silver 4210, 16GB RAM.
6. Dual 240GB SSD OS drives (RAID 1).
7. Windows 10 Pro.
8. Nvidia GPU,
9. MiniDP output,
10. VGA output,
11. Quad GbE NICs,
12. IPMI, Redundant 1100W power supplies,
13. Keyboard and mouse included,
14. Rail kit included

#### B. STORAGE SIZING

1. Contractor shall appropriately size the servers and storage to minimally meet the following requirements:
  - a. Configured JBOD
  - b. Thirty (30) days immediately accessible on-board recording to review recorded events.
  - c. Storage shall be configured at minimally **50%** motion, recorded at the cameras highest resolution. Low Resolution continuous, but recording at a minimum of Eight (8) frames per second upon motion or analytic based event.
  - d. Recording resolution at H.265 with smart codec and WiseStream III compression enabled.
  - e. Calculations shall take into consideration multi-sensor camera channels.
  - f. Provide Hanwha WRR-P-S204S-96TB quantity four (4) at a minimum.

#### C. VIDEO MANAGEMENT SYSTEM (VMS) OVERVIEW

1. VMS: For remote devices and sensors Software Components shall be of the most current commercially available version at the time of system turnover.
2. System shall be an open platform solution specifically designed for use in a security video application.
3. The System shall be comprised of four (4) applications which work together seamlessly and at no addition cost or licensing to the end-user.
  - a. Cloud - a cloud application that enables simple remote connectivity, viewing, and management of an unlimited number of systems and users.
  - b. Server - a media server responsible for discovering, connecting to, and managing system users, devices, and associated data.
  - c. Desktop - a desktop application capable of acting as a stand-alone media player or as a client application for connecting to and managing systems.
  - d. Mobile - a mobile application for iOS and Android devices that allows users to connect to, view, search, and control IP cameras over Wi-Fi or Data networks.

#### D. VMS DEVELOPER & INTEGRATION TOOLS

1. The VMS shall have built-in developer tools which are accessible from any System Server's Web Admin Interface (compatible with all major browsers) and should include, at a minimum:
  2. Generic Events Generator - a tool which helps build HTTP Generic Event calls, a method of sending events from 3rd party systems to the VMS, which can be used to trigger system actions in the VMS.
  3. Server API implementation that gives developers the ability to access every system feature available.
  4. API Change Log - list of breaking changes in API from version to version Video Source Integration SDK - provides the ability to integrate virtually any live or recorded video source (IP Cameras, NVRs, DVRs, etc.) into the VMS with methods for discovering, displaying, analyzing and recording video, as well as integrating device I/O ports and related motion detection information.
  5. Storage SDK - provides the ability to integrate potential storage into System. It allows developers to read from or write to any storage location: local, remote, and even cloud one. Creating a storage plugin requires implementing standard functions such as: I/O stream, if file exist, delete file, list of files in the folder, etc. Storage SDK also contains an example for using an FTP server as a storage location.
- E. VMS SYSTEM ARCHITECTURE:
1. The VMS shall have a Architecture wherein:
  2. All servers in a system are equal and synchronize system databases in real-time.
  3. A user can connect to any system server to see and manage the entire system.
  4. Servers support automatic camera failover to ensure limited loss of video recording in the event of hardware or network failure at no additional cost to the end-user.
  5. Servers will use a SQLite - a free database technology - included in the installation package The VMS shall support one-click system wide updates.
- F. The VMS will not require any licenses to increase the number of supported devices, users, or servers.
- G. The system shall support scaling to support the maximum recommended system sizes shown below. The system shall support exceeding these recommended maximums by consulting with engineering support.
1. The system shall support a maximum of 100 Servers in a system.
  2. The system shall support a maximum of 10,000 resources in a system.
  3. The system shall support a maximum of 1,000 concurrent users in a system.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN, WAN, and IP network before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 WIRING**

- A. Wiring Method: Install cables in raceways unless otherwise indicated.

- B. Wiring in publicly accessible areas or areas that can be exposed to the exterior elements shall be concealed in a proper conduit enclosure to the extent necessary to fully protect the wire from weather or vandalism. Exceptions may include raceways are not required in accessible indoor ceiling spaces and attics.
  - 1. Except raceways are not required in hollow gypsum board partitions.
  - 2. Conceal raceways and wiring except in unfinished spaces.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- D. Label wiring at each end with machine generated labeling tape. No hand written labels shall be permitted.
- E. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- F. For LAN connection and fiber-optic and copper communication wiring, comply with TAA requirements for Telecommunications Systems Infrastructure
- G. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

### **3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION AND PROGRAMMING**

- A. Provide and install all equipment, software, materials, and labor to include system programming for a completely operational video management system described herein and included on the Project Drawings. These specifications and project drawings are complementary in describing the design intent of the security video management system.
- B. Meet with the owner in advance of installation to review special analytics requirements to include License Plate Recognition and advanced analytics.
- C. Before programming, meet with the project owner to determine system programming parameters, camera mounting location, desired field of view, analytics configuration and other system settings required to meet owner's needs.
- D. Install cameras and other appurtenances level and plumb for a high quality, workman-like installation.
- E. If applicable, set PTZ/PTRZ pan unit and pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.
- F. Configure camera "Edge" recording devices and cameras connected at smaller remote sites.
- G. Aim cameras as directed by engineer and/or owner. Optimize system settings both day and night for exact field of view, WDR, Day/Night, analytics, etc.
- H. Program camera system head end. Provide unique on-screen camera identification for all cameras with the following nomenclature:
  - 1. Camera title, date, and time
  - 2. Tours and Salvos (if required)
  - 3. On screen display feature tiles
  - 4. Individual user settings and rights.
- I. Program all system analytics and AI system parameters as directed by the engineer and/or owner.
- J. Unique individual user login settings and/or Active Directory integration as required.

**3.4 CYBER SECURITY PROTECTION**

- A. All equipment requiring users to log on using a password to be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed. Contractor shall implement all camera manufacturer's cyber security recommendations and configurations, following industry best practices per the camera manufacturer Cyber Hardening Guide.
- B. Document that all cameras do not have a default password.
- C. Document that all cameras have the latest firmware installed.
- D. Back up all camera settings utilizing manufacturer camera Device Manager and provide file to owner.
- E. Document that all servers and work stations have current version or Operating System (OS).
- F. Document that latest VMS version that is installed on all servers and work stations.
- G. Set user permissions and rules in VMS.

**3.5 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections and forward results to the engineer and/or owner.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
  - 1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
  - 2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:
    - a. Verify proper fields of view, operation of auto-iris lenses, maximize WDR and day/night settings for the environment.
    - b. Set back-focus of fixed focal length lenses if necessary.
    - c. Set and name all preset positions; consult Owner's personnel.
    - d. Set sensitivity of motion detection and other analytics.
    - e. Set, test and correct as needed, all analytical and/or AI parameters per the owner and/or engineer.
    - f. Connect and verify responses to alarms.
    - g. Verify operation of control-station equipment.
    - h. Validate all Cyber requirements.
    - i. Third Party Integrations (if required): Test each individual alarm point and validate camera call-up, camera pre-position and other settings required for a fully integrated system.
- E. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least thirty (30) days. Provide a minimum of five (5) days' notice of test schedule.

1. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
- F. Video surveillance system will be considered defective if it does not pass tests and inspections. Warranty will only begin after official system acceptance.
- G. Prepare test and inspection reports.

### **3.6 ADJUSTING**

- A. Occupancy Adjustments: When requested within six (6) months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:
- B. Check cable connections.
1. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
  2. Adjust all preset positions; consult Owner's personnel.
  3. Clean lenses or housings.
  4. Recommend changes to cameras, lenses, FOV, and associated equipment to improve Owner's use of video surveillance system.
  5. Make system changes to recording parameters, camera settings, FOV's that can be made without the need to purchase additional equipment and/or software.
  6. Provide additional and/or refresher system training to the owner (max four (4) hours) on system operations, functionality and administrations.
  7. Adjust any analytics.
  8. Provide a written report of adjustments and recommendations.

### **3.7 CLEANING**

- A. Clean installed items using methods and materials recommended in writing by manufacturer.
- B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

### **3.8 TRAINING**

- A. Contractor shall provide minimally eight (8) hours of system administrator training and up to four (4) hour sessions of user training to the owner and designated personnel in the full operations and maintenance of the video management system.
- B. The training shall assure the owner has a comprehensive understanding and basic level of competence of the system.
- C. As a follow up, the contractor shall provide up to four (4) additional hours of training in the following weeks to assure owner competence to any questions or issues that have been experienced once turned over to the owner.

**END OF SECTION 282300**

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 284110****SECURITY CONTROL ROOM EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

**1.2 SUMMARY OF WORK**

- A. This Section includes video equipment, audio equipment, computer equipment and software, lighting instruments, and associated peripherals, installation, and training, including, but not limited to the following:
  - 1. Command Console:
    - a. Console and Accessories
    - b. Displays
    - c. Uninterruptible Power Supply
  - 2. Miscellaneous:
    - a. Installation
    - b. Setup

**1.3 SYSTEM DESCRIPTION**

- A. Provide the services necessary to engineer, furnish, and install Security Control Room Equipment. All work shall be in accordance with the true intent of these Specifications, and as required to leave the Control Room in satisfactory operating condition.
  - 1. The Owner reserves the right to reject any or all alternate equipment bids and to select the bid that is considered to serve "THE BEST INTEREST OF THE OWNER."
- B. The work shall consist of:
  - 1. Supplying and installing Security Control Room Equipment
  - 2. Developing and engineering all wiring drawings for the project, in conjunction with the Project Consultant.
- C. Where devices and material are mentioned by name and/or model number, it shall be interpreted as referring to that item as completely specified in that manufacturer's published data as though that data and literature were printed herein in their entirety.
- D. The systems shall be complete, functioning control room, necessary for the operational functions specified, whether each separate device is specifically mentioned.

**1.4 PROPOSED OPERATING PHILOSOPHY AND WORKFLOW DESCRIPTION**

- A. A major goal of the security control room is the streamlining and improvement of efficiency with respect to workflow.
- B. The security control room will be a central workspace for up to 2 people working simultaneously at computer workstations on various aspects of security operations.
- C. Camera feeds will be monitored.
- D. Intercom functions will be managed.
- E. Access control remote locking/unlocking will be managed.
- F. Security forces personnel will be managed via radio.

**1.5 CONFLICT BETWEEN DRAWINGS AND SPECIFICATIONS**

- A. It is intended that any contractor furnishing materials or labor necessary for the completion of this specification shall furnish it in compliance with this specification. Where conflict exists with other specifications concerning such materials and labor, this specification takes precedence unless otherwise approved in writing by the Engineer.
- B. Drawings pertaining to this specification shall be considered as a part of said specification and shall be a part of the bid documents.

**1.6 RELATED WORK PROVIDED BY OTHERS**

- A. The 120 volt and higher power systems will be provided by others.
- B. Cable tray will be provided and installed by others.

**1.7 QUALITY ASSURANCE**

- A. Parts listed shall be complete, type numbers accurate and equipment furnished shall conform to manufacturer's specifications.
- B. All materials shall be new and shall conform to applicable provisions of Underwriters Laboratories and the American Standards Association.
- C. Procure and pay for all necessary permits, licenses and inspections and observe any requirements stipulated therein. Conform in all trades with all local regulations and codes.
- D. Comply with federal, state and local labor regulations and applicable union regulations.

**1.8 WARRANTY**

- A. All equipment and components shall be guaranteed free of defects in materials and workmanship for a period of one (1) year from the date of acceptance, except where specified otherwise. The date of

acceptance shall be defined as the date the Certificate of Substantial Completion is signed by the Architect/Engineer and the Owner.

### **1.9 DELIVERY, STORAGE AND HANDLING**

- A. Package for delivery to best protect finish surfaces while using the least amount of single-use packaging as possible. If possible, package and ship product using reusable blankets and fabrics or reusable cardboard and crate systems.
- B. Protect materials against weather and contact with damp or wet surfaces from time of delivery through time of installation. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes.
- C. When storing prior to installation, raise off floor on pallets, stack flat with protective material between to eliminate chance of creating nicks, scratches, and other imperfections and damage to finish surfaces, wrap weather-tight, and provide for air circulation within and around stacks and under temporary coverings.
- D. Do not allow materials to become damp. Maintain temperatures at 60°F or higher, and humidity between 20% and 60% prior to, during and after installation.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. The following sections specifically list the acceptable equipment types and items for this project. Where quantities are not noted, they may be obtained from the Drawings. In the event of a discrepancy between the Specifications and the Drawings, the greater quantity or better quality shall be furnished.
- B. During the installation, make provisions for all equipment included in the base bid and any alternates, whether taken or not, so that items which are to be provided as alternates may be added to the system without rewiring or additional construction.
- C. All miscellaneous equipment required for a complete, professional installation shall be included in the base bid. No allowances for any additional equipment, hardware, cabling, or miscellaneous will be considered unless specifically excluded from the base bid.

### **2.2 MANUFACTURERS**

- A. The following manufacturers, quantities, and model numbers shall form the basis of the system. These are minimum requirements. Alternate manufacturers using different part numbers is authorized as long as the solution is functionally equivalent. Contractor is responsible to verify all quantities prior to ordering and installation. Quantities are provided for reference only.

### **2.3 CONSOLE AND ACCESSORIES**

- A. Provide TBC Consoles monitor walls and OPS consoles for the project.

Part #	Description	Quantity
<b>SECURITY COMMAND RM.</b>		
<u><b>Monitor Walls</b></u>		
TW-EL0509	End leg, 5'-9" (1524-2743mm) ht, features an integral cable channel with snap-in cover	4.0
TW-IL0509	Intermediate leg w/ foot, 5-9' height	2.0
TW-V2-4T	4 Trac horizontal Per linear ft.	14.0
AM95	Articulating mount for frame/wall, 95 lbs. weight capacity, 12 degree tilt	8.0
SC1-L	SmartCart with heavy duty locking caster Finish: Laminate or Linoleum	1.0
PS-0820-ET	8 outlets/20 amp, 120 volts power strip; Edison Terminal, Type B plug, 17" overall length	3.0
<u><b>Ops Workstations</b></u>		
ST3-WS-LT-L	Fixed height workstation, integrated mini cable core, extruded aluminum legs and mounting trac, laminate or linoleum finish	2.0
CTR-L	Laminate/linoleum ctop w/ bumper edge (per ft.)	14.0
FP-3500	Articulating compact gas assist arm, extends out to 19 -3/4", silver	4.0
SM-TSS-964	Modular TSS pole with FALL speaker arm (accomodates up to 22 lbs.), 17.5" standard	2.0
PS-0820-ET	8 outlets/20 amp, 120 volts power strip; Edison Terminal, Type B plug, 17" overall length	2.0

**2.4 UNINTERRUPTIBLE POWER SUPPLY**

- A. Provide Uninterruptible Power Supply for the project.
- B. The Uninterruptible Power Supply shall meet the following requirements:
  - 1. Output: Output Power Capacity 3000VA Max Configurable
  - 2. Input: Nominal Input Voltage 120v Input Frequency 50/60 Hz +/- 3 Hz (auto sensing) Input Connections NEMA 5-20P
  - 3. Cord Length 8 feet (2.44 meters)
- C. 

<u>Manufacturer</u>	<u>Model</u>
APC	SMTL3000RM2UC (OR EQUAL)

## 2.5 LCD TV'S

- A. All LCD TV's shall be located as indicated on the Drawings. All interface cables for audio/video shall originate from their locations.
- B. The following are the minimum requirement for the LCD TV's for the media communications systems:
  - 1. Diagonal Measurement: 48"
  - 2. Pixel Resolution: 4K
  - 3. Tuning System ATSC / QAM
  - 4. Aspect Ratio 16:9
  - 5. Response Time 4ms
  - 6. HDMI™ Inputs
  - 7. HD Component Inputs
  - 8. PC Input 15-pin RGB x 1
  - 9. RS-232C Input 9-pin x 1
- C. Install universal wall mount brackets unless otherwise noted. The Contractor will also be responsible for the installation of any required VESA adapter plates necessary for a finished installation.
- D. LCD's will be installed in mounting brackets and secured with tamperproof hardware. A set of removal tools shall be furnished.

## 2.6 MONITOR SPEAKERS

- A. Provide monitor Speakers for the project.
- B. The Speakers shall meet the following requirements:
  - 1. High resolution Active studio reference monitor
  - 2. Ultra-linear frequency response for accurate mix translation
  - 3. 6.7-inch high-precision, low-distortion LF transducer
- C. 

<u>Manufacturer</u>	<u>Model</u>
JBL	305P (OR EQUIVLENT)

## 2.7 PTZ CONTROLLER

- A. Provide a PTZ joystick controller that is interoperable with the video management system.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. This Contractor shall furnish and install all wiring as indicated on the Drawings. All wiring and terminations shall be in full conformance with all of the current editions or revisions of all applicable codes and standards as previously listed under "Regulatory Agencies" of this Section of the Specifications for their intended use on this Project.

- B. No exposed cabling shall be permitted in the wiring of any functions of the provided system. All cable shall be housed in appropriate raceways suitable and designed for such purposes.
- C. All work materials shall be removed at the end of the work day and the work area left in the same condition as found.
- D. This Contractor shall have a minimum of five years of experience in the specific application of the equipment proposed of these systems.
- E. Adherence to a schedule of working hours which is agreeable with the Owner will be required.
- F. All cables must be routed and managed for a neat and aesthetically pleasing appearance. All work must be installed in a neat and workman like manner.
- G. The contractor shall work carefully with all ceilings and return ceilings to original conditions. Any damages or expenses are the responsibility of the contractor. Every effort will be made to schedule the requirements under this Contract in such a manner so as to complete all above ceiling work prior to ceiling tile installation.
- H. The Drawings and specification indicate cable type to be used. Further, the Drawings and specifications indicate a manufacturer's catalog number for reference of quality and functionality.
- I. Communication bonding and grounding shall be in accordance with the NEC and NFPA. Horizontal cables shall be grounded in compliance with ANSI/NFPA 70 and local requirements and practices. Horizontal equipment includes cross connect frames, patch panels and racks, active telecommunication equipment and test apparatus and equipment.
- J. The contractor shall not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.
- K. The contractor shall provide any necessary screws, anchors, clamps, tie wraps, distribution rings, miscellaneous grounding and support hardware, etc., necessary to facilitate the installation of the system.
- L. It shall be the responsibility of the contractor to furnish any special installation equipment or tools necessary to properly complete the system. This may include, but is not limited to, tools for terminating cables, testing and splicing equipment for copper/fiber cables, communication devices, jack stands for cable reels, or cable wenchers.

### **3.2 MATERIAL AND WORKMANSHIP**

- A. Non-compliance with any of the following as deemed by the Owner, Architect, or Consultant shall be cause for rejection of work and replacement by the Installing Contractor at no added cost to the Owner.
- B. Material, workmanship, wire, and wiring methods shall be performed as specified.
- C. If, in the opinion of the Installing Contractor, an installation practice is desired or required, which is contrary to these specifications or drawings, a written request for modification shall be made to the Architect and Consultant. Modifications shall not be implemented without the written approval from the Architect and Consultant.

- D. All materials and labor shall be furnished whether mentioned or not to form a complete system operational as per the intentions and description set forth in Part 1. Include delivery, unloading, placement, fastening to walls, floors, ceiling, counters, or other structures where required, interconnecting wiring of the system components, and all other work and materials necessary to form a complete operational system.
- E. It shall be the responsibility of the contractor to cooperate at all times, and to the fullest extent, with all trades and contractors doing work in the building, to the end that lost time, work stoppages, interference, and inefficiencies do not occur. Communicate installation scheduling with the Electrical Contractor, and coordinate with other trades.

### **3.3 PHYSICAL INSTALLATION**

- A. All equipment not specifically portable shall be held firmly in place and supported by fastenings, brackets, etc., capable of supporting the load with a minimum safety factor of 5 or as approved by the Architect.
- B. Boxes, equipment, cabling, rack, etc. shall be installed and secured plumb and square with building lines.
- C. At all times during the installation the Installing Contractor shall consider not only the operational efficiency of equipment but also the aesthetics of the space. Questions or conflicts between operation and aesthetics should be directed to the Architect and Owner's Representative.

### **3.4 INSTALLATION - GENERAL**

- A. Mount all equipment into Rack Console according to Elevation drawing.
- B. Furnish and install additional AC power strips in each rack, as necessary.
- C. Any miscellaneous items not specifically mentioned but required for proper operation of the system shall be supplied as though specifically mentioned.

### **3.5 CABLE INSTALLATION**

- A. All inter-rack cabling shall be neatly strapped, dressed, and supported as approved by the Owner or Consultant.
- B. Terminal block, boards, strips, or connectors shall be furnished for all cables, which interface with racks, cabinets, consoles, or equipment modules.
- C. Cabling within racks shall be contained in Panduit finger tray or wire-tied to the side of the rack in a neat and orderly fashion. Such cables shall remain separated as indicated in section D of this specification.
- D. All cables routed outside of racks and conduit shall be contained in a suitable harness or wireway to maintain a neat, clean, and finished product.
- E. All cable to be pulled in plenums to be approved for use in environmental A1 application.

**3.6 LABELING**

- A. All cable designations and color-coding shall be in full compliance with EIA/TIA 606.
- B. Clearly label cables at both ends with permanently applied, mechanically printed labels. Hand written labels will not be acceptable. Use standardized colors and alphanumeric codes. Engineer will approve labeling system and method.
- C. In work areas, place cable ID labels around each cable in outlet box, on front of faceplate and on front of jack.

**3.7 GROUNDING PROCEDURES**

- A. In order to minimize problems resulting from improper grounding, and to achieve maximum signal-to-noise ratios, the following grounding procedures shall be adhered to:
  - 1. Under no circumstances shall the racks contact the conduit raceway system, the steel structure of the building, or ventilation ducts.
  - 2. Under no conditions shall the AC neutral conductor, at any location, be used for a system ground.
- B. There shall be no deviations from the above unless specifically required by the manufacturer of the equipment or when necessary to minimize crosstalk and to maximize signal-to-noise ratios in the audio, video, and control systems.
- C. If a different installation practice is desired by the Installing Contractor in regards to the signal grounding, the Installing Contractor may submit alternate grounding methods to the Consultant for approval. Installing contractor shall bear all responsibility for any deviations from the above stated grounding procedure, even if allowed by the Consultant, Owner, or Architect.
- D. Prior to the testing, the installer shall insure that the system is free of short circuits, ground loops, parasitic oscillations, and excessive system noise beyond published specifications of the equipment.
- E. The Installing Contractor, at the Installing Contractor's expense, shall rectify any components not found to function in a satisfactory manner as defined by this specification.
- F. The Final Testing shall be made in the presence of the Owner or Owner's Authorized Representative.

**3.8 FINAL INSPECTION**

- A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of the Owner or Owner's Authorized Representative.
- B. The Installing Contractor, at the Installing Contractor's expense, shall rectify any components not found to function in a satisfactory manner as defined by this specification.

**3.9 WASTE MANAGEMENT**



- A. Separate clean waste mineral and cellulose products from contaminants for recycling in accordance with the Waste Management Plan. Place in designated area and protect from moisture and contamination.
- B. Separate metal waste, packaging, and all other materials in accordance with the Waste Management Plan and place in designated areas for recycling or reuse.
- C. Close and tightly seal all partly used adhesive containers and store protected in well-ventilated, fire-safe area at moderate temperature. Set aside for reuse by Owner.
- D. Check with manufacturer for recycling options. Most manufacturers take back scrap and unused portions for resale or manufacturing into new product.

**END OF 284110**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**TABLE OF CONTENTS**

**DIVISION 28 - ELECTRONIC SAFETY & SECURITY SPECIFICATION**

**Fire Alarm:**

284600 FIRE DETECTION AND ALARM



END OF DIVISION 28 TABLE OF CONTENTS

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 28 46 00 - FIRE DETECTION AND ALARM****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 7 Section "Penetration Firestopping" for material and methods for firestopping systems.

**1.2 DESCRIPTION OF WORK**

- A. This Section requires the Contractor to furnish all materials required to install the fire alarm system. The Contractor shall be responsible for installing, testing, and start-up of a complete functioning fire alarm system, and each element thereof, as specified or indicated on the Drawings or reasonably inferred, including every article, device or accessory (whether or not specifically called for by item) necessary to facilitate each system's function as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation and utilities.
- B. Division 28 of the Specifications and Drawings numbered with prefixes Fgenerally describe these systems, but the scope of the Fire Alarm work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Fire Suppression, Mechanical, Plumbing, Fire Alarm and Electrical Drawings and Specifications; and Addenda.
- C. The Drawings have been prepared diagrammatically and are intended to convey the scope of work, indicating the general location and arrangement of the major equipment, devices, appliances, etc. without showing all the exact details as to elevations, circuits, routing, and other installation requirements. Use the Drawings as a guide when laying out the system and verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory and properly operating system.
- D. The scope of work in this section includes:
  - 1. Fire alarm control unit
  - 2. Remote annunciator
  - 3. Manual fire alarm pull stations
  - 4. System smoke detectors
  - 5. Heat detectors
  - 6. Notification appliances
  - 7. Sprinkler system waterflow and valve tamper alarms
  - 8. Elevator recall
  - 9. Air handling unit shutdown
  - 10. Battery stand-by power
  - 11. Fire Command Center
  - 12. Multi-channel one-way voice notification system
  - 13. Fire pump status monitoring
  - 14. Firefighter's smoke control panel
  - 15. Digital alarm communicator transmitter (DACT)
  - 16. Air sampling smoke detection

**1.3 QUALITY ASSURANCE**

- A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.
- B. All work shall be installed in strict conformance with manufacturer's requirements and recommendations. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.
- C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.
- D. Installation of devices shall be performed or supervised by a National Institute for Certification of Engineering Technologies (NICET) Level 2 or higher Fire Alarm Technician. Submit copies of the certification for employees through shop drawing submittals.

**1.4 APPLICABLE CODES AND STANDARDS**

- A. Execute Work in accordance with the National Fire Protection Association Standards and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities. Upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.
- B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.
- C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.
- D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes.
  - 1. NFPA 70, "National Electrical Code", 2020 Edition.
  - 2. NFPA 72, "National Fire Alarm and Signaling Code", 2019 Edition.
  - 3. NFPA 20, "Installation of Stationary Pumps for Fire Protection", 2019 Edition.
  - 4. Underwriters Laboratories, "Fire Protection Equipment Directory", Latest Edition.
  - 5. Alabama Building Code (IBC) 2021 Edition with local amendments.
  - 6. Alabama Fire Code (IFC) 2021 Edition with local amendments.
  - 7. ICC/ANSI A117.1, "Accessible and Useable Buildings and Facilities", 2017 Edition.
  - 8. ASME A17.1, "Safety Code for Elevators and Escalators", Current Edition.
- E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.

**1.5 DEFINITIONS**

- A. General:
  - 1. Furnish: The term "furnish" is used to mean "supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations."
  - 2. Install: The term "install" is used to describe operations at the project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
  - 3. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."

4. Furnished by Owner or Furnished by Others: The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
  5. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
  6. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the AHJ over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
  7. FACP: Fire Alarm Control Panel.
  8. NICET: National Institute for Certification in Engineering Technologies.
  9. Air sampling smoke detection system: Very early smoke-detection system.
- B. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

## 1.6 COORDINATION

- A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.
- B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping in the manner anticipated in the design.
- C. The Contractor shall maintain a foreman on the jobsite at all times to coordinate their work with other contractors and subcontractors so that various components of the Fire Alarm systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the work in such a manner that the work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.
- D. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and their subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.
- E. Where coordination and interfacing with other systems or equipment is required, it shall be the responsibility of the fire alarm system installer (contractor) to either provide the relays, contacts, power supplies and other necessary hardware or see to it that such hardware is provided with the other systems or equipment.
- F. The contractor shall coordinate work in this section with all related trades. Work and/or equipment provided in other sections and related to the fire alarm system shall include, but not be limited to:
  1. Sprinkler waterflow and valve tamper switches shall be provided by the fire sprinkler installer, but wired and connected by the fire alarm installer.
  2. Duct smoke detectors shall be furnished, wired and connected by the fire alarm system installer. The HVAC installer shall furnish necessary duct opening to install the duct smoke detector's housing.

3. Air handling fan control circuits and contacts to be furnished by the HVAC control equipment.
  4. Conduit shall be by Division 26 "Common Work Results for Electrical".
- G. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

### 1.7 MEASUREMENTS AND LAYOUTS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

### 1.8 SUBMITTALS

- A. Refer to Division 1 and General Conditions for submittal requirements, in addition to requirements specified herein. Submittals not complying fully with the submittal requirements will be rejected.
- B. Contractor shall prepare installation drawings (working shop drawings) based upon this design. Requests for deviations from the approved design shall be submitted in writing to the Engineer of Record for approval.
- C. Shop drawings shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code and relevant laws, ordinances, rules and regulations. Drawings that are not legible, or that do not contain sufficient detail to verify compliance with applicable codes and standards, will be rejected without further review.
- D. Submittals and shop drawings shall not contain HEI's firm name or logo, nor shall it contain the HEI's engineers' seal and signature. They shall not be copies of HEI's work product. If the contractor desires to use elements of such product, the license agreement for transfer of information at the end of this section must be used.
- E. Submit Shop Drawings as early as required to support the project schedule. Allow for two weeks Engineer review time plus mailing time plus a duplication of this time for resubmittal if required. Submit Shop Drawings as soon as possible before construction starts.
- F. Before submitting Shop Drawings and material lists, the Contractor shall verify that the equipment submitted is mutually compatible and suitable for the intended use. Contractor shall verify that the equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- G. Refer to Division 1 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the shop drawings have been posted. If electronic submittal procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives. Contractor shall allow the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the electronic submittal and shall clearly indicate the materials, performance criteria and accessories being proposed. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.



- H. The Engineer's checking and subsequent acceptance of such submittals shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless the Contractor has, in writing, called the Engineer's and Architect's attention to such deviations at the time of submission, and secured written acceptance; nor shall it relieve the Contractor from responsibility for errors in dimensions, details, sizes of members, or quantities; or for omissions of components or fittings; or for not coordinating items with actual building conditions and adjacent work.
- I. Product Data: Provide a bill of materials and product cutsheets showing material specifications, electrical characteristics and connection requirements. Highlight or indicate specific product options and accessories as applicable to the project.
- J. Shop Drawings:
  - 1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
  - 2. Shop drawings shall be prepared by a NICET Level 3 or higher certified technician. Submit copies of the certification for the designer with submittal.
  - 3. The fire alarm system equipment vendor shall provide shop drawings showing fire alarm floor plans and a full building riser diagram. Fire alarm floor plans and riser diagram shall show fire alarm control panel, annunciator, all fire alarm initiating devices and notification appliances. Show typical wiring diagrams of control panel/s, annunciator and each device and wiring connections required. Show all interfaces to other systems, such as temperature control systems, and security systems.
  - 4. The fire alarm floor plans and riser diagram shall show wiring to all fire alarm devices/appliances, indicating wire sizes and quantities as well as conduit/raceway sizes and locations of end-of-line (EOL) resistors. The fire alarm floor plans and riser diagram shall clearly show the routing of all fire alarm system wiring, including all horizontal routing and vertical routing (in chases).
  - 5. Routing of all fire alarm wiring shall comply with the "Survivability" requirements of NFPA 72.
  - 6. Provide a Sequence of Operations Matrix that explains how the submitted fire alarm system functions.
  - 7. Include voltage drop calculations for notification-appliance circuits.
  - 8. Include battery-size calculations.
  - 9. Shop drawing scale shall match the Engineer's drawings where possible. Scale shall not be less than  $3/32" = 1'-0"$ .
  - 10. Shop drawings shall be produced using computer-aided design. Hand drawn documents will not be reviewed or approved.
- K. Indicate within the submittal all applicable UL listings and all applicable approvals or certifications.
- L. Fire Fighter Control Panel: Submit the mechanical smoke control system panel and graphic display with color chart.
- M. Qualification Data: Submit copies of the certification for the Installer.
- N. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

## 1.9 ELECTRONIC DRAWING FILES

- A. In preparation of shop or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of 200 for a drawing set up to 12 sheets and 15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall complete and send the form attached at the end of this section along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached

form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

### 1.10 SUBSTITUTIONS

- A. Refer to Division 1 and General Conditions for Substitutions.
- B. Materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- C. No substitution will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten calendar days prior to the date for receipt of Bids. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other Work that incorporation of the substitute would require shall be included. The burden of proof of the merit of the proposed substitute is upon the proposer. The Engineer's decision of approval or disapproval to bid of a proposed substitution shall be final.
- D. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
- E. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

### 1.11 OPERATION AND MAINTENANCE DATA

- A. Refer to Division 1 and General Conditions for Operational and Maintenance Manuals.
- B. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.
- C. The O&M Manuals shall be provided in labeled 3-ring binder with cover, binding label, tabbed fly sheets and plastic insert folders for Record Drawings. Include the following sections with the appropriate information for each section:
  - 1. Typewritten Index.
  - 2. Qualifications. Provide designer and installer qualification.
  - 3. Bill of Materials. Provide complete nomenclature, model number and vendor information for all parts.
  - 4. Operating Instructions. Complete instructions detailing operation and maintenance of all equipment installed.
  - 5. Product Data: Provide product cutsheets for all equipment utilized and installed.
  - 6. Riser diagram.
  - 7. Device addresses.
  - 8. Record copy of site-specific software.
  - 9. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
    - a. Equipment tested.
    - b. Frequency of testing of installed components.
    - c. Frequency of inspection of installed components.
    - d. Requirements and recommendations related to results of maintenance.
    - e. Manufacturer's user training manuals.
  - 10. Manufacturer's required maintenance related to system warranty requirements.
  - 11. Abbreviated operating instructions for mounting at fire alarm control unit and each annunciator unit.

12. Guarantee. Copy of all guarantees and warranties issued.
13. Contact list with minimum three service representative phone numbers.

#### **1.12 RECORD DRAWINGS**

- A. A set of prints shall be kept on the jobsite during construction for the purpose of noting changes to location of all fire alarm equipment, devices, appliances and circuits as finally installed. During the course of construction, the Contractor shall indicate on these drawings, changes made from the Contract Drawings. Particular attention shall be made to those items which need to be located for servicing.
- B. The record drawings shall show actual locations of initiating devices, notification appliances, and end-of-line devices. Show the approximate location, size and type of all wiring and routing of wiring. Drawings should also include one-line riser diagrams showing all devices.
- C. The Contractor shall sign-off on the Record Drawings as being an accurate representation of the completed installation.
- D. Refer to Division 1 and General Conditions for Record Drawings
- E. At the completion of the project, the Contractor shall obtain at their expense, reproducible copies of the drawings and incorporate changes noted on the jobsite work prints onto these sheets. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", with date. The drawings and associated system calculations shall be delivered to the Architect.

#### **1.13 SPARE PARTS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Provide 10% of the total or a minimum of one (1) manual pull station.
  2. Provide 10% of the total or a minimum of two (2) of each type of automatic smoke detector.
  3. Provide 5% of the total or a minimum of one (1) of each type of automatic heat detector.
  4. Provide 5% of the total or a minimum of two (2) of each strobe type and candela rating.
  5. Provide 5% of the total or a minimum of two (2) of each speaker type. Combination speaker/strobe units matching the units installed are acceptable.
  6. Keys and Tools: One extra set for access to locked or tamper proofed components.

#### **1.14 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing the products indicated in this section with minimum three years documented experience.
- B. Installer: Company specializing in installing the products indicated in this section with minimum three years documented experience. Shall be bondable and licensed Contractor and employ full-time factory-trained and certified installers and technicians. Installers shall provide with the fire alarm submittal proof of factory training for each installer.
- C. Final checkout and verification: Shall be conducted by a technician certified by the National Institute for Certification in Engineering Technologies (NICET) registered as level 2 or higher in the fire protection technology certification program. Provide certification information with fire alarm submittal.
- D. The equipment manufacturer's service department shall be fully stocked in standard parts and components and engaged in the maintenance of fire alarm systems. On-the-premises service shall be available within 4 hours of notification, 7 days a week, 24 hours a day.

#### **1.15 GUARANTEES AND WARRANTIES**

- A. Refer to Division 1 and General Conditions for Guarantees and Warranties.

- B. Furnish service and maintenance of fire alarm system including wiring and raceways for one year from date of substantial completion.
- C. All components, system software, parts and assemblies shall be guaranteed against defects in materials and workmanship for the one-year period stated above, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty.
- D. Labor (including travel expenses) to trouble-shoot, repair, reprogram, or replace components shall be furnished by this contractor at no charge during the warranty period.
- E. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software.

#### **1.16 PROJECT CONDITIONS**

- A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

### **PART 2 - PRODUCTS AND MATERIALS**

#### **2.1 SYSTEM DESCRIPTION**

- A. Noncoded, UL-listed addressable system, with multiplexed signal transmission and voice/strobe evacuation.
- B. All components provided shall be listed for use with the selected system.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Source Limitations for Fire alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested, and will operate, as a system.

#### **2.2 MANUFACTURER**

- A. Subject to compliance with requirements, provide products manufactured by the following manufacturers as indicated on the Drawings:
  - 1. Notifier
  - 2. Johnson Controls, Inc. (Simplex)
  - 3. Siemens-Cerberus Division
  - 4. Kidde/Edwards
  - 5. Gamewell-FCI
  - 6. Fike
  - 7. Silent Knight
  - 8. Approved Equal
    - a. Approved equals will not be considered unless formally submitted during the bidding process as an RFI.

#### **2.3 SYSTEMS OPERATIONAL DESCRIPTION**

- A. Fire alarm signal initiation shall be by one or more of the following devices and systems:
  - 1. Manual pull stations.
  - 2. Heat detectors.
  - 3. Smoke detectors.
  - 4. Air-sampling smoke-detection system.
  - 5. Automatic sprinkler system water flow.
  - 6. Fire extinguishing system operation.

- B. Fire alarm signal shall initiate the following actions:
1. Identify alarm and specific initiating device at fire alarm control unit and remote annunciators (if provided).
    - a. A pulsing alarm tone shall occur within the control panel until acknowledged.
    - b. The alarm LED shall flash on the control panel and remote annunciator panel until the alarm has been acknowledged at the control panel/remote annunciator panel. Once acknowledged, this same LED shall latch on and the custom label for the address in alarm shall be displayed on the alphanumeric LCD readout. A subsequent alarm received from another address after acknowledged shall flash the alarm LED on the control panel showing the new alarm information.
  2. Transmit an alarm signal to the alarm supervising station.
  3. The audible and visible alarm signal shall operate until it is manually silenced or acknowledged.
  4. Record events in the system memory.
  5. Activate voice/alarm communication system.
  6. All fan-powered air-handling equipment shall shutdown and remain down until the fire alarm control panel is reset.
  7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
  8. Activate smoke-control system (smoke management).
  9. Activate stairwell and elevator-shaft pressurization systems.
  10. Shutdown audio system.
  11. Transmit signal to scoreboard and ribbon board control panel to display visual evacuation message when activated.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
  2. Duct-smoke detectors
  3. High- or low-air-pressure switch of a dry-pipe system.
  4. Alert and Action signals of air-sampling detector system.
  5. Fire pump running.
  6. Fire pump loss of power.
  7. Fire pump power phase reversal.
  8. Independent fire detection and suppression systems.
  9. User disabling of zones or individual devices.
  10. Loss of communication with any panel on the network.
- D. System Supervisory Signal Actions:
1. Identify specific device causing supervisory signal fire alarm control unit and remote annunciators (if provided).
    - a. Visible and audible supervisory alarm indicated by address at fire alarm control panel.
    - b. Manual acknowledge function at fire alarm control panel and remote annunciator panel silences audible supervisory alarm; visible alarm is displayed until device is returned to its normal position/supervisory condition is cleared.
  2. Record events in the system memory.
  3. After a time delay of 90 seconds transmit a supervisory signal to the alarm supervising station.
  4. Duct-mounted smoke detectors shall shutdown their respective unit upon detection of smoke and remain down until manually reset.
  5. Individual fan-powered air distribution equipment less than 2,000 cfm that is not provided with duct detection shall shutdown when the respective air handling unit is shutdown.
- E. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
  2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.

3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
  4. Loss of primary power at fire alarm control unit.
  5. Ground or a single break in internal circuits of fire alarm control unit.
  6. Abnormal ac voltage at fire alarm control unit.
  7. Break in standby battery circuitry.
  8. Failure of battery charging.
  9. Abnormal position of any switch at fire alarm control unit or annunciator.
  10. Voice signal amplifier failure.
- F. System Trouble Signal Actions:
1. Identify specific device causing trouble signal fire alarm control unit and remote annunciators (if provided).
    - a. Visible and audible trouble alarm indicated by address at fire alarm control panel.
    - b. Manual acknowledge function at fire alarm control panel and remote annunciator panel silences audible trouble alarm; visible alarm is displayed until device is returned to its normal position/trouble condition is cleared.
  2. Record events in the system memory.
  3. After a time delay of 90 seconds, transmit a trouble signal to the alarm supervising station.
- G. Positive Alarm Sequence
1. Alarm Sequence of Operation: Actuation of an alarm initiating device places circuit in alarm mode, which causes the following system operations. Refer to Section 2.3.A for a listing of all alarm initiating devices.
    - a. Audible and visual notification appears locally at the fire alarm control panel.
    - b. Audible and visual notification throughout the building is delayed 15 seconds.
      - 1) Trained personnel shall acknowledge the alarm within the 15 seconds.
      - 2) If the alarm is not acknowledged within 15 seconds, the notification appliances shall immediately activate throughout the building.
    - c. If the 15 second delay is acknowledged, audible and visual notification throughout the facility is delayed and a 180 second investigation stage is initiated while the alarm is verified.
      - 1) If the system is not reset during the investigation phase, audible and visual notification devices immediately activate throughout the building at the end of the 180 second investigation phase.
    - d. The 180 second investigation phase:
      - 1) If a false alarm is verified, the fire alarm is to be cancelled at the panel by pushing a separate switch or button at the fire alarm control panel that overrides the 180 second countdown and cancels the alarm.
      - 2) If an additional initiating devices goes into alarm during the 180 second investigation phase, the system shall be placed into alarm.
      - 3) If an alarm is verified during the 180 second investigation phase, the fire watch attendant will set the facility into alarm by pulling a designated manual pull station located adjacent to the fire alarm control panel. The manual pull station shall activate an instant alarm when the system is in Positive alarm Sequence.
    - e. Once the system is in alarm:
      - 1) Identify alarm and specific initiating device at fire alarm control unit and remote annunciators (if provided).
        - a) A pulsing alarm tone shall occur within the control panel until acknowledged.
        - b) The alarm LED shall flash on the control panel and remote annunciator panel until the alarm has been acknowledged at the control panel/remote annunciator panel. Once acknowledged, this same LED shall latch on and the custom label for the address in alarm shall be displayed on the alphanumeric LCD readout. A subsequent alarm received from another address after acknowledged shall flash the alarm LED on the control panel showing the new alarm information.

- 2) Transmit an alarm signal to the alarm supervising station.
  - 3) The audible and visible alarm signal shall operate until it is manually silenced or acknowledged.
  - 4) Record events in the system memory.
  - 5) Activate voice/alarm communication system.
  - 6) All fan-powered air-handling equipment shall shutdown and remain down until the fire alarm control panel is reset.
  - 7) Close smoke dampers in air ducts of designated air-conditioning duct systems.
  - 8) Shutdown audio system.
  - 9) Transmit signal to scoreboard and ribbon board control panel to display visual evacuation message when activated.
  - 10) Transmit signal to override bowl public address system to activate audible evacuation message when activated.
2. Supervisory Sequence of Operation: The activation of any supervisory initiating device places system in supervisory mode, which causes the following system operations. Refer to Section 2.3.C for a listing of all supervisory initiating devices and sequence of operations.
  3. Trouble Sequence of Operation: System or circuit trouble places system in trouble mode, which causes the following system operations. Refer to Section 2.3E for a listing of trouble sequence of operations.

## 2.4 FIRE ALARM SYSTEM CONTROL UNIT

- A. General Requirements for Fire alarm Control Unit:
  1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
    - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
    - b. Include a real-time clock for time annotation of events on the event recorder and printer.
    - c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
    - d. The FACP shall be listed for connection to a central-station signaling system service.
    - e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
    - f. The control unit shall have dedicated alarm, supervisory and trouble LED's and dedicated alarm, supervisory and trouble acknowledge, and alarm silence switches.
    - g. Lamp Test: Manual lamp test function causes each LED to function at fire alarm control panel.
    - h. Drill Sequence of Operation: Manual drill function causes alarm mode operation as described above.
    - i. The FACP shall be provided with surge protection.
    - j. Install in a surfacemounted enclosure.
    - k. The fire alarm system control unit shall be UL listed for releasing service.
      - a. The fire alarm system control unit shall be UL listed for smoke control service.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
  1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.

2. Keypad: Arranged to permit entry and execution of programming, display, and control commands. and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
- C. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals and digital alarm communicator transmitters shall be powered by 24-V dc source.
  1. The location of the dedicated branch circuit disconnecting means shall be permanently identified at the control unit.
  2. The circuit disconnecting means shall have a red marking and be provided with a breaker lock or other approved method to avoid accidental operation.
  3. Alarm current draw of entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
- D. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
  1. Batteries: Sealed lead acid.
  2. The secondary power system shall operate system in standby mode for 24 hours followed by alarm mode for 15 minutes.
- E. System Supervision: Automatically detects and reports open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification appliance circuits. Alarm, supervisory and trouble signals shall be monitored by the supervising station over a Digital Alarm Communicator Transmitter (DACT), or other approved method.
- F. Fire Pump Control and Status: Provide supervised START (no STOP control shall be installed) controls and visible alarm status indication at the Fire Command Center and at the Remote Annunciator for the fire pump in accordance with NFPA 20. Coordinate with the fire pump controller supplier and provide the necessary conduit and wiring for the control and status indication. Refer to Division 21.
- G. Smoke Control Systems:
  1. Provide output signals using addressable relays to start the smoke control system(s). Signal shall remain on until alarm conditions are cleared and fire alarm system is reset. Signal shall not stop in response to alarm acknowledge or signal silence commands.
  2. Modify section(s) accordingly for sequence of operations for the smoke control interface on the project.
  3. Smoke Control starts when any designated alarm is received at fire alarm control unit. Refer to smoke control sequence of operation for additional information.
  4. First fire alarm system initiating device to go into alarm condition shall activate the smoke control functions. Subsequent devices going into alarm condition shall have no effect on the smoke control mode.
  5. Fire Fighter Smoke Control Panel
    - a. General
      - 1) Comply with local building code.
      - 2) Include manual control and override of automatic control of mechanical smoke control systems.
      - 3) Include a graphic display with switches for control and indicator lights for monitoring status and override of automatic control of smoke control equipment as specified herein and described on the drawings.
      - 4) UL864 – UUKL listed as a Firefighters Smoke Control Station.
    - b. Construction:
      - 1) Unitized cabinet, primed and painted with a baked enamel, textured finish. Provide a security door with viewing window.
      - 2) Include an aluminum substrate for mounting of graphics, indicating lights, switches, control devices and test stations.
      - 3) Front panel shall have a polyester film overlay protected by a non-glare textured coating which is non-yellowing, durable and scratch resistant. The



- overlay shall be bonded to the front panel with an adhesive that does not delaminate and provides 100 percent bonding.
- 4) Graphics: The front panel overlay shall be a multi-color graphic display showing the mechanical smoke control system as shown on the drawings. Smoke control fans within the building shall be shown on the fire-fighter's control panel. Display a clear indication of the direction of airflow and the relationship of components.
  - 5) Switches: Rotary or flip type for ON-OFF-AUTO, OPEN-AUTO-CLOSE, ON-OFF or OPEN-CLOSE operation as required per code for the operated equipment. Include a keyed switch for panel enable and a momentary test button for sample testing of all indicating lights.
  - 6) Indicating Lights: High intensity LED or pilot-lamp type lights of colors as required by code. Indicate the following:
    - 7) Normal, Off, On, or Fault status of equipment.
    - 8) Positive confirmation of actuation, testing, manual override, and the presence of power downstream of all disconnects.
    - 9) Panel power.
    - 10) Panel communication fault.
  - 11) Audible Signal: Provide audible signal to indicate failure of smoke control equipment.
- c. Operating Features:
- 1) Full monitoring and manual control capability over smoke control systems or equipment.
  - 2) Capability to override any operation in progress or other control signal associated with the smoke control equipment except electrical overload or personnel safety devices.
  - 3) Act as highest priority over the smoke control systems or equipment.
  - 4) Indicate actual status of systems and equipment used for smoke control.
  - 5) Ability to activate an audible signal if the operational proof sensor failed to provide positive feedback that the equipment operated as commanded.
  - 6) Alarm a failure of smoke control systems or equipment.
  - 7) Provisions for verification of system operation.
  - 8) Conduct a pre-programmed weekly test sequence to report abnormal conditions audibly, visually, and by printed report. The pre-programmed weekly test shall operate all devices, equipment, and components used for smoke control.
- H. Activation of a smoke detector or waterflow alarm switch serving a smoke control zone shall activate the smoke control system for that zone.
- I. Elevator Recall and Shutdown: Provide output signals to the elevator controller(s) using addressable relays to initiate elevator recall and shutdown functions per ASME A17.1. Provide equipment, output signals and logic as required by code and by the elevator system supplier and installer.
1. Elevator recall shall be initiated by any one of the following alarm-initiating devices:
    - a. Elevator lobby detector(s).
    - b. Smoke detector in elevator machine room.
    - c. Smoke detector(s) in elevator hoistway.
    - d. Heat detector(s) in elevator pit.
  2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
  3. Elevator shutdown shall be initiated by any one of the following alarm-initiating devices:
    - a. Heat detector in elevator machine room.
    - b. Heat detector(s) at top of elevator hoistway.

**2.5 EMERGENCY VOICE ALARM COMMUNICATIONS SYSTEMS (EVACS)**

- A. The system shall incorporate one-way emergency voice communication via specified speakers. A central audible module shall provide for the necessary alarm message/tone generation, main and remote microphone connections and mixers/pre-amplifier circuits. Continuous supervision shall be provided along with specific information as to the type of failure (main microphone trouble, tone trouble, etc.)
1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.
    - a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
    - b. Programmable tone and message sequence selection.
    - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
    - d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire alarm control unit.
  2. Hand held push to talk, noise canceling microphone in recessed protective panel mounted enclosure; 5 feet coiled cable; and LED to indicate the microphone push to talk has been pressed.
  3. Audible power amplifiers shall be self filtered; contain 24 volt power supply, transformer and amplifier monitor circuits; Amplifier shall operate all system speakers plus twenty-five (25) percent spare capacity.
  4. Digitized voice messages are required to notify building occupants during alarm conditions. Message player shall not rely on tape or mechanical means of transmitting the voice message. A standard evacuation message shall be provided; however, the system shall be capable of transmitting a custom message of up to five (5) minutes long.
  5. Alarm sequence shall consist of a temporal (3) alarm tone for a maximum of 15 seconds followed by an automatic pre-selected message. At the end of the message the tone shall resume. This sequence shall continue until the fire alarm control panel has been silenced. Manual voice paging shall be available via panel switches to page individual floors or groups of floors. Each floor shall be an individual audible zone and have a corresponding audible switch.

**2.6 DIGITAL ALARM COMMUNICATOR TRANSMITTER**

- A. Digital alarm communicator transmitter (DACT) shall be acceptable to the central station and shall comply with UL 864.
- B. The installing contractor shall select the appropriate DACT equipment based on the available communication methods.
- C. Coordinate with General Contractor to ensure proper connections are provided for communication to and from the DACT. Two (2) separate communication methods are required and shall not be subject to a common failure within the scope of work identified within these contract documents. Unless noted otherwise, the installing contractor shall utilize two (2) of the following communication methods:
1. Copper wire (POTS) telephone line for fire alarm use as required by NFPA 72.
    - a. If two (2) POTS telephone lines are utilized per NFPA 72, additional communication methods are not required.
  2. Building 10/100 Base network (LAN), DSL modem, or cable modem.
  3. GSM cellular networks in the area including 2G, 3G and 4G.
    - a. The transmitter shall automatically detect and choose the best network in the area based on signal strength and immediately self-adjust for operation as necessary.

4. Other alternative method complying with the performance requirements of NFPA 72 for 'Communication Methods for Supervising Station Alarm Systems that is acceptable to the Authority Having Jurisdiction and the Engineer of Record. Approval of any alternative methods must be obtained from the Engineer of Record via an RFI prior to submitting bids for the scope of work.
- D. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire alarm control unit and automatically transmit across the primary communication method. If service on the primary communication method is interrupted for longer than 45 seconds, the transmitter shall initiate a local trouble signal and transmit a signal indicating loss of primary communication to the supervising station over the secondary communication method. Transmitter shall automatically report communication restoration to the supervising station. If service is lost on both communication methods, transmitter shall initiate a local trouble signal.
- E. Digital data transmission shall include the following:
  1. Address of the alarm initiating device.
  2. Address of the supervisory signal.
  3. Address of the trouble signal.
  4. Loss of ac supply.
  5. Loss of power.
  6. Low battery.
  7. Abnormal test signal.
  8. Communication bus failure.
- F. Secondary Power: Integral rechargeable battery and automatic charger.
- G. Self-Test: Conducted automatically every 24 hours with report transmitted to supervising station.

## 2.7 REMOTE ANNUNCIATOR

- A. Description: Alphanumeric display and LED indicating lights shall match those of fire alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.
  1. Mounting: Surface.
  2. Provide remote microphone and emergency/voice alarm system controls.

## 2.8 INITIATING DEVICES

- A. Manual Fire Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
  1. Double action mechanism requiring two actions to initiate an alarm, pull lever type; with integral addressable module arranged to communicate manual station status (normal, alarm, or trouble) to fire alarm control unit.
  2. Station Reset: Key or wrench operated switch.
  3. Indoor Protective Shield: Factory fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
- B. System Smoke Detectors: Photoelectric type complying with UL 268 operating at 24-V dc, nominal with integral addressable module arranged to communicate detector status (normal, alarm, or trouble) to fire alarm control unit.
  1. Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base.
  2. Device shall have an integral visual-indicating light, LED type, indicating detector has operated and power-on status.

3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
  4. Photoelectric detectors shall have sensitivity between 0.5 and 3.5 percent/foot smoke obscuration.
- C. Duct Smoke Detectors: Photoelectric type complying with UL 268A with a standard, relay or isolator detector mounting base. Provide manufacturer's standard housing to protect the measuring chamber from damage and insects. Provide drilling templates and gaskets to facilitate locating and mounting the housing.
1. Provide for variations in duct air velocity between 100 and 4,000 feet per minute.
  2. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied. Provide an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten feet.
  3. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
  4. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor control circuit.
  5. Provide remote alarm LEDs and remote test stations as shown on the plans.
  6. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
- D. Air-Sampling Smoke Detectors: Laser based smoke detection using a piping system and fan to transport particles of combustion to the detector. Provide two levels of alarm from each zone covered by the detector and two supervisory levels of alarm from each detector.
1. Air being sampled must pass through filters to remove dust particles greater than 20 microns before entering detection chamber.
  2. Detectors must communicate with FACP via addressable, monitored dry contact closures and interface modules.
  3. Pipe airflow balancing calculations must be performed using approved calculation software.
  4. Obscuration Sensitivity Range: 0.005 to 6 percent obs/ft.
  5. Include display module within each detector.
  6. Pipe material shall be CPVC and complying with UL 1887.
  7. Sampling holes of 5/64 inch (2mm), or other sized holes per manufacturers written instructions, must be separated by not more than maximum distance allowable for conventional smoke detectors. Intervals may vary in accordance with calculations.
  8. conventional smoke detectors. Intervals may vary in accordance with calculations.
- E. Heat Detectors – Comply with UL 521. Detector shall have twist lock base interchangeable with smoke detectors bases and be equipped with an integral addressable module arranged to communicate detector status (normal, alarm, or trouble) to fire alarm control unit.
1. Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
  2. Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 135 deg F (88 deg C).

## 2.9 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
1. Combination Devices: Factory integrated audible and visible devices in a single mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections. Minimum audible level and strobe intensity shall meet all requirements for separate appliances.
  2. Provide strobe synchronization as required per NFPA 72.
  3. Wall mounted notification appliances shall be manufacturer standard white finish.
  4. Ceiling mounted notification appliances shall be manufacturer standard white finish.

- B. Alarm Horns: Comply with UL 464. Electric vibrating polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
- C. Alarm Speakers: Comply with UL 1480. High quality tone and voice reproduction; capacitor connected for connection to supervised notification appliance circuit; semi-flush mounting; four inch cone; high impact, flame retardant PC/ABS thermoplastic; 25 or 70 VRMS; multi-tapped output power rated □ to 2 watts and produce 79 to 88 dB at 10 feet.
- D. Special Application Speakers (Ceiling Mounted):
  - 1. Quam UL22/25 or UL22/70 – Lay-in Speaker: UL Listed, shallow depth, lightweight, tile replacement, fire-protective signaling device with an 8C10PAFR - 8" O.D. loudspeaker, 10 oz. magnet, fire retardant components and a 4W-70V rotary select transformer. Integral enclosure is 1,412 CID molded fiber. Grille is perforated steel with four (4) seismic tie-off points in a white powder coat finish. Line supervision capacitor is included. No assembly required.
  - 2. Atlas/Soundolier, model number #UHT, UL listed to Standard 1480, 8-inch cone, multi-tapped design with output power of 1/2, 1, 2, 5 watt and 10 watt with either 25 or 70.7 VRMS input. Semi-flush ceiling mounted; #U51-8 standard round grille with #U95-8 enclosure (required for UL listing). Speaker output shall exceed 80 dBa at 10 feet and not exceed 120 dBa at the minimum hearing distance from the device. The speakers shall have multiple taps and shall utilize the 2-watt tap on the Atlas/Soundolier 10 watt speaker.
- E. Visible Alarm Notification Appliances (Strobes): Xenon strobe lights complying with UL 1971, unfiltered or clear filtered white light, with candela ratings as indicated on drawings. Strobes shall meet all requirements of the Americans with Disabilities Act.

## 2.10 AUXILIARY DEVICES

- A. Waterflow Alarm Switches: Shall be provided by the Fire Sprinkler Installer and shall be wired complete and ready for use by the Fire Alarm System Installer. Switch shall have an adjustable delay to minimize false alarms due to fluctuations in water pressure.
- B. Valve (Tamper) Switches: Shall be provided by the Fire Sprinkler Installer and shall be wired complete and ready for use by the Fire Alarm System Installer.
- C. Monitor Module: Addressable microelectronic module providing a system address for alarm initiating devices for wired applications with normally open contacts. Include address setting means on the module.
- D. Control/Relay Module: Provide intelligent control relay modules. The Control Relay Module shall provide one form "C" dry relay contact rated at 2 amps @ 24 VDC to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware.
- E. Fire Department Key Box: Shall be by Knox Company or as otherwise specified by the authority having jurisdiction. Provide internal switch(es), as required by the Authority Having Jurisdiction, to indicate supervisory condition(s) at the fire alarm control and annunciator panels.
  - 1. .

## 2.11 FIRE ALARM WIRE AND CABLE

- A. Fire Alarm Power Branch Circuits: Building wire as specified in Division 26.
- B. Fire alarm Wire and Cable: NRTL listed and labeled as complying with NFPA 70 (NEC) Article 760. All wiring, including wiring to existing modified devices and appliances shall be new.

- C. Signaling Line, Initiating Device and Notification Appliance Circuits: Power limited fire protective signaling cable, solid copper conductor, 300 volts insulation, suitable for temperature, conditions and location installed. Minimum wire size for initiating device circuits, control circuits and notification appliance circuits shall be determined by calculations and manufacturer's requirements or recommendations. Wire and cable shall be twisted and shielded if recommended by the system manufacturer.
- D. The type of cable chosen should be based on fire alarm system requirements, specification requirements and applicable code requirements. Consideration should also be given to the length of cable runs and potential interference.
- E. Initiating, notification, and control circuits shall be sized based on 20% additional power consuming devices.
- F. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems.
- G. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket and red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated.
- H. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits: Provide circuitry, which meets the performance requirements during abnormal conditions, based upon the class of the circuitry selected.
  - 1. Initiating Device Circuits: Class B
    - a. Pathway Survivability: Level 0.
  - 2. Notification Appliance Circuits: Class B.
    - b. Pathway Survivability: Level 0.
  - 3. Signaling Line Circuits: Class B.
    - c. Pathway Survivability: Level 0.
  - 4. Any circuits interconnecting fire alarm control panels between separate buildings shall be provided with surge protection.

## 2.12 ACCESS TO EQUIPMENT

- A. All detectors, modules, equipment, etc. shall be located so as to provide easy access for operation, service inspection and maintenance.
- B. Access Doors:
  - 1. Provide access doors for all concealed equipment, except where above lay-in ceilings.
  - 2. Access doors shall be adequately sized for the devices served with a minimum size of 18" x 18", furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
  - 3. Access doors must be of the proper materials for type of construction where installed.
  - 4. The exact location of all access doors shall be verified with the Architect prior to installation.
  - 5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
  - 6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
    - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
    - b. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
  - 7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
    - a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
  - 8. Locking Devices: Flush, screwdriver-operated cam locks.

9. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
  - a. Arrow United Industries.
  - b. Bar-Co., Inc.
  - c. J.L Industries.
  - d. Karp Associates, Inc.
  - e. Milcor Div. Inryco, Inc.
  - f. Nystrom Building Products
  - g. Wade
  - h. Zurn

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. The Contractor shall install, program and test all new equipment identified in this contract in accordance with the applicable codes, standards, and manufacturer's instructions.
- B. The installation supervisor shall be on the job site during the entire installation. The installation supervisor shall maintain marked up copies of the drawings at the job site showing as-built conditions. These drawings shall be updated daily and available for Owner review.
- C. The Contractor shall provide all required conduit and all associated hardware, and shall install (pull), connect, and test all cable for a complete fire alarm system. All wiring shall be installed in accordance with the guidelines of these specifications and documents as well as the NFPA codes and standards listed in these specifications.

#### **3.2 EXAMINATION**

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.3 EQUIPMENT INSTALLATION**

- A. Comply with NFPA 72 and requirements of authorities having jurisdiction for installation and testing of fire alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
  1. Devices placed in service before all other trades have completed cleanup shall be replaced.
  2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
- C. Manual Fire alarm Boxes: Provide manual fire alarm boxes as shown on drawings. Mount manual fire alarm box on a background of a contrasting color. The operable part of manual fire alarm box shall be at 48 inches above floor level unless noted otherwise.
- D. Smoke and Heat Detectors: Provide detectors as shown on drawings.

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke detector spacing.
  2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat detector spacing.
  3. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
  4. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
  5. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
  6. Install ceiling mounted detectors in areas with exposed structure tight to underside of floor/roof deck unless noted otherwise on drawings.
- E. Duct Smoke Detectors: Comply with NFPA 72. Install sampling tubes so they extend the full width of the duct. Tubes more than 36 inches long shall be supported at both ends.
1. Do not install smoke detector in duct smoke detector housing during construction. Install detector only during system testing and prior to system turnover.
  2. Provide duct detection and shutdown for fan powered air distribution equipment exceeding 2,000 cfm.
  3. Provide equipment and connections to shutdown fan powered air distribution equipment with a capacity less than 2,000 cfm that are part of an air distribution system with a capacity greater than 2,000 cfm.
- F. .
- G. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in unsprinklered elevator shafts.
- H. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, or valve-tamper switch that is not readily visible from normal viewing position.
- I. Install ceiling mounted visible and audible/visible notification appliances in areas with exposed structure to bottom of floor/roof structure or at 30 ft AFF, whichever is lower.
- J. Install ceiling mounted visible and audible/visible notification appliances in areas with finished ceilings flush with bottom of ceiling or at 30 ft AFF, whichever is lower.
- K. Install wall mounted visible and audible/visible notification appliances with visible element (strobe) between 80 inches and 96 inches above finished floor unless noted otherwise on drawings.
- L. Install wall mounted audible devices with the top of the device at least 90 inches above finished floor or 6 inches below the ceiling, whichever is lower, unless noted otherwise on Drawings. If combination devices are installed, they shall be installed per the visible signal device requirements.
- M. All notification appliance speakers shall be tapped at  $\square$  watt unless noted otherwise on drawings. In rooms less than 100 sq ft, speakers are permitted to be tapped at  $\square$  watt.

### 3.4 PATHWAYS

- A. Pathways shall be installed in conduit.
- B. All detection and control circuits associated with smoke control systems shall be fully enclosed within continuous raceways.
- C. Minimum allowable conduit size shall be  $\square$  inch. The conduit shall be sized so that conduit fill does not exceed 75% of NFPA 70 maximum fill requirements. Cables in vertical risers shall not exceed 50% of NFPA 70 maximum fill requirements. Conduit installation shall be as required by the Contractor's layout and as described in these specifications. All conduit field routing shall be



acceptable to the Owner. Routing not acceptable shall be rerouted and replaced without expense to the Owner.

- D. All wire, cable, conduit and raceways shall be concealed in walls, ceiling spaces, electrical shafts or closets in finished areas except as specifically noted otherwise. Conduit and raceways may be exposed in unfinished areas or where specifically approved by the Owner.
- E. Except as otherwise specified or indicated on the drawings, all conduit shall be installed parallel or perpendicular to dominant surfaces with right angle turns made of symmetrical bends or fittings. Except where prevented by the location of other work, a single conduit or a conduit group shall be centered on structural members.
- F. Conduit shall be located at least six inches from hot water or steam pipes, and from other hot surfaces. Conduit shall not block access to any existing equipment or fixtures.
- G. Mount end-of-line device in box with last device or separate box adjacent to last device in circuit for conventional hardwired class B initiating and notification appliance circuits.
- H. Conduit shall be securely fastened to all boxes and cabinets. Threads on metallic conduit shall project through the wall of the box to allow the bushing to butt against the end of the conduit. The locknuts both inside and outside shall then be tightened sufficiently to bond the conduit securely to the box. Conduit shall enter cabinets from the bottom and sides only.

### 3.5 CONNECTIONS

- A. All wiring shall be terminated at devices or panels using terminal connectors for screw type terminals. All terminal connectors for conductors shall be pre-insulated ring type or pre-insulated spade type. Pre-insulated terminal connectors shall include a vinyl sleeve, color coded to indicate conductor size. Pre-insulated terminal connectors shall include a metallic support sleeve bonded to the vinyl-insulating sleeve and designed to grip the conductor insulation.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  - 1. Alarm initiating connection to smoke control system (smoke management) at firefighters' smoke control system panel.
  - 2. Alarm initiating connection to stairwell and/or elevator shaft pressurization systems.
  - 3. Smoke dampers in air ducts of designated HVAC systems.
  - 4. Provide equipment and connections to shutdown fan powered air distribution equipment with an individual capacity less than or equal to 2,000 cfm that are part of an air distribution system with a design capacity greater than 2,000 cfm.
  - 5. Alarm initiating connection to elevator recall system and components.
  - 6. Alarm initiating connection to activate emergency lighting control.
  - 7. Connection to disable sound systems upon alarm activation.
  - 8. Supervisory connections at valve supervisory switches.
  - 9. Supervisory connections at low-air pressure switch of each dry-pipe sprinkler system.
  - 10. Supervisory connections at elevator shunt-trip breaker.
  - 11. Data communication circuits for connection to smoke control equipment.
  - 12. Supervisory connections at fire pump power failure including a dead-phase or phase-reversal condition.

### 3.6 INSTALLATION OF ACCESS DOORS

- A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.

**3.7 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. All conduits and junction boxes shall be labeled as specified in Division 26 (red).
- C. The location of end-of-line resistors shall be identified with a label indicating "EOL."
- D. Provide label at each initiating device indicating the device address. Label shall be visible from the floor below or immediately adjacent to the device.

**3.8 GROUNDING**

- A. Ground fire alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

**3.9 FIELD QUALITY CONTROL**

- A. Systems shall be checked and tested in accordance with the instructions provided by the manufacturer to insure that the system functions as required and is free of grounds, opens, and shorts. Each device shall be tested.
  - 1. Smoke detectors shall be tested with products of combustion.
- B. Upon completion of the system installation and before the Date of Final Acceptance, a factory-trained technician shall perform all necessary tests and adjustments and shall then file a Letter of Certification and a Certificate of Completion (NFPA 72) with the Owner indicating that the system functions and conforms to the Fire Alarm System Specifications.
- C. Upon completion of the system installation, a factory-trained technician shall perform all necessary tests and adjustments in the presence of the Owner's designated personnel. Test in accordance with NFPA 72 and requirements of the authority having jurisdiction. Perform the following tests at a minimum:
  - 1. Visual Inspection: Conduct visual inspection prior to testing. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
  - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
    - a. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
    - b. Test visible appliances for the public operating mode according to manufacturer's written instructions.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. Fire alarm system will be considered defective if it does not pass tests and inspections.
- F. Include services of factory trained and certified technician to supervise installation, adjustments, final connections, and system testing as performed by the fire alarm contractor's factory-trained technicians.

**3.10 DEMONSTRATION**

- A. The equipment supplier's factory trained technician shall train the Owner's personnel in the proper use and maintenance of the system. Training sessions shall be conducted as needed, not to exceed a total of 2 sessions, with each session lasting a maximum of 4 hours each.
- B. Demonstrate normal and abnormal modes of operation, and required responses to each.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**PROJECT MANUAL  
VOLUME 5**

**FOR**

**MOBILE ARENA  
401 Civic Center Drive  
Mobile, Alabama 36602**

**Project No. AMOB230117**

**BID SET**

December 13, 2024



**City of Mobile  
Architectural Engineering Department  
Government Plaza  
205 Government Street, South Tower, 5th Floor  
Mobile, Alabama 36602**

**Bid Date:** \_\_\_\_\_

**Set Number:** \_\_\_\_\_

## **OWNERSHIP OF DOCUMENTS AND DISCLAIMER**

The Project Manual, Technical Specifications, Drawings, and all other documents relating to this project have been prepared for this individual and particular project, and for the exclusive use of the original Owner, developer or other party so indicated.

Actual project conditions and as-built conditions may vary significantly. Changes made during bidding, negotiations, construction, due to additions or deletions of portions of this project, and/or for other reasons, may not be indicated in these documents.

These documents may not be used or relied upon as a certification of information indicated, or used for any other project, by any third parties or other parties, for any purpose whatsoever, without the prior written consent of Goodwyn Mills Cawood, LLC, or prior to receipt of mutually agreed to compensation paid to Goodwyn Mills Cawood, LLC, therefore.

The ownership, copyrights, and all other rights to these documents, are reserved by Goodwyn Mills Cawood, LLC, including in part, all copies thereof in any form or media. Reproduction of the material contained in these documents or substantial quotation of their provisions without prior written permission of Goodwyn Mills Cawood, LLC, violates the copyright and common laws of the United States and will subject the violator to legal prosecution.

### **Goodwyn Mills Cawood, LLC**

11 N. Water Street

Suite 15250

Mobile, AL 36602

## SECTION 00 01 05 – PROJECT DIRECTORY

**PROJECT DIRECTORY**

**OWNER:** **City of Mobile Architectural Engineering Department**  
Government Plaza 205 Government Street, South Tower, 5th  
Floor  
Mobile, Alabama 36602  
Phone: (251) 208-7492  
**Carleen Stout, Deputy Director, Real Estate  
and Asset Manager**

**ARCHITECT:** **GOODWYN MILLS CAWOOD, LLC**  
11 North Water Street  
Mobile, Alabama 36602  
Phone: (251) 460-4006  
**James R. Walker, AIA, Project Architect**  
**George Keith Parker, AIA, Project Manager**

**ARCHITECT:** **POPULOUS**  
4800 Main Street, Suite 300  
Kansas City, Missouri 64112  
Phone: (816) 221-1500  
**Aaron Bruckerhoff, AIA, Project Architect**

**CONSTRUCTION  
MANAGER:** **VOLKERT, INC**  
11 N Water Street, Suite 18290  
Mobile, AL 36602  
Phone: (864) 245-1917  
**Sam Matheny, Program Manager**

**STRUCTURAL  
ENGINEERS:** **WALTER P MOORE**  
1301 McKinney Drive, Suite 1100  
Houston, TX 77010  
Phone: (713) 630-7300  
**Erin Kueht, P.E., Structural**

**MECHANICAL/ELECTRICAL  
PLUMBING/ FP ENGINEERS:** **HENDERSON ENGINEERS**  
1801 Main Street, Suite 300  
Kansas City, MO 64108  
Phone: (816) 663-8700  
**Tyler Johnson, P.E., Project Manager**  
**Evan O'Brien, P.E., Lead Mechanical**  
**Mike Fiser, P.E., Lead Electrical**

**CIVIL  
ENGINEERS:**

**DRIVEN ENGINEERING**  
805 Morris Hill Road  
Semmes, AL 36575-6445  
Phone: (251) 649-4011  
**Avalisha Fisher, P.E., Civil**



SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

## VOLUME 1

### SECTION 00 01 10 – TABLE OF CONTENTS

#### DIVISION 00 – PROCUREMENT & CONTRACTING REQUIREMENTS

00 01 00	COVER
00 01 05	DIRECTORY
00 01 07	PROFESSIONAL SEALS
00 01 10	TABLE OF CONTENTS
00 10 00	INVITATION TO BID
00 20 00	INSTRUCTIONS TO BIDDERS
00 22 00	SUPPLEMENTARY INSTRUCTIONS TO BIDDERS
00 24 00	PROPOSAL FORM
00 25 00	ATTACHMENT A TO PROPOSAL FORM
00 50 00	STANDARD FORM OF AGREEMENT OWNER/CONTRACTOR AIA A101-2017
00 72 00	GENERAL CONDITIONS OF THE CONTRACT AIA A201-2017
00 73 00	SUPPLEMENTARY PROJECT CONDITIONS

#### DIVISION 01 – GENERAL REQUIREMENTS

01 10 00	SUMMARY
01 23 00	ALTERNATES
01 25 00	SUBSTITUTION PROCEDURES
01 26 00	CONTRACT MODIFICATION PROCEDURES
01 29 00	PAYMENT PROCEDURES
01 31 00	PROJECT MANAGEMENT AND COORDINATION
01 32 00	CONSTRUCTION PROGRESS DOCUMENTATION
01 33 00	SUBMITTAL PROCEDURES
01 35 16	ALTERATION PROJECT PROCEDURES
01 40 00	QUALITY REQUIREMENTS
01 42 00	REFERENCES
01 43 39	MOCKUPS
01 45 29	STRUCTURAL TESTING AND INSPECTIONS
01 50 00	TEMPORARY FACILITIES AND CONTROLS
01 60 00	PRODUCT REQUIREMENTS
01 73 00	EXECUTION
01 77 00	CLOSEOUT PROCEDURES
01 78 23	OPERATION AND MAINTENANCE DATA
01 78 39	PROJECT RECORD DOCUMENTS
01 79 00	DEMONSTRATION AND TRAINING

#### DIVISION 02 – EXISTING CONDITIONS

NOT ISSUED

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 03 – CONCRETE**

03 10 00	CONCRETE FORMING AND ACCESSORIES		
03 20 00	CONCRETE REINFORCING		
03 30 00	CAST IN PLACE CONCRETE		
03 35 43	POLISHED CONCRETE FINISHING		
03 41 34	PRECAST PRETENSIONED CONCRETE SEATING UNITS		
03 45 00	PRECAST ARCHITECTURAL CONCRETE		

**DIVISION 04 – MASONRY**

04 20 00	UNIT MASONRY		
04 21 13.23	ADHERED BRICK VENEER		

**DIVISION 05 – METALS**

05 12 00	STRUCTURAL STEEL FRAMING		
05 31 00	STEEL DECKING		
05 40 00	COLD-FORMED METAL FRAMING		
05 45 00	METAL SUPPORT ASSEMBLIES		
05 50 00	METAL FABRICATIONS		
05 51 13	METAL PAN STAIRS		
05 51 16	METAL FLOOR PLATE STAIRS		
05 51 19	METAL GRATING STAIRS		
05 52 13	PIPE AND TUBE RAILINGS		
05 53 13	BAR GRATINGS		
05 70 00	DECORATIVE METAL		
05 70 10	VISION BARRIERS		
05 73 13	GLAZED DECORATIVE METAL RAILINGS		
05 75 00	DECORATIVE FORMED METAL		

**DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES**

06 10 00	ROUGH CARPENTRY		
06 20 00	FINISH CARPENTRY		
06 40 00	ARCHITECTURAL WOODWORK		
06 42 16	FLUSH WOOD PANELING		
06 65 00	SOLID SURFACE FABRICATIONS		

**DIVISION 07 – MOISTURE PROTECTION**

07 11 13	BITUMINOUS DAMPROOFING		
07 13 26	SHEET WATERPROOFING		
07 18 00	TRAFFIC COATINGS		
07 21 00	THERMAL INSULATION		
07 26 16	BELOW-GRADE VAPOR RETARDERS		
07 27 26	FLUID-APPLIED MEMBRANE AIR BARRIERS		

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
07 42 13	INSULATED METAL WALL PANELS		
07 42 93	SOFFIT PANELS		
07 46 46	FIBER-CEMENT SIDING		
07 54 19	PVC MEMBRANE ROOFING		
07 62 00	SHEET METAL FLASHING AND TRIM		
07 71 00	ROOF SPECIALTIES		
07 72 00	ROOF ACCESSORIES		
07 76 00	ROOF PAVER AND PEDESTAL SYSTEM		
07 81 00	APPLIED FIRE PROTECTION		
07 81 23	INTUMESCENT FIRE PROTECTION		
07 82 00	BOARD FIRE PROTECTION		
07 84 13	PENETRATION FIRESTOPPING		
07 84 43	JOINT FIRESTOPPING		
07 91 00	PREFORMED PRECAST SEATING BOWL JOINT TREATMENTS		
07 92 00	JOINT SEALANTS		
07 95 00	EXPANSION CONTROL		

**DIVISION 08 – OPENINGS**

08 11 13	HOLLOW METAL DOORS AND FRAMES
08 14 16	FLUSH WOOD DOORS
08 31 13	ACCESS DOORS AND FRAMES
08 33 13	COILING COUNTER SHUTTERS
08 33 23	OVERHEAD COILING DOORS
08 41 13	ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
08 44 13	GLAZED ALUMINUM CURTAIN WALLS
08 51 13	ALUMINUM WINDOWS
08 56 53	SECURITY WINDOWS

**VOLUME 2**

08 71 00	DOOR HARDWARE
08 80 00	GLAZING
08 81 13	DECORATIVE GLASS GLAZING
08 83 00	MIRRORS
08 88 53	SECURITY GLAZING
08 91 19	FIXED LOUVERS

**DIVISION 09 – FINISHES**

09 21 16.23	GYPSUM BOARD SHAFT WALL ASSEMBLIES
09 22 16	NON-STRUCTURAL METAL FRAMING
09 29 00	GYPSUM BOARD
09 30 13	TILE
09 51 00	SUSPENDED CEILING SYSTEMS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
09 61 13	FLOOR SEALERS		
09 61 23	HAZARD STRIPING		
09 65 13	RESILIENT BASE AND ACCESSORIES		
09 65 16	RESILIENT SHEET FLOORING		
09 65 19	RESILIENT TILE FLOORING		
09 66 23	RESINOUS MATRIX TERRAZZO FLOORING		
09 67 23	RESINOUS FLOORING		
09 68 00	CARPETING		
09 69 00	ACCESS FLOORING		
09 72 00	WALL COVERINGS		
09 72 19	GRAPHICS WALL COVERINGS		
09 84 33	SOUND-ABSORBING WALL UNITS		
09 84 36	SOUND-ABSORBING CEILING UNITS		
09 91 13	EXTERIOR PAINTING		
09 91 23	INTERIOR PAINTING		
09 93 00	STAINING AND TRANSPARENT FINISHING		
09 96 00	HIGH-PERFORMANCE COATINGS		

**DIVISION 10 – SPECIALTIES**

10 11 00	VISUAL DISPLAY UNITS
10 12 00	DISPLAY CASES
10 14 00	SIGNAGE
10 21 13.14	STAINLESS STEEL TOILET COMPARTMENTS
10 21 16	SHOWER AND DRESSING COMPARTMENTS
10 22 26.13	ACCORDION FOLDING PARTITIONS
10 22 29	UPFOLDING PANEL PARTITIONS
10 22 39	FOLDING PANEL PARTITIONS
10 26 00	WALL AND DOOR PROTECTION
10 28 00	TOILET, BATH, AND LAUNDRY ACCESSORIES
10 28 19	TUB AND SHOWER ENCLOSURES
10 35 00	FLAGPOLES
10 43 13	DEFIBRILLATOR CABINETS
10 43 14	AUTOMATED EXTERNAL DEFIBRILLATORS
10 44 13	FIRE PROTECTION CABINETS
10 44 16	FIRE EXTINGUISHERS
10 51 13	METAL LOCKERS
10 51 19	PHENOLIC LOCKERS
10 51 20	CUSTOM WOOD LOCKERS
10 53 00	WALKWAY COVERS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
----------------	-------	------------------	-----------------

**DIVISION 11 – EQUIPMENT**

11 13 13	LOADING DOCK BUMPERS		
11 13 16	LOADING DOCK SEALS AND SHELTERS		
11 13 19	STATIONARY LOADING DOCK EQUIPMENT		
11 23 00	COMMERCIAL LAUNDRY EQUIPMENT		
11 31 00	RESIDENTIAL APPLIANCES		
11 40 00	FOOD SERVICE EQUIPMENT		
11 47 00	ICE MACHINES		
11 61 00	THEATER AND STAGE EQUIPMENT		
11 61 43	STAGE CURTAINS		
11 61 44	HALF-HOUSE CURTAINS		
11 61 53	ARENA CURTAINS		
11 82 26	FACILITY WASTE COMPACTORS		

**DIVISION 12 – FURNISHINGS**

12 22 00	CURTAINS AND DRAPES		
12 36 16	METAL COUNTERTOPS		
12 48 13	ENTRANCE FLOOR MATS AND FRAMES		
12 63 26	ARENA SEATS		
12 66 00	TELESCOPING STANDS		
12 66 23	PORTABLE PLATFORMS		

**DIVISION 13 – SPECIAL CONSTRUCTION**

13 17 00	HYDROTHERAPY EQUIPMENT, POOLS, AND TUBS		
13 18 11	ICE RINK GENERAL REQUIREMENTS		
13 18 12	ICE RINK REFRIGERATION SYSTEM		
13 18 13	ICE RINK FLOOR SYSTEM		
13 18 14	ICE RINK PIPING, VALVES, AND ACCESSORIES		
13 18 15	ICE RINK WASTE HEAT RECOVERY SYSTEM		
13 18 16	ICE RINK DASHER BOARD SYSTEM AND ACCESSORIES		

**VOLUME 3**

13 18 17	ICE RINK CENTRAL CONTROL SYSTEM		
13 18 19	ICE RINK WATER TREATMENT SYSTEM		
13 28 16	HOCKEY SAFETY NETTING SYSTEM		

**DIVISION 14 – CONVEYING SYSTEMS**

14 21 00	GEARLESS MACHINE ROOM LESS TRACTION ELEVATORS		
14 22 00	ELECTRIC TRACTION FREIGHT ELEVATORS		
14 31 00	ESCALATORS		
14 42 00	WHEELCHAIR LIFTS		

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 21 – FIRE SUPPRESSION**

21 00 00	TABLE OF CONTENTS AND SEAL		
21 00 10	GENERAL FIRE SUPPRESSION REQUIREMENTS		
21 05 00	COMMON WORK RESULTS FOR FIRE SUPPRESSION		
21 05 15	BASIC FIRE SUPPRESSION PIPING METHODS AND MATERIALS		
21 05 53	IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT		
21 11 00	FIRE SUPPRESSION WATER SERVICE PIPING		
21 12 00	FIRE SUPPRESSION STANDPIPES		
21 13 13	WATER BASED FIRE SUPPRESSION SYSTEMS		
21 31 13	ELECTRIC DRIVE CENTRIFUGAL PUMPS		

**DIVISION 22 – PLUMBING**

22 00 00	TABLE OF CONTENTS AND SEAL		
22 00 10	GENERAL PLUMBING REQUIREMENTS		
22 00 15	COORDINATION		
22 05 10	COMMON WORK RESULTS FOR PLUMBING		
22 05 13	COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT		
22 05 15	BASIC PIPING MATERIALS AND METHODS		
22 05 19	METERS AND GAUGES FOR PLUMBING PIPING		
22 05 23	GENERAL DUTY VALVES FOR PLUMBING PIPING		
22 05 29	HANGERS AND SUPPORTS FOR PLUMBING PIPING		
22 05 33	HEAT TRACING FOR PLUMBING PIPING		
22 05 50	VIBRATION ISOLATION FOR PLUMBING PIPING AND EQUIPMENT		
22 05 53	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT		
22 07 00	PLUMBING INSULATION		
22 11 00	WATER DISTRIBUTION PIPING AND SPECIALTIES		
22 11 11	MECHANICALLY JOINED PLUMBING PIPING SYSTEMS		
22 11 14	STAINLESS STEEL WATER DISTRIBUTION PIPING & SPECIALTIES		
22 11 23	DOMESTIC WATER PUMPS		
22 13 00	SANITARY DRAINAGE AND VENT PIPING & SPECIALTIES		
22 13 28	CONDENSATE PUMPS FOR HVAC EQUIPMENT		
22 14 00	STORM DRAINAGE PIPING AND SPECIALTIES		
22 14 89	SUMP PUMPS		
22 34 00	FUEL FIRED DOMESTIC WATER HEATERS		
22 40 00	PLUMBING FIXTURES		
22 70 00	NATURAL GAS SYSTEMS		

**DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING**

23 00 00	TABLE OF CONTENTS AND SEAL		
23 00 10	GENERAL MECHANICAL REQUIREMENTS		
23 00 15	ELECTRICAL COORDINATION FOR MECHANICAL EQUIPMENT		

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

23 05 00	COMMON WORK RESULTS FOR HVAC
23 05 10	BASIC PIPING MATERIALS AND METHODS
23 05 13	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
23 05 14	VARIABLE FREQUENCY DRIVES
23 05 16	EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING
23 05 19	METERS AND GAUGES FOR HVAC PIPING
23 05 23	GENERAL DUTY VALVES FOR HVAC PIPING
23 05 29	HANGERS AND SUPPORTS FOR HVAC PIPING & EQUIPMENT
23 05 50	VIBRATION ISOLATION FOR HVAC
23 05 53	IDENTIFICATION FOR HVAC PIPING & EQUIPMENT
23 05 93	TESTING, ADJUSTING AND BALANCING FOR HVAC
23 07 00	HVAC INSULATION
23 08 00	COMMISSIONING OF HVAC SYSTEMS
23 09 13	INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
23 09 14	REFRIGERANT MONITORING SYSTEMS
23 09 23	DIRECT-DIGITAL CONTROL FOR HVAC
23 21 13	HYDRONIC PIPING
23 21 13.13	BURIED HYDRONIC AND STEAM PIPING
23 21 13.23	MECHANICALLY JOINED HYDRONIC PIPING SYSTEMS
23 21 14	HYDRONIC SPECIALTIES
23 21 23	HYDRONIC PUMPS
23 25 00	HVAC WATER TREATMENT
23 31 13	METAL DUCTS
23 33 00	AIR DUCT ACCESSORIES
23 34 23	HVAC POWER VENTILATORS
23 34 33	AIR CURTAINS
23 36 00	AIR TERMINAL UNITS
23 37 13	DIFFUSERS, REGISTERS AND GRILLES
23 51 00	BREECHES, CHIMNEYS AND STACKS
23 51 13	DRAFT CONTROL DEVICES
23 52 16	CONDENSING BOILERS
23 53 23	BOILER ACCESSORIES
23 64 16	CENTRIFUGAL WATER CHILLERS
23 65 00	COOLING TOWERS
23 72 00	AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

#### VOLUME 4

23 73 13	CENTRAL STATION AIR HANDLING UNITS
23 82 00	TERMINAL HEATING AND COOLING UNITS
23 84 14	SELF CONTAINED HUMIDIFIERS
23 84 17	DESICCANT WHEEL UNITS
23 84 19	HYDROTHERAPY AIR HANDLING UNITS

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
-------------	-------	---------------	--------------

**DIVISION 26 – ELECTRICAL**

26 00 00	TABLE OF CONTENTS AND SEAL
26 00 10	GENERAL ELECTRICAL REQUIREMENTS
26 05 00	COMMON WORK RESULTS FOR ELECTRICAL
26 05 02	EQUIPMENT WIRING SYSTEMS
26 05 04	PROVISIONS FOR ELECTRIC UTILITY SERVICE
26 05 19	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES
26 05 26	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
26 05 33	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
26 05 43	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS
26 05 53	IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 05 73	POWER SYSTEM STUDIES
26 09 10	CENTRALIZED DIMMING SYSTEM
26 09 23	LIGHTING CONTROL DEVICES
26 22 00	LOW-VOLTAGE TRANSFORMERS
26 24 13	SWITCHBOARDS
26 24 16	PANELBOARDS
26 27 26	WIRING DEVICES
26 28 13	FUSES
26 28 16	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
26 32 13	PACKAGED ENGINE-DRIVEN GENERATORS
26 33 53	STATIC UNINTERRUPTIBLE POWER SUPPLIES
26 36 00	TRANSFER SWITCHES
26 41 13	LIGHTNING PROTECTION FOR STRUCTURES
26 43 13	SURGE PROTECTIVE DEVICES
26 51 00	INTERIOR LIGHTING
26 53 00	INDOOR ARENA LIGHTING
26 56 00	EXTERIOR AREA LIGHTING

**DIVISION 27 – COMMUNICATIONS (TECHNOLOGY)**

27 00 00	TABLE OF CONTENTS - COMMUNICATIONS
27 05 00	COMMONWORK RESULTS FOR COMMUNICATIONS
27 05 26	GROUNDING AND BONDING FOR COMMUNICATIONS
27 05 28	PATHWAYS FOR COMMUNICATIONS
27 05 43	UNDERGROUND PATHWAYS & STRUCTURES FOR COMMUNICATIONS SYSTEMS
27 05 53	IDENTIFICATIONS FOR COMMUNICATIONS
27 11 00	COMMUNICATIONS EQUIPMENT ROOM FITTINGS
27 13 00	COMMUNICATIONS BACKBONE CABLING
27 15 00	COMMUNICATIONS HORIZONTAL CABLING
27 31 24	IP TELEPHONE SYSTEM
27 32 44	EMERGENCY RESPONDER TESTING



SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
27 35 23	EMERGENCY RESPONDER RADIO COVERAGE		
27 60 00	NETWORK ELECTRONICS		
27 62 00	WIRELESS NETWORK SYSTEMS		

**DIVISION 27 – COMMUNICATIONS (AUDIO – VIDEO)**

27 00 01	TABLE OF CONTENTS AND SEAL – AUDIO-VIDEO
27 00 11	GENERAL COMMUNICATIONS REQUIREMENTS - AUDIO - VIDEO
27 05 01	COMMON WORK RESULTS FOR COMMUNICATIONS - AUDIO - VIDEO
27 41 00	AUDIO VIDEO SYSTEMS
27 41 16	AUDIO VIDEO SYSTEMS EQUIPMENT
27 41 22	LARGE FORMAT DISPLAY SYSTEMS
27 41 33	TELEVISION DISTRIBUTION SYSTEM
27 41 51	BROADCAST SYSTEMS PRE-WIRE

**DIVISION 28 – ELECTRONIC SAFETY AND SECURITY**

28 00 00	TABLE OF CONTENTS (SECURITY)
28 05 00	BASIC SECURITY REQUIREMENTS
28 05 20	BASIC SECURITY MATERIALS AND METHODS
28 05 26	GROUNDING AND BONDING FOR SECURITY SYSTEMS
28 05 28	SECURITY SYSTEMS PATHWAYS AND SUPPORT EQUIPMENT
28 13 00	ACCESS CONTROL SOFTWARE AND DATABASE MANAGEMENT
28 15 00	ACCESS CONTROL HARDWARE DEVICES
28 15 23	INTERCOM ENTRY SYSTEM
28 23 00	VIDEO SURVEILLANCE CAMERA SYSTEMS
28 41 10	SECURITY CONTROL ROOM EQUIPMENT
28 45 00	TABLE OF CONTENTS AND SEAL (FIRE ALARM)
28 46 00	FIRE DETECTION AND ALARM

**VOLUME 5****DIVISION 31 – EARTHWORK**

02 06 13	GEOTECHNICAL REPORT - SEE APPENDIX
31 00 00	TABLE OF CONTENTS AND SEAL
31 00 00	EARTHWORK
31 11 00	CLEARING, GRUBBING AND DEMOLITION
31 22 00	SITE GRADING
31 23 23 23	SOIL COMPACTION CONTROL
31 40 00	SHORING AND UNDERPINNING
31 63 29	DRILL DISPLACEMENT CAST-IN-PLACE PILES
32 12 16	ASPHALT PAVING
32 13 13	CONCRETE PAVING, CURBS, AND WALKS
32 90 00	PLANTING
33 14 11	WATER SERVICE PIPING
33 30 00	SANITARY SEWERAGE

SECTION NO.	TITLE	INITIAL ISSUE	LATEST ISSUE
33 31 00	SANITARY SEWER COLLECTION SYSTEM		
33 40 00	STORMWATER UTILITIES		

**DIVISION 32 – EXTERIOR IMPROVEMENTS**

32 00 00	TABLE OF CONTENTS AND SEAL
32 13 13	CONCRETE PAVING
32 13 16	DECORATIVE CONCRETE PAVING
32 13 73	CONCRETE PAVING JOINT SEALANTS
32 14 00	UNIT PAVING
32 17 26	TACTILE WARNING SURFACING
32 31 16	WELDED WIRE FENCES AND GATES
32 31 19	DECORATIVE METAL FENCES AND GATES
32 31 19.53	DECORATIVE METAL SECURITY FENCES AND GATES
32 32 23	SEGMENTAL RETAINING WALLS
32 33 00	SITE FURNISHINGS
32 84 00	PLANTING IRRIGATION
32 84 23	IRRIGATION WORK
32 90 00	PLANTING (LANDSCAPE WORK)
32 90 05	LANDSCAPE MAINTENANCE
32 91 13	SOIL PREPARATION
32 92 00	TURF AND GRASSES
32 92 23	SODDING
32 93 00	PLANTS

**DIVISION 33 – UTILITIES**

REFER TO DIVISION 31 ABOVE

**APPENDIX**

GEOTECHNICAL REPORT DATED AUGUST 16, 2024 (from Geotechnical Engineering Testing, Inc.)  
AVAILABLE UPON REQUEST

END OF SECTION

CIVIL SPECIFICATIONS CONTENTS

SECTION 020163	GEOTECHNICAL REPORT
SECTION 310000	EARTHWORK
SECTION 311100	CLEARING AND GRUBBING
SECTION 312200	SITE GRADING
SECTION 31232323	SOIL COMPACTION CONTROL
SECTION 31400	SHORING AND UNDERPINNING
SECTION 321216	ASPHALT PAVING
SECTION 321313	CONCRETE PAVING, CURBS, AND WALKS
SECTION 329000	PLANTING
SECTION 331400	WATER UTILITY TRANSMISSION AND DISTRIBUTION
SECTION 333000	SANITARY SEWERAGE
SECTION 333100	SANITARY SEWERAGE PIPING
SECTION 334000	STORMWATER UTILITIES



*Alisha L. Fisher*  
12/12/2024

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 020613 - GEOTECHNICAL REPORT**

**PART 1 REPORT**

- A. See attached pages from Geotechnical Engineering Testing, INC.

**END OF SECTION**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 02200 - EARTHWORK****PART 1 GENERAL****1.01 SUMMARY**

- A. Furnish all labor, materials, equipment necessary to complete all earthwork beneath the building and to a point 5 feet beyond the building and utility trenching at all locations on the site as follows:
  - 1. Earth moving and excavation.
  - 2. Grading.
  - 3. Backfilling.
  - 4. Filling
  - 5. Compacting.
  - 6. Utilities trenching.
- B. Related Documents:
  - 1. Geotechnical data prepared by Christian Testing Laboratories, Inc. entitled: "Report of Geotechnical Exploration, Proposed New Four-Story Dormitory, USA Student Housing Phase II – Delta I Dorm, University of South Alabama, Mobile, Alabama, CTL Project No. CS-8702-11" dated January 6, 2012. A copy of this document can be found in SECTION 02010 - Geotechnical Report.
  - 2. Work must be performed in accordance with and meet the recommendations included in the above referenced geotechnical data, except where the Civil Drawings indicate more stringent requirements. In such cases, the Civil Drawings will control.
- C. Related Work Specified Elsewhere:
  - 1. Clearing, Grubbing, and Demolition – SECTION 311100.
  - 2. Asphalt Paving – SECTION 321216.
  - 3. Planting – SECTION 329000.
  - 4. Concrete – SECTION 321313.
  - 5. Site Grading – SECTION 312200.
  - 6. Soil Compaction Control – SECTION 31232323.

**1.02 SUBMITTALS**

- A. Test Reports: The testing laboratory will submit the following reports directly to the Engineer and shall copy the contractor:
  - 1. Analysis of soil materials including fill, backfill, borrow, soil surcharge, and topsoil.
  - 2. Verification of each footing subgrade.
  - 3. Compressive strength or bearing test reports.
  - 4. Coordinate all test reports with SECTION 31232323 – Soil Compaction Control

**1.03 QUALITY ASSURANCE**

- A. Testing Laboratory Services: See SECTION 31232323 – Soil Compaction Control.

#### 1.04 SITE CONDITIONS

##### A. Site Utilities:

1. Advise utility companies of excavation activities before starting excavations. Locate and identify underground utilities passing through work area before starting work.
2. If underground utilities are encountered in locations other than indicated, immediately advise utility owners before proceeding. Amend project record documents to show actual locations.
3. Protect existing utilities not indicated to be removed.
4. Do not interrupt existing utilities without advance notice to and written approval from the owner.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Sufficient approved materials are not available from required excavations on site. Additional materials must be provided beyond the limits of excavation shown at no additional cost to the owner.
- B. For each soil material proposed for use as fill or backfill, the testing laboratory shall classify soil material, develop Proctor curve, and perform other tests required.
- C. Obtain approval of the Architect/Engineer/Testing Laboratory for each soil material.
- D. Topsoil: Friable clay loam surface soil.
- E. Satisfactory Topsoil: Fertile agricultural soil, typical for locality, capable of sustaining vigorous plant growth; free of subsoil, rocks larger than 2 inches in diameter, clay, toxic matter, plants, weeds, and roots.
- F. Backfill and Fill Materials: Materials classified as satisfactory.
- G. Satisfactory Soil Material (ASTM D 2487): Free of stones larger than 2 inches in any dimension, trash, debris, organic material, other objectionable material and classified as follows:
  1. SW (well-graded sand).
  2. SP (poorly graded sand).
  3. SM (silty sand).
  4. SC (clayey sand).
- H. Unsatisfactory Soil Material (ASTM D 2487):
  1. GW (well-graded gravel).
  2. GP (Poorly graded gravel).
  3. GM (silty gravel).
  4. GC (clayey gravel).
  5. CL (lean clay).
  6. ML (silt).
  7. OL (organic clay).
  8. OL (organic silt).
  9. CH (fat clay).
  10. MH (elastic silt).



11. OH (organic clay).
12. OH (organic silt).
13. PT (peat).
- I. Structural Fill: Satisfactory silty sand (SM) or clayey sand (SC) containing less than 95 percent passing the No. 40 sieve and between 10 and 20 percent passing the No. 200 sieve.
- J. Utility Trench Backfill: Satisfactory clean sand, (SW) or (SP), containing between 10 and 20 percent passing the No. 200 sieve.
- K. Plastic Warning Tape: Acid and alkali-resistant polyethylene film specifically manufactured for marking and identifying underground utilities.
  1. Minimum width, 6 inches; minimum thickness, 4 mils.
  2. Metallic core encased in protective jacket against corrosion and detectable by metal detector when tape is buried 3 feet deep.
  3. Continuous printed inscription shall describe utility. Tape colors shall be as follows:
    - a. Electric: Red.
    - b. Gas: Yellow.
    - c. Pipeline: Yellow.
    - d. Telephone: Orange.
    - e. CATV: Orange.
    - f. Water System: Blue.
    - g. Sewer: Green.

### **PART 3 EXECUTION**

#### **3.01 CONSTRUCTION REQUIREMENTS**

- A. Preparation:
  1. Protections: Provide markers indicating limits of work and clear identification of items and areas requiring protection.
  2. Provide barricades, warning signs, and warning lights around open excavations as necessary to prevent injury to persons.
  3. The contractor is solely responsible for determining the potential for injury to persons and damage to property.
    - a. Where such potential is present, take appropriate protective measures.
    - b. Protect persons from injury and protect existing and new improvements from damage caused directly or indirectly by construction operations.
  4. Do not allow excavation of subgrades and soil at foundations to be subjected to freezing temperatures or frost. Provide protective insulating materials as necessary. Should prepared, compacted subgrades be damaged by freezing, remove soil materials to the depth required by the architect and replace and recompact in conformance with specified requirements.

## B. Dewatering:

1. Do not allow surface or ground water to flow into or accumulate in excavations. Do not allow water to flow in an uncontrolled fashion across the project site or to erode slopes or to undermine foundations. Do not allow water to be diverted onto adjacent properties. Arrange excavation operations so as to provide continual and effective drainage of excavations.
2. Provide and maintain temporary diversion ditches, dikes, and grading as necessary; do not use trench excavations for this purpose. When required by surface or subsurface water conditions, provide sumps, well points, French drains, pumps, and other control measures necessary to keep excavations free of water. When existence of ground water near or above final excavation level is indicated or suspected, provide control measures prior to excavating to water level and maintain water level continuously below working level.

## C. Excavation:

1. General: Excavation includes the removal of any materials necessary to achieve the required subgrade elevations and includes reuse or disposal of such materials.
2. Unnecessary Excavation: The expense of excavation of materials outside of limits indicated or ordered in writing by the architect and the correction thereof to the satisfaction of the architect shall be borne by the contractor.
  - a. Unnecessary excavation under footings: Either deepen footings to bear on actual subgrade elevation without changing top elevations or place concrete fill up to required elevation, as required by the architect.
  - b. Unnecessary excavation other than under footings: Either place compacted fill or otherwise correct conditions, as required by the architect.
3. Approval of Subgrade: Notify the architect when regulation elevations have been reached.
  - a. When required by the architect due to the presence of unsatisfactory materials, perform additional excavation and replace with approved compacted fill material in accordance with the architect's instructions.
4. Excavation Stabilization: Wherever it is possible to slope faces of excavations to achieve stabilization, do so in compliance with requirements of governing authorities. Otherwise, provide shoring and bracing.
  - a. Design, provide, maintain, and remove shoring and bracing in compliance with requirements of governing authorities. Remove temporary shoring and bracing when stabilization is no longer required.
5. Excavation for Structures:
  - a. Excavate beyond footings and foundations so as to allow proper construction and inspection of concrete formwork and other materials. Excavate to the required elevation within the following tolerance:
    - i. Plus 1/2 inch or minus 1/2 inch.
6. Excavation for Footings and Foundations:
  - a. Delay excavation to final grade and final compaction until just before concrete will be placed.
  - b. Remove any loose or sloughed material and adjust excavations to conform to required lines, grades, and tolerances and to form a suitable bearing surface. Do not disturb bottom of completed excavations.

7. Excavation for Trenches:
  - a. Unless otherwise required, begin trenching, utility installation, and backfilling at lowest portion of utility line, working toward highest portion of line.
  - b. Required trench width: Excavate accurately to provide not less than 6 nor more than 9 inches of clearance on each side of pipes and conduits, unless otherwise indicated.
    - i. Where indicated trench widths are exceeded, redesign, stronger pipe, or special installation procedures may be required by the architect at no additional cost to the owner.
  - c. Unless otherwise indicated, trench walls for piping shall be vertical from trench bottom to one foot above top of pipe or to top elevation of initial backfill, whichever is higher.
  - d. Excavate trenches to the depths necessary to achieve required flow lines and invert elevations and to prevent freezing of liquids or frost heave during winter.
  - e. Dig trenches so as to provide not less than the following minimum cover:
    - i. Water lines, gas distribution lines, electrical lines, etc.: 30 inches minimum unless indicated otherwise.
  - f. Trench bottoms: Unless otherwise indicated, excavate and shape trench bottoms as follows:
    - i. Support pipes and conduit on smooth, accurately graded subgrade, shape surface by hand to provide continuous support on undisturbed soil for bell and body of pipe and joints, fittings, and body of conduit.
- D. Storage:
  1. Stockpile materials to be used for filling and backfilling, including excavated materials classified as satisfactory soil materials, at locations indicated or as directed. Stockpile in a manner to freely drain surface water; cover if necessary to prevent wind-blown dust.
    - a. Store soil materials without intermixing. Protect from contamination with other soils or debris.
- E. Plastic Warning Tape:
  1. Install tape 12 inches above utility line, approximately 18 inches below finished grade.
- F. Backfilling:
  1. Preparation: Backfill excavations as soon as practicable. Complete the following operations before backfilling:
    - a. Inspection and acceptance of below-grade construction.
    - b. Inspection, testing, and approval of underground utilities.
    - c. Surveying of underground utilities for record documents.
    - d. Concrete formwork removal.
    - e. Removal of loose material, muck, debris, and trash from excavation.
    - f. Installation of temporary or permanent horizontal bracing for structures to receive backfill.
  2. Remove temporary shoring and bracing as the work progresses and when its use is no longer necessary.
  3. Backfill for Utility Trenches:
    - a. Backfill with clean sand material with between 10 percent and 20 percent passing the No. 200 sieve. Place and compact in 8-inch maximum layers as required herein.

4. Testing of Piping:
  - a. Before performing testing of utilities (specified elsewhere), backfill and compact trenches to a level 1 foot above top of pipe, except at joint and couplings.
  - b. After successful testing, complete backfilling as soon as practicable.
  - c. Backfilling near footings, general: Where trenches occur underneath of footings, or where trench bottoms occur below and within 18 inches horizontally of footing bottoms, backfill trench with concrete to top of footing and up to 4 feet perpendicularly from each face of footing.
  - d. Do not place material on muddy or frozen surfaces or on surfaces containing frost.
- G. Filling:
  1. Preparation: Verify that area has been stripped of vegetation including roots below grade. Remove and dispose of any unsatisfactory soils.
    - a. When filling slopes steeper than 1 in 4 rise, plow, step, or break up surfaces to promote bond of new to existing material.
    - b. Should density of subgrade to receive fill be less than specified for fill, break up and pulverize subgrade to a depth of at least 6 inches, moisture condition if necessary, and recompact to required density at optimum moisture content.
  2. Installation: Place fill materials to required elevations in lifts of required depth. Provide fill materials beneath each area as indicated.
    - a. Exterior steps/ramps: Satisfactory soil materials.
    - b. Building slabs: Select fill material.
    - c. Soil Surcharge: Structural fill material.
- H. Building Slab Areas:
  1. Place fill or backfill lifts such that compaction true to grade and level is accomplished with a minimum of surface disturbance and segregation or degradation of materials. Maintain grade control and cross section by means of line and grade stakes. Maintain moisture content within prescribed limits during placing and compacting.
  2. When the total thickness of materials to be placed is less than the maximum lift thickness permitted, place material in a single lift. When the total thickness of materials to be placed is greater than the maximum lift thickness permitted, place materials in two or more lifts of uniform thickness with no lift less than 3 inches in thickness.
  3. For modular concrete block retaining walls, see SECTION 020613 - Geotechnical Report, SECTION 31232323 – Soil Compaction Control, and drawings for additional requirements.
- I. Compaction:
  1. Place materials used in backfilling and filling in layers not exceeding loose depths as follows:
    - a. Heavy equipment compaction: 8 inches.
    - b. Hand-operated tampers: 4 inches.

2. Place material simultaneously on opposite sides of walls, small structures, utility lines, etc. to avoid displacement or overstressing.
  3. Compact fills and backfills to the following minimum densities indicated by SECTION 31232323 – Soil Compaction Control.
  4. Moisture Control: During compaction, control moisture of subgrades and subsequent lifts to within tolerances from optimum moisture content as recommended by testing laboratory. Wet surface with water when additional moisture is required. Aerate soil to aid in drying or replace soil when excessive moisture is present.
- J. Grading:
1. General: Smooth grade to a uniform surface that complies with compaction requirements and required lines, grades, and cross sections and is free from irregular surface changes. Provide smooth transition between existing adjacent grades and changed grades. Cut out soft spots, fill low spots, and cut down high spots to conform to required surfaces tolerances.
  2. Slope grades to direct water away from structures and to prevent ponding. Finish subgrade to required elevations within the following tolerance:
    - a. Exterior steps and ramps: Plus or minus 2 inch.
    - b. Inside building lines, as measured within a 10-foot straightedge: 1/4 inch.
- K. Proof-rolling:
1. After completion of required compaction, but prior to obtaining field density test, and immediately prior to proceeding with subsequent construction, proof-roll in the presence of Engineer and testing laboratory representative.
  2. Proof-roll using a heavy pneumatic-tired vehicle having four tires abreast, each tire loaded to 30,000 pounds and tire inflated to 150 psi. In areas which show pumping or which are otherwise unsatisfactory, undercut fill material and replace with compacted fill, or stabilize in place, as required by the Architect/Engineer.
  3. Proof-roll Areas to Receive: Building slabs on grade.
- L. Field Quality Control:
1. Testing Laboratory Services: Provide timely notice to testing laboratory. Do not proceed with construction until testing of each subgrade and lift of fill or backfill has been performed and required inspections and approvals have been obtained.
  2. Maximum Density at Optimum Moisture Content: Determine in accordance with ASTM D 698, Method D.
  3. In-Place Density Tests: ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2922 (nuclear method), as applicable.
  4. If testing service reports indicate that subgrade or fills are below specified density, scarify or remove and replace to the required depth, recompact, and retest at no cost to the owner.
  5. See SECTION 31232323 – Soil Compaction Control for additional requirements.

M. Maintenance:

1. Completed Areas: Protect from damage by pedestrian or vehicular traffic, freezing, erosion, and contamination with foreign materials.
2. Damaged Areas: Where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction and whether due to subsequent construction operations or weather conditions, restore materials to required conditions: Scarify or remove and replace to the required depth, return to optimum moisture content, and compact materials to the required density before continuing construction.
3. Correction: Should settling occur within the project correction period, remove finished surfacing, add additional approved material, compact material, and reconstruct surfacing. Construct surfacing to match and blend in with adjacent surfacing as nearly as practicable.

N. Disposal of Excess and Waste Materials:

1. Remove any material not required for use on the project (including unsatisfactory soil, excess satisfactory soil, trash, and debris) and legally dispose of it off the owner's property.

**END OF SECTION**

**SECTION 311100 - CLEARING, GRUBBING, AND DEMOLITION****PART 1 GENERAL****1.01 SUMMARY**

- A. Furnish all labor, material, and equipment necessary to complete all clearing, grubbing, and demolition of the site as indicated on the Drawings and as required to complete new construction under this Contract, and as specified herein.
- B. The removal, demolition, and lawful disposal of all items indicated by the drawings to be removed or which conflict with the work in this contract are required by this specification.
- C. The items of work to be performed include, but are not limited to:
  - 1. Protecting areas indicated not to be disturbed with suitable barriers.
  - 2. Removal from the site and disposing of all trees, stumps, roots, and debris not indicated to remain.
  - 3. Grubbing of all areas within the limits of clearing.
  - 4. Field verify location of existing utilities.
  - 5. Prepare Traffic Control Plan; furnish, install, and maintain required Traffic Control Devices.
  - 6. Comply with the ADEM Stormwater Permit.
  - 7. Install and maintain throughout project duration Temporary Erosion Control items as noted by the plans and by the CBMPP for the project.
- D. Related work specified elsewhere:
  - 1. Earthwork – SECTION 310000.
  - 2. Site Grading – SECTION 321200.
  - 3. Asphalt Paving – SECTION 321216.
  - 4. Concrete Paving, Curbs, and Walks – SECTION 321313.

**1.02 SUBMITTALS**

- A. Traffic control plan including contractor representative.
- B. Certification of existing utility locations.
- C. Certification of Disposal of Materials from Demolition.

**PART 2 PRODUCTS**

(Not applicable.)

**PART 3 EXECUTION****3.01 TRAFFIC CONTROL**

- A. Prior to starting clearing operations, provide and install hazard markings as required to protect the work. The contractor shall provide a written traffic control plan and certification indicating the items installed meet the requirements of Part VI of the FHWA Manual on Uniform Traffic Control Devices, latest edition.
- B. Provide the name, address, and telephone numbers for the person responsible for the daily inspection and maintenance of the traffic control devices.

**3.02 LOCATION OF EXISTING UTILITIES**

- A. Prior to starting construction, locate and verify existing utility information. Provide written information detailing discrepancies or conflicts of existing utilities. Verify and field locate (uncover) the existing utilities at service connection points for potable water, fire protection water, sewer service, and gas service, and locations where other construction which is part of this project must occur over or in close proximity to an existing utility. Provide written certification to the Architect/Engineer of completion of this work prior to starting work under this section.

**3.03 EXECUTION**

- A. Grub and clear required areas with any equipment or methods at the Contractor's option. The following results shall be obtained:
1. Grub and clear all areas from which topsoil is indicated to be stripped or as required to complete new construction called for by the drawings.
  2. Beneath building or paved areas to a depth of two (2) feet below the lowest limits of excavation at each point of work, all stumps and other wood and debris shall be removed, except roots less than 1/2 inch in diameter may remain or be removed.
  3. Beneath lawn, or planted area as from a depth of two (2) feet below new subgrade to stripped original grade, all wood and debris shall be removed except stumps and related roots of trees over 12 inches in diameter with trunks not more than 15 inches long may remain if in original location and if no part of stump is less than three (3) feet from new subgrade.
  4. Remove all asphalt and concrete pavement (including sidewalk, ditches, etc.) as indicated by the drawings, provide neat, straight, saw-cut lines of removal at the locations indicated. Complete the removal of pavement at the time specified.

**3.04 TEMPORARY EROSION CONTROL**

- A. Prepare and obtain the ADEM Stormwater Permit, including fees; comply with permit requirements, including providing Construction Best Management Practices Plan (CBMPP), inspections, and termination of the permit once the site is stabilized.
- B. Install and maintain all erosion control items called for by the drawings or the ADEM permit. Take all necessary precautions to prevent silt, soil, eroded materials or debris, or other effects of erosion from damaging new construction or moving off-site onto adjacent property.
- C. Maintenance of the devices shall be required throughout the duration of the overall project (not just site work, etc.).
- D. Provide the name, address, and telephone numbers for the person responsible for the required ADEM site inspections, site erosion control, and maintenance of the erosion control devices.

**3.05 DISPOSAL**

- A. Dispose of all debris, asphalt and concrete pavement, trees, brush and other rubble from clearing, grubbing and demolition operations at an approved disposal area provided by the Contractor off the project site.
1. Comply with all local regulations. Obtain necessary permits.
  2. No burning or burial of debris on-site will be permitted.



3. Provide certification to Owner that all debris removed from the site was lawfully disposed of in an ADEM approved landfill.

**END OF SECTION**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 312200 - SITE GRADING****PART 1 GENERAL****1.01 SUMMARY**

- A. Furnish all labor, material, and equipment necessary to complete all site grading, exclusive of preparation of areas beneath or adjacent to new buildings, as indicated on the drawings and specified herein.
- B. The items of work to be performed include, but are not limited to:
  - 1. Stripping and storing topsoil.
  - 2. Rough grading.
  - 3. Removing from the site and disposing of all debris and excess materials.
  - 4. Fine grading and excavation for all construction including spreading and topsoil.
  - 5. Restoring to original grades and conditions all properties damaged by any activity related to the work and taking adequate precautions to avoid settlements or cave-in of properties higher than site; silting, eroding or other damage to properties lower than site.
- C. Related Documents:
  - 1. Geotechnical Engineering Testing, Inc. has prepared a Report of Geotechnical Exploration for this project.
  - 2. Work must be performed in accordance and meet the recommendations included in the above referenced geotechnical data except where the Civil Drawings indicate more stringent requirements. In such cases, the Civil Drawings will control.
- D. Related work specified elsewhere:
  - 1. Clearing, Grubbing and Demolition – SECTION 311100.
  - 2. Earthwork – SECTION 310000.
  - 3. Soil Compaction Control – SECTION 31232323.
  - 4. Asphalt Paving – SECTION 321216.
  - 5. Concrete Paving, Curbs and Walks – SECTION 321313.
  - 6. Topsoil, Ground Preparation and Turfing – SECTION 329000.

**1.02 SUBMITTALS**

- A. Test Reports: The testing laboratory will submit the following reports directly to the Engineer and shall copy the contractor:
  - 1. Analysis of soil materials including fill, backfill, and borrow materials.
  - 2. Verification of each pavement structure layer density.
  - 3. Verification of soil density over completed site.
  - 4. Coordinate all test reports with SECTION 31232323 – Soil Compaction Control.

**1.03 QUALITY ASSURANCE**

- A. Testing Laboratory Services: See SECTION 31232323 – Soil Compaction Control.

**1.04 SITE CONDITIONS**

- A. Traffic: Do not interfere with or close driveways without permission of governing authorities. Do not interfere with adjacent private facilities.
- B. Site Utilities:
1. Advise utility companies of excavation activities before starting excavations. Locate and identify underground utilities passing through work area before starting work.
  2. If underground utilities are encountered in locations other than indicated, immediately advise utility owners before proceeding. Amend project record documents to show actual locations.
  3. Protect existing utilities indicated to remain.
  4. Do not interrupt existing utilities without advance notice to and written approval from the owner.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. Suitable Subgrade Soils - any in-place soil material which can be compacted to the density requirements specified.
- B. Fill materials shall be approved and conform to the following except as specifically indicated otherwise on the drawings or in the specifications:
1. Fill material shall be any stable soil material which can be compacted to the required density and is suitable for the specific use intended. Material shall be obtained from on-site excavation.
  2. Fill, except as otherwise specified, shall be earth, free of debris, cinders, combustibles, frost, ice, roots, sod, wood, cellulose and organic materials.
  3. Fill under topsoil of lawn and planted areas shall be earth, free of debris, cinders, frost, ice, sod, wood, and roots over 1/4" in diameter.
  4. Beneath paved areas, structural fill or backfill material for undercut areas shall be a satisfactory sand (SW or SP) material with between 10% and 20% passing the #200 sieve. This material shall also be required for backfill of all utility and storm drainage trenches excavated beneath paved areas.
- C. Topsoil shall be as follows:
1. Topsoil: Friable clay loam surface soil.
  2. Satisfactory Topsoil: Fertile agricultural soil, typical for locality, capable of sustaining vigorous plant growth; free of subsoil, rocks larger than 2 inches in diameter, clay, toxic matter, plants, weeds, and roots.

**PART 3 EXECUTION****3.01 CONSTRUCTION REQUIREMENTS**

- A. Strip topsoil, where available, over the entire site area as indicated by the drawings. Contractor may select any method, but shall comply with the following:
1. Do not strip topsoil in a muddy condition.
  2. Avoid including topsoil, debris, stones over 2", and other extraneous matter in topsoil.

3. Leave areas free of trash, debris and foreign materials.
  4. Remove all topsoil from indicated areas to minimum depth of 6" or as required by site conditions.
  5. Store topsoil in an approved location and protect it against loss and from admixture of debris.
- B. Excavate to lines and elevations, as necessary for the proper construction of the work, including undercut beneath paved areas. Compact subgrade as required. Equipment and methods shall be suitable for the work at hand. Work shall conform to the following, unless indicated otherwise by the drawings:
1. Excavation material suitable for fill material shall be separated from unsuitable materials.
  2. Excavated material unsuitable for fill shall be removed from the site promptly, and disposed of by the contractor off the project site.
  3. Excavation in areas at which excavation, filling, or backfilling will be performed under other sections of work shall be coordinated with said sections.
  4. Existing suitable subgrade materials beneath concrete or asphalt paving or scarified to a depth of 6" below the top of subgrade and compacted as specified.
- C. Undercut unsuitable existing soils beneath asphalt or concrete pavement areas as directed by the Engineer. Undercut and backfill required for unsuitable materials must be authorized by the Engineer prior to performing the work and shall be paid for in accordance with the CHANGE clauses of the contract. Prior to performing undercut and backfill, every attempt to compact and utilize existing subgrade materials will be required of the Contractor at no cost to the Owner. This will include disking, scarifying, or other operations as directed by the Engineer.
- D. Backfill for areas of undercut beneath paving shall be placed in 8" maximum thickness loose lifts and compacted to 100% standard density. Payment shall be as specified for "Undercut".
- E. Fill to line and grade, then compact as required for proper construction of the work and as required by the drawings and specifications. Equipment and method shall be suitable for the work at hand. Work shall conform to the following, unless otherwise indicated on the drawings:
1. Loosen existing soil for depth of 6" just before filling.
  2. Do not place fill in water, on muddy, frozen or frosty areas, or over debris, wood or foreign material.
  3. Fill in areas at which excavation, filling, or backfilling will be performed under other sections of these specifications shall be coordinated with said section.
  4. Schedule and review inspection of new subgrade surfaces with Architect/Engineer.
  5. Surfaces of new subgrades shall be left clean prior to constructing overlying layer of topsoil, etc.
  6. Complete fine grading to the elevations and Finish grade Contours indicated by the drawings. Ensure proper elevations after placement of topsoil, solid sod, or other overlying layers.

**END OF SECTION**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 31232323 - SOIL COMPACTION CONTROL****PART 1 GENERAL****1.01 SUMMARY**

- A. Furnish all labor, material and equipment necessary to coordinate construction of the project with the geotechnical report requirements and that all work meets the minimum specified soil test requirements detailed herein.
- B. The actual cost of material testing including compaction shall be paid for by the Owner.
- C. Soil testing shall be performed by Geotechnical Engineering Testing, Inc. of Mobile, Alabama.
- D. The items of work to be performed include, but are not limited to:
  - 1. Control of grading, filling, preparation of subgrade beneath building areas and utility trenches – SECTION 310000.
  - 2. Control of site grading, filling, preparation of subgrade under paving – SECTION 312200.
  - 3. Control of subgrade and base layers under paving – SECTION 321216.

**1.02 MINIMUM DENSITIES**

- A. Compact fills and backfills to the following minimum densities expressed as percentages of maximum densities as follows:
  - 1. Fill under lawn and planted areas, 90 percent Standard Density as per ASTM D-698.
  - 2. Fill under stoops and where not otherwise specified, 98 percent Standard Density as per ASTM D-698.
  - 3. Subgrade or fill for slabs on grade, behind walls, steps, and other places where settlements will be objectionable, 100 percent Standard Density as per ASTM D-698.
  - 4. In place processed subgrade, fill and backfill under paving, 100 percent Standard Density as per ASTM D-698 (See SECTION 312200).
  - 5. Base under paving (See SECTION 321216 for required density).
  - 6. Backfill for pipe trenches, within paved areas, 100 percent Standard Density as per ASTM D-698.
- B. For pavement structure layers, materials shall be within 2 percent of optimum moisture for test results to be considered valid. Under building areas, the materials shall be within range deemed acceptable by the testing laboratory.

**1.03 SUBMITTALS**

- A. Test Reports.
- B. Final Certification of all project tests including a copy of all test reports bound along with a letter from testing laboratory stating all test results meet the minimum requirements of the specifications and/or changes approved by the Architect/Engineer (any such changes shall be individually itemized in the letter). The letter shall be signed and stamped by a Professional Engineer in the State of Alabama.

**PART 2 PRODUCTS**

(Not applicable.)

**PART 3 EXECUTION****3.01 FIELD TEST**

- A. Field density, gradation, moisture contents, tests to check compaction compliance shall be conducted in all fill areas at a minimum frequency as follows to assure that material is being compacted to the required density:
1. Fill and backfill materials gradations (including borrow materials: One test per 250 cubic yards stockpiled or in-place source material.
  2. In-place densities:
    - a. One test per 1,000 square feet, or fraction thereof, of existing subgrade under buildings (including footings) or paving compacted by other than hand operated machines, not less than three tests (see d. also).
    - b. One test per 1,000 square feet, or fraction thereof, of each lift of base, fill, or backfill beneath building (including footings) or paving compacted by other than hand operated machines, not less than three tests.
    - c. One test per 500 square feet, or fraction thereof, of each lift of existing subgrade, base, fill or backfill in areas compacted by hand-operated machines, not less than three tests.
    - d. For isolated footings for columns or strip footings for walls, one test for each isolated column footing or 100 linear feet of strip footing or fraction thereof of existing subgrade, or each lift of fill or backfill.
    - e. One test per 200 L.F. of trench per lift, not less than (2) tests per lift per pipe run (last two lifts only require testing - underlying layers shall be reviewed by visual inspection of the Architect/Engineer).
  3. Moisture Contents: In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved by the Engineer.
  4. Optimum moisture and maximum density: Tests shall be made for each type material or source of material including borrow materials to determine the optimum moisture and maximum density values. One representative test shall be performed per 500 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or maximum density.

**3.02 TEST REPORTS**

- A. All tests will be promptly reported to the Architect/Engineer. The results of each test will be clearly stated on the test report as passing or failing the requirements of the specifications. Each test will be certified as correct, stamped and signed by a Registered Civil Engineer in the State of Alabama. Failing tests shall be faxed to the Architect/Engineer no later than one (1) working day after the test is made.
- B. It is the Contractor's responsibility to insure that work on overlying fill and base layers is not commenced until subgrade is visually inspected and approved by the Architect/Engineer.
- C. Any area with failing test results shall be reworked as necessary and re-tested in accordance to the Specifications. The retest shall be noted and referenced to the appropriate failing test.

**3.03 CONDITIONS OF APPROVAL**

- A. For surfaces beneath paving, the layer being tested shall not be considered approved until compaction has been completed within the required moisture limitations, field density test reflect "passing" density, surfaces have been fine



graded to required surface tolerances, and the required proof-rolling has been completed, and any defective areas repaired.

**END OF SECTION**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION: 31400 - SHORING AND UNDERPINNING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Related work specified elsewhere includes:
  - .. Section 311100 - "Site Clearing"
  - .. Section 310000 - "Earthwork"

**1.2 DESCRIPTION OF WORK**

- A. If necessary or otherwise required, the extent of shoring and underpinning work includes, but is not limited to, the following:
  - 1. Shoring and underpinning necessary to protect existing buildings, streets, walkways, utilities, and other improvements and excavation against loss of ground, caving embankments, or any other damage.
  - 2. Maintenance of shoring and underpinning.
  - 3. Removal of underpinning, as required.
- B. Type of shoring and underpinning system, if any, includes, but is not limited to the following, as designed, and provided by the Contractor:
  - 1. Soldier piles.
  - 2. Lagging.
  - 3. Other types, as required by project conditions.
- C. Restrictions:
  - 1. No driven piles will be allowed. H-piles, if any must be set in augered holes, in concrete.
  - 2. No internal underpinning will be allowed, unless pre-approved by the Owner and Architect.

**1.3 SUBMITTALS**

- A. Layout Drawings: Provide layout drawings for shoring and underpinning system and other data prepared and sealed by a registered Professional Engineer licensed in the State where the project is located. System design and calculations must be acceptable to local authorities having jurisdiction and are subject to review and acceptance by this project's design consultants.
- B. Certification: Provide a survey of completed shoring and sheeting work, if any, certifying locations, elevations, conditions, etc.

**1.4 QUALITY ASSURANCE**

- A. Provide design by a Structural Engineer currently licensed to practice in the project's jurisdiction. Design shall include, in

part, installation and removals of shoring and underpinning systems and components.

- B. Regulations: Comply with local codes and ordinances of governing authorities having jurisdiction, and adjacent surrounding or anticipated traffic and bearing loads, etc.
- C. Protection: Protect all persons, adjoining properties and utilities. Should any property damage occur repair and restore to original condition, subject to approval of the Architect, and that of its Owner.

## 1.5 JOB CONDITIONS

- A. Before starting any demolition or other work, check and verify governing dimensions and elevations. Survey condition of adjoining properties. Take photographs to record any prior settlement or cracking of structures, pavements, and other improvements. Prepare a list of such damages, verified by dated photographs, and signed by Contractor and others conducting the investigation.
- B. Survey adjacent structures and improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations. Locate datum level used to establish benchmark elevations sufficiently distant so as not to be affected by movement resulting from excavation operations.
  - 1. Provide any stress and strain gauges on existing buildings to remain as necessary to detect and record any movement or no movement in Project log.

## 1.6 EXISTING UTILITIES

- A. Protect existing active sewer, water, gas, electricity and other utility services and structures identified to remain.
- B. Notify municipal agencies and service utility companies having jurisdiction. Comply with requirements of governing authorities and agencies for protection, relocation, removal and discontinuing of services, as affected by this work.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Provide suitable shoring and underpinning materials which will support loads imposed. Materials need not be new but should be in serviceable condition.
  - 1. If wood is part of shoring system near existing structures, use pressure preservative treated materials or remove before placement of backfill.
- B. Do not use excavation or borings spoils in work to remain, unless acceptable to the accepted project Geotechnical Consultant.

## PART 3 - EXECUTION

### 3.1 SHORING

- A. Wherever shoring is required, locate the system to clear permanent construction and to permit forming and finishing of concrete surfaces. Provide shoring system adequately anchored and braced to resist earth and hydrostatic pressures.
- B. Shoring systems retaining earth on which the support or stability of existing structures is dependent must be left in place at completion of work.

- C. Protect tops of walls as necessary (and forms, sheeting, etc.) as required to prevent water penetration, wash-out, etc.

**3.2 UNDERPINNING**

- A. Locate underpinning to clear columns, floor framing construction, and other permanent work. If necessary to move a brace, install new underpinning prior to removal of original brace.
- B. Do not place underpinning where it will be cast into or included in permanent concrete work, except as otherwise acceptable to Architect.
- C. Install internal underpinning, if required, to prevent spreading or distortion to braced frames.
- D. Maintain underpinning until structural elements are rebraced by other underpinning or until permanent construction is able to withstand lateral earth and hydrostatic pressures.
- E. Remove sheeting, shoring and underpinning in stages to avoid disturbance to underlying soils and damage to structures, pavements, facilities, and utilities.
- F. Repair or replace, as acceptable by Architect, adjacent work damaged or displaced through the installation or removal of shoring and underpinning work.

**END OF SHORING AND UNDERPINNING**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 31 63 29 – DRILL DISPLACEMENT CAST-IN-PLACE PILES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. All piles shall be a full displacement pile. No partial or intermediate displacement type piles may be utilized.
- B. All piles shall be designed for two times the minimum working compressive capacity of 200 kips and a minimum working tension capacity of 40 kips.
- C. The pile caps are designed for 18-inch diameter piles. Any cost associated with checking and/or modifying pile caps due to change in pile size will be the responsibility of the contractor.
- D. Preconstruction testing will include a minimum of 6 static load tests or a combination of 4 static load tests and 3 High Strain Dynamic Load Tests (Drop Hammer) at locations designated by the geotechnical engineer of record. One tension load test shall be performed on a pre-production pile.
- E. The contractor is responsible for High Strain Dynamic Load Tests and retaining a third-party engineer to perform and evaluate these tests in accordance with ASTM D4945. The third-party engineer shall not be an employee of the contractor or pile designer. All High Strain Dynamic Load Tests shall be monitored by representatives of the geotechnical engineer of record.
- F. The apparatus for applying the static load shall be subject to the approval of the Engineer and have a capacity of 325 percent of the design load.
- G. All pre-production load tests shall be performed to geotechnical failure, which is defined as excessive pile movement or plunge.
- H. The static test pile shall be loaded to a minimum of 300 percent of the design load or failure, whichever occurs first in accordance with ASTM D 1143 (compression) or ASTM D3689 (tension). All static load tests shall be performed or monitored by representatives of the geotechnical engineer of record.
- I. Ultimate capacity of the pile will be determined by any of the following methods: Davisson Offset Limit, Brinc-Hansen 90-percent Criterion or Butler-Hoy Criterion but will be limited to the load that produces a maximum of 1.0 inch of pile head deflection.
- J. Should a test pile fail to meet two times the design load, an additional test pile shall be installed and tested at the expense of the contractor.
- K. Production piles may not be installed until all Preconstruction testing has been completed and evaluated, and the pile design is approved by the project design team.
- L. All project production piles should be installed in the same manner, to the same minimum depth and with the same equipment utilized for the test pile installation on the project.
  - 1. Target drilling and grouting parameters of production piles may not be reduced from the parameters achieved during pre-production test pile installation regardless of ultimate capacity of test piles.
  - 2. The concrete or grout mix design utilized for the production piles must be the same as the mix design for the pre-production test piles.

- M. The drilled displacement (DD) pile shall not be installed closer than seven feet, center to center, until initial cement grout set has occurred in the adjacent pile shaft, which typically occurs approximately 24 hours after pile construction.
- N. Verification testing (proof testing) shall be performed on a minimum of 8 production piles. Piles to be selected by the geotechnical engineer of record.
- O. Verification tests can be performed using static load tests or High Strain Dynamic Load Tests in accordance with ASTM D1143 or ASTM D4945. If High Strain Dynamic Load Tests are utilized for verification tests, the same type test must be utilized in pre-production load testing.
- P. Should a production pile fail to meet 1.75 times the design load based upon verification testing:
  - 1. an additional 1 percent of production piles shall be tested at the contractor's expense.
  - 2. any required additional piles and/or modifications to pile caps will be at the contractor's expense.
- Q. Pile Integrity Testing (PIT) will be required on all preproduction test piles, verification test piles and a minimum of 20 percent of production piles. Piles to be selected by the geotechnical engineer of record. Additional piles may be selected by the geotechnical engineer if circumstances either during or after pile installation should make a piles' integrity suspect or if the initial tests reveal major defects.
- R. A third-party engineer retained by the geotechnical engineer of record will perform and evaluate integrity tests. The Low Strain Integrity Testing (PIT) will be performed in accordance with ASTM D5882. The contractor will be responsible for providing access to the pile, providing a level pile head and ensuring that the pile top is relatively smooth and free from water, dirt or other debris. Integrity testing shall not be performed until the concrete has cured for a minimum of seven (7) days.
- S. Piles shall be reinforced with a minimum of 4 vertical bars enclosed by ties in the upper 20'-0" of the pile and 1 additional vertical bar centered in the full depth of the pile. Reinforcing calculations shall be provided for review.

### 1.3 SITE INFORMATION

- A. Data on subsurface conditions are not intended as representations or warranties of continuity of such conditions. It is expressly understood that Owner and/or members of the design team will not be responsible for interpretations or conclusions drawn by the Contractor. Data is made available for the convenience of the Contractor and is not guaranteed to represent conditions that may be encountered.
- B. Available soil borings and other geotechnical information have been presented in the geotechnical report dated August 16, 2024, prepared by Geotechnical Engineering-Testing, Inc.
- C. Additional test borings and other exploratory operations may be made at the Contractor's option at no additional cost to the Owner.

### 1.4 CONTRACTOR EXPERIENCE

- A. The quality of DD piles is highly dependent upon the skill of the contractor and the specific crew that is assigned to the project. It is essential that the contractor demonstrate competence to perform the work by providing documentation of successful completion of prior projects of a similar nature to the project being bid.
- B. The following experience requirements for contractors and their personnel are as follows:
  - 1. The contractor should have completed a minimum of three projects in the two-year period preceding the bid date in which DD piles were installed successfully under subsurface and project conditions similar to those of the current project.



2. The designated job site supervisor (foreman or crew chief) should have a minimum of three years of experience in the supervision of the installation of DD piles.
  3. Drill rig operators should have a minimum of three years of experience installing DD piles.
  4. The designated project manager should have a minimum of three years' experience with DD projects of similar size and scope.
- C. The contractor shall submit a list of personnel to be used on the project and provide documentation of experience.

### **1.5 DESIGN SUBMITTALS**

- A. The DD piles shall be designed by a licensed Professional Engineer (Design Engineer) that is licensed in the state of Alabama. The Design Engineer should have experience in the design of at least five successfully completed DD pile projects over the past five years with DD piles of similar capacity to those required for the project and similar soil conditions. The contractor shall provide documentation of design engineer's experience.
- B. Revisions to the design due to field conditions will need to be documented through submittals of revised calculations and/or working drawings in the affected portion of the project. The contractor shall submit as-built drawings upon completion of the pile installation.

### **1.6 DESIGN CALCULATIONS**

- A. Design calculations should include, but not be limited to, the following items:
1. A written summary report that describes the overall DD pile design
  2. DD pile structure critical design cross-section(s) including soil/rock strata, piezometric levels, and location, magnitude and direction of applied loads.
  3. Design criteria, including soil/rock shear strengths (friction angle and cohesion), unit weights, unit skin friction values, and unit end-bearing values. Any additional subsurface borings, laboratory work, or other subsurface data collected for the design beyond what was provided by the owner.
  4. Safety factors used in the design.
  5. Design calculation sheets (both static and seismic) with the project number, DD pile structure location, designation, date of preparation, initials of designer and checker, and page number at the top of each page. An index page should be provided with the design calculations.
  6. Design notes including an explanation of any symbols and computer programs used in the design.
  7. Pile to cap/footing calculations.

### **1.7 PILE INSTALLATION PLAN**

- A. The Pile Installation Plan is used by the contractor to demonstrate the acceptability of the equipment, techniques, and source of materials to be used on the project. This plan should include, but not be limited to, the following items:
1. List and sizes of proposed equipment, including drilling rigs, augers and other drilling tools, pumps for grout or concrete, mixing equipment, automated monitoring equipment, and similar equipment to be used in construction, including details of procedures for calibrating equipment as required. Note: grout pump must be calibrated a minimum of one time for every 100 piles installed.
  2. Step-by-step description of pile installation procedures.
  3. A plan of the sequence of pile installation.
  4. Target drilling and grouting parameters (along with acceptable ranges) for pile installation, including auger rotation speed, drilling penetration rates, torque, applied crowd pressures, grout pressures, and grout volume factors.
  5. Details of methods of reinforcement placement, including support for reinforcing cages at the top of the pile and methods for centering the cages within the grout or concrete column.

6. Mix designs for all grout or concrete to be used on the project, including slump loss vs. time curves and strength development vs. time curves for mixes with fly ash and/or slag.
  7. Equipment and procedures for monitoring and recording auger rotation speed, auger penetration rates, auger depths, and crowd pressures during installation.
  8. Equipment and procedures for monitoring and recording grout or concrete pressures and volumes placed during installation.
  9. Contingency plans for equipment failures during drilling or grouting operations (grout pump, monitoring equipment, etc.)
  10. Procedures for protecting adjacent structures, on or off the right-of-way, that may be adversely affected by foundation construction operations.
  11. Other required submittals shown on the plans or requested by the engineer.
- B. The plan should also include the following items for the equipment proposed:
1. The rated capacity and boom lengths of the drill rig
  2. The torque, rotational speed and down crowd capacity of the drilling machine
  3. The horsepower of the hydraulic power unit used to turn the auger.
  4. The positive displacement piston-ball valve pump, pump stroke displacements, engine horsepower and pump pressures of the grout pump to be used.
  5. Automated monitoring equipment utilized to provide rate of penetration of tool, torque and down pressure from the rig, concrete (or grout) volume during extraction of tool and concrete pressure during pumping. The data from the automated data monitoring equipment shall be provided to a representative of the geotechnical engineer within 2 days of the production day.
- C. With respect to the above parameters, the installation plan should include documentation that the proposed drilling equipment has been demonstrated effective on similar size piles in similar soil conditions.

## 1.8 TESTING PLAN

- A. The DD pile contractor should include a plan for constructing and performing the required tests to meet the requirements of the testing plan along with the Pile Installation Plan in accordance with the Minimum Project Requirements Established by the Design Team. The testing program should consist of pre-production static load tests or a combination of static load tests and high strain dynamic load tests, production static and/or high strain dynamic load tests, and post-installation integrity tests in sufficient quantities to provide the data necessary to demonstrate that the installed piles meet the load and deflection criteria established in the project plans with an appropriate factor of safety.
- B. Pre-production load test program will meet requirements outlined in the Minimum Project Requirements Established by Design Team. Piles installed for pre-production testing (including any reaction piles required for static load testing) should include all construction, monitoring, testing, and inspection requirements of production piles. The results of the installation and testing will be used to:
1. Establish target drilling penetration rate(s) for the various subsurface conditions on the site.
  2. Establish pressure/volume relations for placement of grout/concrete. The grout factor (i.e., ratio of used volume of grout/concrete to theoretical volume for the specified pile size)  $\pm 7.5\%$  that is calculated on the test pile(s) should be used for the installation of the production piles.
  3. Establish target values for torque and downward thrust or crowd for displacement or partial displacement piles.
  4. Establish mix design parameters such as grout flow, necessary admixtures, etc.
  5. Evaluate design correlations of side and base resistance with the site-specific soil parameters.
- C. All pile installation and testing will be witnessed by a representative of the geotechnical engineer of record.

- D. Conformance monitoring includes the use of automated measuring and recording equipment to confirm the pile installation criteria, integrity testing, and verification tests on production piles to demonstrate that the installed production piles meet the established load-deflection criteria. This shall include at a minimum automated monitoring equipment to provide “real time” evaluation of each pile on a project. The installation plan should include type of monitoring equipment, manufacturer, data to be collected, current calibration records, and sample data records. As a minimum, the monitoring equipment should have the capability to monitor and record the following:
1. Auger rotation.
  2. Depth of the auger injection point.
  3. Torque delivered to the auger.
  4. Crowd force (downward thrust on auger).
- E. All measurements should be referenced to (or plotted against) the depth of the auger injection point. This can be accomplished with a rotational position indicator on the auger head system and an electronic position indicator on the crane line or boom holding the auger. Torque and thrust load cells should be positioned on the auger head system.
- F. As a minimum, the following automatic measurements should be recorded during the grouting or concreting operation:
1. Volume of grout or concrete
  2. Maximum and minimum grout or concrete pressure
  3. Auger rotation (if rotated)
  4. Depth of the injection point.
- G. All measurements should be referenced to (or plotted against) the depth of the auger injection point. This can be accomplished with electronic flowmeters and electronic pressure transducers placed in the grout or concrete pressure line, an electronic position indicator on the crane line or boom holding the auger, and a rotational position indicator on the auger system.
- H. Calibration should be made on all monitoring equipment at the beginning of the project in accordance with the equipment manufacturer’s specifications. The values indicated by the monitoring equipment should be within three percent of the manufacturer recommendations.
- I. A data sheet from the automated equipment shall be provided for each pile.
- J. Verification testing will be performed on production piles as outlined in Minimum Project Requirements Established by Design Team. The contractor shall propose the type of verification testing to be performed. The same load testing equipment and engineer utilized during the Pre-Production testing shall be utilized for the verification testing.
- K. Integrity testing will be performed on production piles as outlined in Minimum Project Requirements Established by Design Team.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 321216 - ASPHALT PAVING****PART 1 GENERAL****1.01 SCOPE**

- A. Furnish all labor, material and equipment necessary to complete all asphalt paving as indicated on the drawings and specified herein.
- B. Detail material and construction requirements for this work shall be in accordance with the Alabama Department of Transportation “Standard Specifications for Highway Construction”, 2022 edition, hereinafter referred to as Standard Specifications.
- C. The items of work to be performed shall include, but are not limited to:
  - 1. Constructing, shaping, and compaction of subgrade surface adjacent to base course.
  - 2. Constructing base course.
  - 3. Construction of asphalt.
  - 4. Painting parking stripes, symbols, and legends.
  - 5. Furnishing and installing signs and posts.
- D. Related work specified elsewhere:
  - 1. Site Grading – SECTION 312200.
  - 2. Soil Compaction Control – SECTION 31232323.

**1.02 SPECIAL REQUIREMENTS**

- A. Prior to starting construction of each overlying layer of the pavement structure, the preceding layer shall be compacted and fine graded in accordance with the Specifications. The surface shall then be proof-rolled in the presence of the Engineer and any yielding or “pumping” areas removed and replaced.
- B. Asphalt paving shall be placed with equipment in good operating condition. All equipment shall be subject to the rejection by the Engineer if not in satisfactory operating condition.
- C. Asphalt will be supplied to the project with a sufficient number of trucks to prevent the formation of cold joints. Asphalt temperature will be strictly enforced in accordance with the job mix formula.
- D. If different subcontractors exist for completion of the paving work, both the General Contractor and Material Supplier shall maintain a supervisor on the site while paving is in progress. No paving work shall be undertaken unless the supervisors are present on the site.
- E. Any areas of ponded or trapped water in the asphalt wearing surface shall be cut out and replaced as required to correct the area. The cut-out area shall be square or rectangular and not less than 200 square feet. Should cut-out areas, patches, or areas otherwise deemed unsatisfactory exceed 10 percent of the pavement area, the entire new pavement area shall be re-surfaced at no cost to the Owner. Tack Coat and 200 pounds per square yard of Bituminous Concrete Wearing Surface shall be required.

**PART 2 PRODUCTS**

(Not applicable.)

**PART 3 EXECUTION****3.01 MATERIALS AND METHODS**

- A. Subgrade
  - 1. Immediately before base material is placed, the underlying 6" of backfill material shall be scarified and compacted to 100 percent ASTM D-698 density, then shaped and compacted to the final required grade. Soft, spongy or otherwise unsuitable material shall be replaced. Every precaution shall be taken to obtain a subgrade of uniform bearing. Fill and tamp traces of utility trenches. Compaction shall be a minimum of 100% Standard Density.
- B. Base Course
  - 1. Base course shall be a Crushed Aggregate Base Course, Type "B", Yard Mixed, and placed to the thickness indicated by the drawings. Base thickness greater than 6" must be placed in two (2) equal layers. Material and workmanship shall meet requirements set forth in Section 301 of the Standard Specifications.
- C. Bituminous Treatment
  - 1. Bituminous treatment shall meet the requirements of Section 401 of the Standard Specifications and as indicated by the drawings.
- D. Bituminous Concrete Binder Layer
  - 1. Binder layer shall consist of an Superpave Bituminous Concrete Binder Layer mix applied at the spread rate indicated by the drawings and in accordance with Section 424 of the Standard Specifications.
- E. Tack Coat
  - 1. Tack coat shall meet the requirements of Section 405 of the Standard Specifications and as indicated by the drawings.
- F. Bituminous Concrete Wearing Surface
  - 1. Wearing surface shall consist of a Superpave Bituminous Concrete Wearing Surface mix applied at the spread rate indicated by the drawings and in accordance with Section 424 of the Standard Specifications.
- G. Traffic Stripe and Markings
  - 1. Material and construction requirements for traffic stripe and markings shall be in accordance with applicable portions of Section 701 and 703 of the Standard Specifications.
  - 2. Stripe and markings shall be reflective (Type A) paint (Class 1) and thermoplastic (Class 2) materials as indicated by the drawings. The required dry film thickness on the finish pavement surface for all paint stripe and markings will be 0.090 inches; for thermoplastic materials the minimum thickness shall be 0.125 inches.
  - 3. Color of stripe and markings shall be as indicated by the drawings.
- H. Signs and Posts
  - 1. Signs and posts shall be as indicated by the drawings and Section 710 of the Standard Specifications. The sign material shall be Type B sheeting Class 2 or 2A face.
  - 2. Post shall be #2 "U" post mounted in accord with D.O.T. Std. Dwg. IHS 710-12 and IHS 710-21.

**END OF SECTION**

**SECTION 321313 - CONCRETE PAVING, CURBS, AND WALKS****PART 1 GENERAL****1.01 SUMMARY**

- A. Furnish all labor, material and equipment necessary to complete all concrete paving, curbs, gutters, and walks as indicated on the drawings and specified herein.
- B. The items of work to be performed shall include, but are not limited to:
  - 1. Constructing, shaping, and compacting of subgrade.
  - 2. Concrete sidewalk paving, and driveway turnouts.
  - 3. Concrete curbs and gutters.
  - 4. Concrete drives for emergency vehicle access.
- C. Related work specified elsewhere:
  - 1. Earthwork – SECTION 310000.
  - 2. Site Grading – SECTION 312200.
  - 3. Soil Compaction Control – SECTION 31232323.
  - 4. Cast-In-Place Concrete – SECTION 033000.
- D. Detail material and construction requirements for this work shall be in accordance with the Alabama Department of Transportation “Standard Specifications for Highway Construction, latest Edition”, hereinafter referred to as “Standard Specifications”.

**1.02 LABORATORY CONTROL AND TEST**

- A. Shall be same as required under SECTION 033000 – Cast-In-Place Concrete.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. Portland Cement shall conform to ASTM Specification C-150, Type I or III.
- B. Aggregates for concrete shall conform to ASTM Specifications C-33. Fine Aggregates shall be natural sand, or subject to approval, sand prepared from stone, gravel or other inert materials having similar characteristics. Coarse Aggregates shall be crushed rock or gravel or, subject to approval, a combination of these materials. Maximum size of aggregate shall be 1-1/2 inch.
- C. Fiber mesh reinforcing shall be as approved by the Engineer for all site concrete, including curb and gutter.
- D. Water shall be clear, and free from injurious amount of oils, acids, alkalis, organic materials, or other deleterious substances.
- E. Reinforcing bars shall be deformed steel bars per ASTM A-615, Grade 40.
- F. Welded steel wire fabric for concrete reinforcement shall conform to ASTM Specification A-185.
- G. Pre-molded joint filler: See notes on the drawings. Joint Sealant shall be Type 3 – Low Modulus Silicone Cold Poured Joint Sealant meeting the requirements of Section 832 of the Standard Specifications.
- H. Base course beneath concrete sidewalk and paving shall be as indicated on the drawings.

**2.02 STORAGE OF CONCRETE MATERIALS**

- A. Cement - Provide suitable means for storing and protecting the cement against dampness. Bags of cement which have become partially set or which contain lumps of caked cement shall be rejected.
- B. Aggregates - Shall be stockpiled as to prevent segregation of component sizes and intrusion of foreign matter. Aggregates of different gradings shall be stored separately.

**2.03 PROPORTIONING AND MIXING CONCRETE**

- A. Concrete shall be a mix of proportioned fine and coarse aggregates with Portland Cement. Minimum cement content shall be 6.5 sacks per cubic yard of concrete and maximum water content shall be six U.S. gallons per sack of cement, including moisture in aggregates.
- B. Proportioning Aggregates
  - 1. The ratio of fine to total aggregate shall be such as will produce a dense, homogeneous, and workable mixture, which can be placed without segregation of materials and which will attain at 28 days a minimum compressive strength of 3000 psi (unless otherwise specified) and flexural strength of 600 psi as established by laboratory tests.
- C. Measurement of Materials
  - 1. Measure concrete materials by such weighing methods as will permit accurate control of proportions and easy check thereof at all times.
- D. Mixing Concrete
  - 1. Mix all concrete in an approved power batch mixer. Mix for a period of not less than 1-1/4 minutes after all materials are in the drum.
- E. Ready-Mixed Concrete
  - 1. Certificates shall be furnished from the mixing plant that concrete has a 28 day compressive strength of at least 3000 psi (unless otherwise specified) and a flexural strength shall be 600 psi, when tested in accordance with methods described in ASTM Standard C-34-49. No change shall be made in materials or the established mix without prior approval. Ready-mixed concrete shall be transported to the site in transit-mix or agitator trucks paving watertight drums loaded within the limits of rated capacities. The concrete shall be delivered and discharged within one hour after the cement is in the mixer. Concrete which, when delivered, is not plastic and workable shall be rejected.
- F. Ready Dry-Batched Mixes
  - 1. Certificates shall be furnished for concrete strength and prior testing similar to those above specified for ready-mixed concrete. Ready dry-batched mixes shall be transported to the site in trucks having batch compartments of adequate size for the rated tarpaulin while in transit. Add water to batch after discharge into the mixer, which must be within two hours after the cement was added to the batch.
- G. Retempering of concrete that has partially hardened, that is, re-mixing with or without additional cement, aggregate or water, will not be permitted.



**PART 3 EXECUTION****3.01 SUBGRADE AND BASE**

- A. The Contractor shall verify all grades shown on the plans before proceeding with the work. The Engineer reserves the right to improve the gradients by reasonable field adjustments prior to the completion of the subgrade work.
- B. Paving shall not be placed until all underground work, such as sewers, water pipes, storm drain pipe, underground electric work, etc. are all in place, backfilled, and trench work compacted.
- C. Shape, compact and bring subgrade to required grade.
- D. For concrete paving (not including sidewalk) construct a 4-inch thick crushed stone base course in accord with Section 301 of the Standard Specifications. For concrete sidewalk, base shall be a 4" granular soil base placed in accord with Section 301 of the Standard Specifications. Compaction shall be 95 percent modified proctor density as per AASHTO T-180.
- E. Loosen exceptionally hard spots and re-compact. Replace spongy and otherwise unsuitable material. Fill and tamp traces of utility trenches.
- F. Place concrete only on a moist compacted subgrade or base, free from loose material. Place no concrete on a muddy or frozen subgrade.

**3.02 FORMS**

- A. All forms shall be free from warp, tight enough to prevent leakage of mortar, and substantial enough to maintain their shape and position, without springing or settlement, when concrete is placed or vibrated. Forms shall be staked, braced and/or tied together securely. Forms shall be clean and those for surfaces to be exposed shall produce a smooth, even finish without fins or board marks.
  - 1. Set forms for slabs on ground at exact finished grade. Check for line and grade and correct as necessary immediately before concreting. Provide uniform bearing for such forms. Use flexible or curved forms when edge of surface is to be curved to a radius of 100 feet or less. Where adjacent to curbs, joints in sidewalks and curbs shall coincide.
  - 2. Expansion joints at pavement: provide expansion joints, with pre-molded filler at walk junctions and intersections, at building, platforms or other fixed structures, or termination at curbs. Locate expansion joints as indicated on the plans.
  - 3. Control joints in pavements shall be hand formed with proper tools so as to provide radius edged joints as shown on the drawings. Saw cut control joints in exposed aggregate concrete will not be allowed.
  - 4. Where adjacent to curb and gutter or other, concrete joints shall coincide.

**3.03 DIMENSIONS**

- A. Concrete paving shall be of one course construction, thickness and layout shown on the drawings.

**3.04 REINFORCING**

- A. Reinforcing shall be accurately placed, and securely supported and fastened to prevent movement during placement of concrete.

### 3.05 CONCRETE PLACEMENT AND FINISHING

A. Paving or Sidewalk Concrete: Concrete shall be placed in the forms in one layer of such thickness that when compacted and finished, the sidewalk will be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be tamped and consolidated with a suitable wood or metal tamping bar, and the surface shall be finished to grade with a wood float. Finished surface of the walk shall not vary more than 3/16 inch from the testing edge of a 10-foot straightedge. Irregularities exceeding the above shall be satisfactorily corrected. The surface shall be divided into rectangular areas by means of contraction joints spaced at not more than 5 feet on centers unless so indicated by the drawings.

1. Concrete finishing: After straight-edging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic.
2. Finishing for exposed aggregate surfaced sidewalk shall be coordinated with the Architect/Engineer to achieve the desired finish. Three (3) 4 foot x 4 foot sample pours shall be constructed to allow the Architect to review the work to be produced by the Contractor and to set the finish requirements. The sample pours shall be repeated until a finish acceptable to the Architect is produced.
3. Edge and joint finishing: All slab edges, including those at formed joints, shall be finished carefully with an edger having a radius of 1/8 inch. Transverse joints shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corner and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.
4. Contraction joints: The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8 inch blade to a depth indicated. The time of sawing shall be varied, depending on existing and anticipated weather conditions, and such sawing shall be at the required rate. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit that is in good working order shall be available at the job site at all times during the sawing operations.
5. Expansion joints: Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Transverse expansion joints shall be filled with 3/4 inch joint filler strips. Joint filler shall be placed with top edge 1 inch below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler

shall be removed. Expansion joints shall be formed about structures and features that project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. The filler shall be installed in such manner as to form a complete, uniform separation between the structure and sidewalk pavement. All joints shall receive sealer as indicated by the drawings. Surface uniformity: The completed surface shall be uniform in color and free of surface blemishes and tool marks.

B. Curb and gutter concrete: Concrete shall be placed in layers not to exceed 6 inches. Concrete shall be thoroughly consolidated by tamping and spading or with approved mechanical vibrators.

1. Concrete finishing: The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2 inch and the surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes from marks, and tool marks have been removed. The surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float. Except at grade changes or curves, finished surfaces shall not vary, from the testing edge of a 10-foot straightedge, more than 1/8 inch for gutter and entrance and 1/4 inch for top and face of curb. Irregularities exceeding the above shall be satisfactorily corrected. Visible surfaces and edges of finished curb and gutter shall be free of blemishes and from tool marks, and shall be uniform in color, shape, and appearance.

2. Joints: Expansion joints and contraction joints shall be constructed at right angles to the line of curb and gutter.

a. Contraction joints: Contraction joints shall be constructed by means of 1/8 inch thick separators, of a section conforming to the cross section of the curb and gutter. Contraction joints shall be constructed directly opposite contraction joints in abutting Portland Cement concrete pavement or sidewalk. Where curb and gutter do not abut, contraction joints shall be so placed that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint. Separators shall be removed prior to finishing.

b. Expansion joints: Expansion joints shall be formed by means of preformed expansion-joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting Portland Cement concrete pavement and shall be the same type of thickness as joints in the pavement. Where curb and gutter do not abut Portland Cement concrete pavement, expansion joints at least 3/4 inch in width shall be provided at intervals not exceeding 25 feet. Expansion joints shall be provided in non-reinforced concrete gutter at locations indicated. All expansion joints shall receive sealer, as indicated by the drawings.

C. Curb-forming machines:

1. Curb-forming machines for constructing curb and gutter will be approved based on trial use on the job. Use of the equipment shall be discontinued at any time during construction if the equipment produces unsatisfactory

results, and the work shall be accomplished as specified above. Unsatisfactory work shall be removed and reconstructed for the full length between regularly scheduled joints. Removed portions shall be disposed of as directed.

### **3.06 PROTECTION**

- A. Remove no forms (except face forms) for 24 hours after placing concrete. Barricade against vehicular traffic for 14 days. Compact thoroughly the backfill at all edges.

### **3.07 COLD WEATHER PROTECTION**

- A. Whenever the air temperature may be expected to reach the freezing point, spread straw or other blanketing material to sufficient depth to keep concrete from freezing. Provide enclosure and heating device capable of maintaining concrete temperature of at least 50°F. Maintain such protection for at least five days. The Contractor shall be responsible for removing and replacing any concrete injured by frost action.

### **3.08 CURING**

- A. Except as otherwise specified, cure all concrete by covering surface with burlap or cotton mats, straw, sand or other approved material. Keep such coverings wet for at least seven days after concrete is placed. Wiping of concrete surfaces with grout or other coatings shall not be performed unless specifically authorized by the Engineer. This process shall not be used as a substitute for cleaning or repair of curb or curb and gutter.

### **3.09 REPAIR OF CRACKS AND BREAKS**

- A. Hairline cracks may be repaired with epoxy grout. Sections containing breaks which penetrate the full concrete depth shall be removed from joint to joint unless specifically approved by Architect/Engineer.

### **3.10 FINAL CLEANING**

- A. All concrete work, including sidewalks, steps, curbs, driveway turnouts, and curb and gutter, shall be sand or water blasted free of all stains or discolorations present on the exposed surfaces and to a uniform finish and color. This work shall not be commenced until all other construction, including paving, is completed.

**END OF SECTION**

**SECTION 329000 - PLANTING****PART 1 GENERAL****1.01 SUMMARY**

- A. This section shall include requirements for all materials and labor as required to establish an acceptable stand of seeded grass with mulch and solid sod over the entire project limits indicated by the drawings.
- B. Solid sod shall be placed in area indicated on the landscape drawings. All other unsurfaced areas shall receive seeded grass, mulch, and erosion control netting.
- C. The items of work to be performed include, but are not limited to:
  - 1. Preparation of sub-soil, re-spreading/spreading topsoil.
  - 2. Preparation of topsoil for planting.
  - 3. Fine grading areas to receive topsoil.
  - 4. Planting seeded grass, mulching, and solid sodding.
- D. Related work specified elsewhere:
  - 1. Site Grading – SECTION 312200.

**1.02 SUBMITTALS**

- A. Provide required warranty (grass bond).

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. Seed
  - 1. Seed shall be state-certified seed of the latest season's crop and shall be delivered in original sealed packages bearing the producer's guaranteed analysis for percentages of mixtures, purity, germination, weed-seed content, and inert material.
  - 2. Seed shall be labeled in conformance with U.S. Department of Agriculture rules and regulations under the Federal Seed Act and applicable state seed laws.
  - 3. Seed that has become wet, moldy, or otherwise damaged will not be acceptable.
- B. Topsoil
  - 1. Topsoil shall be the existing surface soil.
  - 2. Additional topsoil, if required beyond that available, shall be a natural, friable soil representative of productive soils in the vicinity. It shall be obtained from well drained borrow areas provided by the Contractor and shall be free of any admixture of subsoil, foreign matter, objects larger than one inch in any dimension, toxic substances, and any material or substance that maybe harmful to plant growth. The pH range shall be 5.3 to 6.0. Topsoil that does not meet the lower pH limit shall be amended by the addition of lime, at a rate recommended based on soil tests.
- C. Liming Material
  - 1. The Contractor shall use either agricultural limestone.
    - a. Agricultural limestone shall have a minimum calcium carbonate equivalent of 90% and shall be ground to such fineness that at least 90% will pass a 10-mesh sieve and at least 50% will pass a 60-mesh sieve.

**D. Fertilizer**

1. Fertilizer shall be commercial grade, free flowing, uniform in composition and shall conform to applicable state and Federal regulations. Fertilizer shall conform to Fed. spec. 0-F-241, Type I, Class (1), (2) or Type II, Class (1), (2), or (3) and shall bear the manufacturer's guaranteed statement of analysis. When slow release nitrogen forms are used in the fertilizer mixture, they shall be derived from sulfur coated area (SCU), urea formaldehyde (UF), plastic or polymer coated prills, or isobutylenediurea (IBDU). Fertilizer for use prior to tilling and for use during the establishment period shall be selected by the Contractor.

**E. Mulch**

1. Mulch shall be straw or hay mulch fixed in place with disk land packers or disk harrows.
  - a. Straw shall be stalks from oats, wheat, rye, barley, or rice that are free from noxious weeds, mold, or other objectionable material. Straw shall be in an air-dry condition and suitable for placing with blower equipment.
  - b. Hay shall be native hay, or other herbaceous mowings, free from noxious weeds, mold, or other objectionable material. Hay shall be in an air-dry condition and suitable for placing with blower equipment.

**F. Solid Sod**

1. Sod shall be live centipede sod with a minimum 2" thickness of root mat and soil attached. Sod strips shall be furnished with a minimum 12" width.

**G. Water**

1. Water shall not contain elements toxic to plant life.

**PART 3 EXECUTION****3.01 SITE PREPARATION****A. Preparation of Seed Beds**

1. Placing topsoil: Topsoil shall be distributed evenly over the disturbed area to a minimum compacted thickness of 6 inches. Topsoil shall be spread so that planting can proceed with little additional soil preparation or additional tillage. Surface irregularities resulting from topsoiling or other operations shall be leveled to prevent depressions. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, excessively compacted, or in a condition detrimental to the proposed planting or grading. Soil compacted by construction equipment shall be pulverized to a minimum depth of 4" by disking before spreading topsoil.
2. Tillage: Prior to seeding or sodding, the soil shall be tilled to a depth of at least 6". Tillage shall be accomplished by plowing, disking, harrowing, by the use of rototillage machinery or other approved operations until the condition of the soil is acceptable. The work shall be performed only during periods when beneficial moisture, or other unsatisfactory conditions prevail, the work shall be stopped when directed. Undulations or irregularities in the surface shall be leveled before the next specified operation. Care shall be taken to correctly grade areas to receive solid sod (top of sod at new finish grade) and to provide the required minimum topsoil thickness below sodded areas.
3. Hand Raking: Prior to seeding, the seeded area shall be hand raked and all roots, limbs, debris, and other objectionable matter removed from the topsoil.

B. Application of Fertilizer and Lime

1. At a minimum, 8-8-8 fertilizer shall be applied at the rate of 1,500 pounds per acre. Other fertilizer and application rates may be used upon approval.
2. Lime: Ground agricultural limestone shall be applied at the rate of 4,000 pounds per acre.
3. All fertilizers and ground limestone shall be incorporated into the soil to a depth of at least 4” and may be incorporated in part of the tillage operation hereinbefore specified. Immediately before seeding, sodding, sprigging, the soil shall be restored to an even condition.

3.02 APPLICATION

A. Seeding

1. Broadcast seeding: Seed shall be broadcast either by hand crank seeders or with approved hydraulic seeding equipment, as specified hereinbefore, in combination with fertilizer, or with the approved hydraulic equipment in combination with fiber mulch and fertilizer as specified hereinbefore, or with other approved sowing equipment. Seed shall be distributed uniformly over designated areas. Half of seed shall be sown with sower moving in one direction, and the remainder with sower moving at right angles to first sowing. Seed shall be covered to an average depth of 1/4 inches by brush harrow, spike-tooth harrow, chain harrow, cultipacker, hand rake with wood tines, or other approved device. Seed shall not be broadcast during windy weather.

2. Seeding rates

Special Urban Seed Mixes

March thru June

Bermudagrass (Hulled)	30 lbs. per acre
Kobe Lespedeza	60 lbs. per acre

July and August

Bermudagrass (Hulled)	30 lbs. per acre
Reseeding Crimson Clover	80 lbs. per acre

September thru December

Bermudagrass (Unhulled)	30 lbs. per acre
Reseeding Crimson Clover	80 lbs. per acre

January and February

Bermudagrass (Unhulled)	30 lbs. per acre
Reseeding Crimson Clover	60 lbs. per acre
Kobe Lespedeza	60 lbs. per acre

3. Mulch shall be spread uniformly in a continuous blanket, using 2 tons per acre. Mulch shall be spread by hand or by a manure spreader, a modified grain combine with straw-spreader attachment, or a blower-type mulch spreader. Mulching shall be started at the windward side and continued uniformly until the area is covered. The mulch shall not be bunched. Immediately following spreading, the mulch shall be anchored to the soil by a V-type-wheel land packer, a scalloped-disk land packer designed to force mulch into the soil surface, or other suitable equipment.

B. Sodding

1. Solid sod shall be live, active hybrid Bermuda grass sod.
  2. Sod shall be placed in designated areas. Voids between sod strips shall be carefully filled with topsoil. Sod shall be placed with no edges exposed. Where necessary, strips shall be turned down. In areas exposed to concentrated flows of water or where on a slope steeper than 3:1, the sod shall be staked in place. All areas shall be rolled by a small hand-propelled steel wheel roller. Roll sod a minimum of (2) times each in a parallel and at a right angle to the sod strips and as required additionally to level surface defects.
  3. Sod shall be placed below the top surface of sidewalks, curbs, or other finished surfaces.
- C. Watering
1. Watering shall be required as necessary to obtain a suitable stand of seeded or sodded grass.
- D. Restoration and Clean-Up
1. Excess and waste material shall be removed daily. When turfing in an area that has been completed, the area shall be cleaned of all debris and excess material. Where existing turf areas have been damaged during turfing operations, the contractor shall restore the areas to their original condition at his expense.

### **3.03 PROTECTION OF GRASSED AREAS**

- A. Immediately after seeding or sodding, the area shall be protected against traffic or other use by erecting barricades, as required, and approved signs shall be placed at appropriate intervals until final acceptance.

### **3.04 WARRANTY**

- A. The Contractor shall rework, re-seed and mulch areas seeded under the Contract where a satisfactory stand of grass is not present, or remove and replace areas of dead or damaged solid sod placed under the Contract in the eleventh (11th) month following acceptance of the project by the Owner. A bond of not less than \$10,000.00 shall be provided to the Owner to guarantee the performance of this work.

**END OF SECTION**



**SECTION 331411 - WATER SERVICE PIPING****PART 1 GENERAL****1.01 SUMMARY**

- A. Furnish all labor, material ,equipment and incidentals necessary to complete all water service piping as indicated on the drawings and specified herein.
- B. Detail material and construction requirements for this work shall be in accordance with the Standard Plumbing Code, latest edition as interpreted by the City of Mobile Inspection Services Department and the latest version of the “Standard Specifications for Water Mains, Sanitary Sewers, and Sewage Pumping Station” of the Board of Water and Sewer Commissioners of the City of Mobile, Alabama, hereinafter called MAWSS Specifications and all addenda issued through the bid date of the project.
- C. The items of work to be performed include, but are not limited to:
  - 1. Site piping, domestic and fire water.
  - 2. Control valves, including backflow preventer valve, pit and piping.
  - 3. Water meter, pit, and piping.
- D. Related work specified elsewhere:
  - 1. MAWSS Standard Specification Section 11.
  - 2. MAWSS Standard Specification Appendix A.
  - 3. MAWSS Standard Specifications Section 15 Backfilling
  - 4. MAWSS Standard Specifications Section 17 Encasement Pipe
  - 5. MAWSS Standard Specification Section 20 Horizontal Directional Drilling (HDD)/HDPE Pipe
  - 6. All MAWSS Standard Specifications and be found at the following location:  
<https://www.mawss.com/bids/standard-specifications/>
  - 7. Earthwork – SECTION 310000.
  - 8. Site Grading – SECTION 312200.
  - 9. Soil Compaction and Control – SECTION 312323.
  - 10. Water Distribution – SECTION 331400.

**1.02 SUBMITTALS**

- A. Provide manufacturer data and installation instructions on water line materials.
- B. Test Results: As specified in MAWSS Standard Specification Section 11.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. Shall be in accordance with MAWSS Standard Specification Appendix A.

**PART 3 EXECUTION****3.01 INSTALLATION**

- A. Refer to MAWSS Standard Specification Section 11

**END OF SECTION**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 333000 - SANITARY SEWERAGE**

**PART 1 GENERAL**

- A. All work under this Contract shall be done in accordance with the requirements of the Mobile Area Water and Sewer Board Standard Specifications Section 12 Sanitary Sewer
- B. Submit Product Data, as specified under MAWSS Section 12.
- C. Submit Shop Drawings for precast concrete manholes, including frames and covers as specified under MAWSS Section 12.
- D. All Specifications can be found at the following location. <https://www.mawss.com/bids/standard-specifications/>

**PART 2 PRODUCTS**

- A. Shall be in accordance with MAWSS Standard Specification Appendix A.

**PART 3 EXECUTION**

- A. Refer to MAWSS Standard Specification Section 12.

**END OF SECTION**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 333100 – SANITARY SEWER COLLECTION SYSTEM****PART 1 GENERAL****1.01 SUMMARY**

- A. Furnish all labor, material, equipment and incidentals necessary to complete the sanitary sewer collection system as indicated on the drawings and specified herein.
- B. Detail material and construction requirements for this work shall be in accordance with the Standard Plumbing Code, latest edition as interpreted by the City of Mobile Inspection Services Department and the latest version of the “Standard Specifications for Water Mains, Sanitary Sewers, and Sewage Pumping Station” of the Board of Water and Sewer Commissioners of the City of Mobile, Alabama, hereinafter called MAWSS Specifications and all addenda through the bid date of the project.
- C. The items of work to be performed include, but are not limited to:
  - 1. Sanitary sewer conduits.
  - 2. Manholes and clean-outs.
- D. Related work specified elsewhere:
  - 1. MAWSS Standard Specifications Section 12 Sanitary Sewers
  - 2. MAWSS Standard Specifications Section 15 Backfilling
  - 3. MAWSS Standard Specifications Section 17 Encasement Pipe
  - 4. MAWSS Standard Specification Section 19 Rehabilitation of Sanitary Sewer Manholes
  - 5. MAWSS Standard Specification Section 20 Horizontal Directional Drilling (HDD)/HDPE Pipe
  - 6. MAWSS Standard Specification Appendix A
  - 7. MAWSS Standard Specification Appendix C
  - 8. All MAWSS Standard Specifications and be found at the following location:  
<https://www.mawss.com/bids/standard-specifications/>
  - 9. Earthwork – SECTION 310000.
  - 10. Site Grading – SECTION 312200
  - 11. Soil Compaction and Control – SECTION 312323

**1.02 SUBMITTALS**

- A. Provide manufacturer data and installation requirements on all materials.
- B. All referenced submittal information from MAWSS Standard Specifications.
- C. Test Reports As stated in MAWSS Standard Specifications.

**PART 2 PRODUCTS****2.01 MATERIALS**

- 1. Shall be in accordance with the MAWSS Standard Specifications Section 12 and Appendix A “List of Acceptable Products and Approved Manufacturers”.
- 2. Clean-outs – As indicated by drawings.
- 3. Manholes – As indicated by drawings.

4. Collection Piping – As indicated by drawings.

**PART 3 EXECUTION**

- A. Shall be in accordance with MAWSS Standard Specification Section 12.

**END OF SECTION**

**SECTION 334000 - STORMWATER UTILITIES****PART 1 GENERAL****1.01 SUMMARY**

- A. Furnish all labor, material and equipment necessary to complete all construction of the underground storm drainage system indicated on the drawings and specified herein.
- B. Detail material and construction requirements for this work shall be in accordance with the Alabama Department of Transportation "Standard Specifications for Highway Construction", latest edition, hereinafter referred to as "Standard Specifications".
- C. The items of work to be performed include, but are not limited to:
  - 1. Constructing underground storm sewer piping.
  - 2. Backfilling and compaction of pipe trench lines.
  - 3. Construction of inlets, junction boxes, and other drainage structures.
- D. Related work specified elsewhere:
  - 1. Earthwork – SECTION 310000.
  - 2. Soil Compaction Control – SECTION 31232323.

**1.02 SUBMITTALS**

- A. Provide manufacturer data and installation instructions on all materials required under this section.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. Storm drain piping shall be as follows:
  - 1. Circular pipe 24-inch diameter and larger and all arch pipe shall be Class III R.C. pipe. Circular pipe shall have rubber gasket joints and arch pipe shall have "Ram Nek" type gaskets.
  - 2. Pipe 12" to 24" diameter inclusive shall be A-2000 Ribbed P.V.C. pipe with watertight joints. Pipe less than 12" diameter shall be Schedule 40 Polyvinyl Chloride (P.V.C.) sewer pipe with elastomeric joints. Fittings shall be of the same materials as the pipe.
- B. Materials for drainage structures shall meet the requirements of Section 621 of the Standard Specifications or as called for by the drawings.
- C. Underdrain pipe shall be P.V.C. perforated pipe with filter material as specified in Section 606 of the Standard Specifications.
- D. Rip Rap materials shall be stone from quarry meeting the requirements of Section 610 of the Standard Specifications. Filter fabric beneath rip rap shall also be as specified in Section 610.

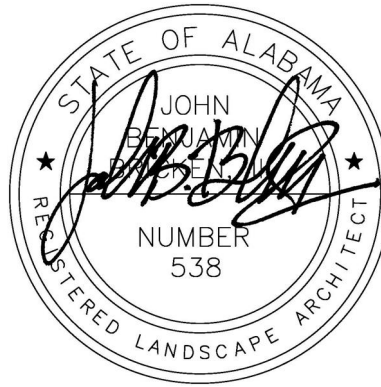
**PART 3 EXECUTION****3.01 CONSTRUCTION REQUIREMENTS**

- A. Pipelines
  - 1. Pipelines shall be laid true to lines and grades set forth by the plans in accordance with the Standard Specifications. All pipe bedding shall be Class "C" as defined by the Standard Specifications.

2. Beneath paved areas, trenches and related excavations shall be backfilled with material meeting the requirements for select fill and backfill material beneath paved areas. Material shall be placed in 8" loose lifts and compacted to 95% Standard Density. Excavated materials shall be removed from the new pavement area as unsatisfactory materials.
- B. Inlets and Junction Boxes
1. Inlets and junction boxes shall be constructed in accordance with the plans and Section 621 of the Standard Specifications.
  2. All inlets and boxes shall have weep holes.
  3. Manhole steps placed to allow reasonable access, maximum 6" vertical spaces.
- C. Underdrain
1. Underdrain pipe shall be constructed in specific locations authorized by the Engineer.
  2. The underdrain pipe shall be constructed in accordance with plan details and Section 606 of the Standard Specifications.
- D. Rip Rap and Filter Cloth
1. Rip rap and filter fabric shall be placed as detailed in the Standard Specifications and as shown on the drawings.
- E. Cleanout and Inspection
1. The entire system shall be cleaned of silt, sediment, debris, and other objectionable matter, and inspected. Pipe shall be cut-off flush with the face of the structure. The pipe and structure shall be grouted as indicated by the drawings. Steps, castings and other incidentals shall be placed as indicated by the drawings.

**END OF SECTION**





December 13, 2024  
CONSTRUCTION DOCUMENTS

Landscape Architecture Sections:

32-1313	Concrete Paving
32-1313.26	Colored Concrete Paving
32-1316	Decorative Concrete Paving
32-1373	Concrete Paving Joint Sealants
32-1400	Unit Paving
32-1540	Crushed Stone Surfacing
32-1726	Tactile Warning Surfacing
32-3116	Welded Wire Fences and Gates
32-3119	Decorative Metal Fences and Gates
32-3119.53	Decorative Metal Security Fences and Gates
32-3223	Segmental Retaining Walls
32-3300	Site Furnishings
32-8400	Planting Irrigation
32-8423	Irrigation Work
32-9000	Planting (Landscape Work)
32-9005	Landscape Maintenance
32-9113	Soil Preparation
32-9120	Bio-retention Soil
32-9200	Turf and Grasses

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 32 13 13 - CONCRETE PAVING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 DESCRIPTION OF WORK**

- A. Extent of portland cement concrete paving is shown on drawings, including exterior walks, paving, entry pads, dumpster pads, and mechanical equipment pads.
  - 1. Stamped, integrally colored concrete exterior walks, with shake-on color hardener/curing compound, only at locations where indicated on the Drawings.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
  - 2. Section 321316 "Decorative Concrete Paving" for stamped concrete other than stamped detectable warnings.
  - 3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
  - 4. Section 321713 "Parking Bumpers."
  - 5. Section 321723 "Pavement Markings."
  - 6. Section 321726 "Tactile Warning Surfacing" for detectable warning pavers.
  - 7. Section 321729 "Manufactured Traffic-Calming Devices."

**1.3 SUBMITTALS**

- A. Product Data: Include manufacturer's complete current product data, material descriptions, chemical composition, physical properties, test data, and mixing and application instructions.
  - 1. Include manufacturer's current color charts for integrally colored concrete.
  - 2. Include manufacturer's current color charts for shake-on color hardeners.
  - 3. Include manufacturer's current selections for any locations indicated to receive concrete pattern stamps.
- B. Samples for Verification: Cured samples of each color and pattern selection, approximately 2-feet x 2-feet in size, for acceptance, and for use in verifying the completed work.
- C. Product Certificates: Signed by manufacturers certifying that products furnished comply with requirements that are recommended by manufacturer for uses indicated.
- D. Qualification Data:
- E. Coordinate "Qualification Data" Paragraph below with qualification requirements in Section 014000 "Quality Requirements" and as may be supplemented in "Quality Assurance" Article.
- F. Qualification Data: For installers and manufacturers, to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other specified information.

1. For products required to be installed by workers approved by product manufacturers, include letters of acceptance by product manufacturers certifying that installers are approved to apply their products.
- G. Material Certificates: For the following, from manufacturer:
1. Cementitious materials.
  2. Steel reinforcement and reinforcement accessories.
  3. Fiber reinforcement.
  4. Admixtures.
  5. Curing compounds.
  6. Applied finish materials.
  7. Bonding agent or epoxy adhesive.
  8. Joint fillers.
  9. Concrete mix designs.
- H. Material Test Reports: For each of the following:
1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- I. Field quality-control reports.

#### **1.4 QUALITY ASSURANCE**

- A. Codes and Standards: Comply with “Alabama Highway Department Standard Specifications for Highway Construction” (ALDOT), latest edition, and local governing regulations if more stringent than herein specified.
- B. Comply with the more stringent requirements of at least the following, either the latest edition or latest adopted edition of the locality, and all revisions and amendments thereto:
1. Uniform Federal Accessibility Standards (UFAS).
  2. Americans With Disabilities Act of 1990 (ADA) “Accessibility Guidelines” (ADA-AG), and all revisions and amendments thereto.
  3. U.S. Architectural & Transportation Barriers Compliance Board’s ADA-ABA “Accessibility Guidelines” (ADA-AG), Published in the Federal Register July 23, 2024, and revisions and amendments thereto.
  4. American National Standards Institute (ANSI), ANSI A 117.1, 2003.
  5. International Building Code, as applicable at the project locale.
- C. Testing: All laboratory and field testing required to ensure compliance with these specifications will be performed by a qualified independent testing laboratory. Refer to Division 1 for additional information and requirements.
- D. Refer to Division 1 Section “Special Procedures” for additional information and minimum experience requirements.

#### **1.5 PRECONSTRUCTION TESTING**

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

#### **1.6 FIELD CONDITIONS**

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
  2. Do not use frozen materials or materials containing ice or snow.
  3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- C. Hot-Weather Concrete Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
  3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Forms:
1. Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.
  2. Use flexible spring steel forms or laminated boards to form radius bends as required.
  3. Coat forms with a non-staining form release agent that will not discolor or deface surface of concrete.
- B. Welded Wire Mesh:
1. Welded plain cold-drawn steel wire fabric, ASTM A 185.
    - a. Size: 6" x 6" W1.4 / W1.4 at sidewalks, pedestrian only traffic areas and mechanical pads, and 6" x 6" W2.9 /W2.9 at vehicular paving areas and dumpster pads, unless heavier mesh is indicated on the Drawings.
  2. Furnish in flat sheets, not rolls, unless otherwise acceptable to Architect, for all concrete paving subject to possibility of bearing the weight of vehicular traffic.
  3. Furnish in rolls for all concrete paving accessible only to pedestrian traffic, unless indicated otherwise on structural drawings.
  4. Locations for Use: All concrete pads and paving, at 1/3 of total depth of concrete from top of slab.
- C. Reinforcing Bars: Deformed steel bars, ASTM A 615, Grade 40 or 60.
- D. Concrete Materials: Comply with requirements of Section 03 3000 - "Cast-in-place Concrete", for concrete mix design, materials, admixtures, bonding materials, and other materials as required.

1. Integrally colored concrete for walks as indicated, or if not indicated, as selected by Architect from manufacturer's standard colors after bidding.
  2. Stamped concrete walk pattern as indicated, or if not indicated, as selected by Architect from manufacturer's standard patterns, after bidding.
- E. Expansion Joint Materials: Comply with requirements of Section 07 9000 - "Joint Protection" for preformed and pourable expansion joint fillers and sealers.
- F. Curing and Sealing Compound: Conform to TT-C-800, with 30% solids content minimum.
- G. Patterned Concrete Stamp Mats: Provide durable semi-rigid polyurethane mats with projecting textured and ridged underside, capable of imprinting texture and joint patterns on plastic concrete, equivalent to standard "random slate", approximately 9" x 9" "slate tile", or equivalent priced patterns, of one of the following:
1. Bomanite Corporation
  2. Increte Systems, Inc
  3. Patterned Concrete Industries, Ltd.
  4. Scofield, L.M. Company
  5. Specialty Concrete Products, Inc.
  6. Symons Corporation
- H. Color Hardener: Equivalent to "Lithochrome Color Hardener", as manufactured by L.M. Scofield Company.
- I. Epoxy Adhesive: Provide best quality two-part product, as indicated in current edition of Alabama State Highway Department's "Standard Specifications for Highways and Bridges."

## 2.2 CONCRETE MIX, DESIGN, AND TESTING

- A. Comply with requirements of Section 03 3000 - "Cast-in-place Concrete", for concrete mix design, sampling and testing, and quality control, and as herein specified.
- B. Design mix to produce normal-weight concrete consisting of portland cement, aggregate, water-reducing or high-range water-reducing admixture (super-plasticizer), air-entraining admixture and water to produce the following properties:
1. Sidewalks, curbs and gutters, entry pads, mechanical equipment pads, and below unit pavers' substrates (crushed limestone unless otherwise indicated) - and subject only to pedestrian traffic:
    - a. Compressive Strength: 3,000 psi, minimum at 28 days.
    - b. Slump Range: 3" to 5".
    - c. Air Content: 5% to 6%.
    - d. Thickness: 4", unless indicated otherwise.
    - e. Compacted Subgrade: 4" porous fill on compacted subgrade (98% S.P.D.).
  2. Paving, pads, and below unit pavers' substrates (crushed limestone unless otherwise indicated) - and subject to vehicular traffic, valley gutters, dumpster pads, and where indicated:
    - a. Compressive Strength: 4,000 psi, minimum at 28 days (minimum 600 psi flexural strength).
    - b. Slump: Less than 4".
    - c. Air Content: As required by referenced standards.
    - d. Thickness: 6", unless greater thickness is indicated on the Drawings.
    - e. Subgrade: Unless otherwise indicated on the Drawings, 6" ALDOT graded aggregate base, over properly prepared and tested subgrade, including in part, in compliance with applicable portions of Section 204-2; Compaction to 98% Standard Proctor Density. Refer to Project Manual Section 02 3000 - "Subsurface Investigation" for additional information and requirements.

3. Colored Concrete: Ready-mix concrete supplier's standard integrally colored concrete mix design, colors as selected by Architect after bidding, and otherwise in compliance with the above requirements for mix design based on location and use of the completed concrete work.

### **PART 3 - EXECUTION**

#### **3.1 SURFACE PREPARATION**

- A. Remove loose material from compacted subbase surface immediately before placing concrete.
- B. Proof-roll prepared subbase surface to check for unstable areas and need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.
- C. Subgrade shall be approved by Architect's representative before paving is begun

#### **3.2 FORM CONSTRUCTION**

- A. Set forms to required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.
- B. Check completed formwork for grade and alignment to following tolerances:
  1. Top of forms not more than 1/8" in 10'.
  2. Vertical face on longitudinal axis, not more than 1/4" in 10'.
- C. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.

#### **3.3 REINFORCEMENT**

- A. Locate, place and support reinforcement as specified in Section 03 3000 - "Cast-in-place Concrete", unless otherwise indicated. Install welded wire fabric in as long lengths as practicable, lapping at least one mesh.

#### **3.4 CONCRETE PLACEMENT**

- A. Comply with requirements of Section 03 3000 - "Cast-in-place Concrete", for mixing and placing concrete, and as herein specified.
- B. Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase, if required, to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- C. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with core to prevent dislocation of reinforcing, dowels, and joint devices.
  1. Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2-hour, place a construction joint.

### 3.5 JOINTS

- A. General: Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated.
- B. Weakened-Plane (Contraction) Joints:
  - 1. Provide weakened-plane (contraction) joints, sectioning concrete into areas as shown on drawings. Construct weakened-plane joints for a depth equal to at least 1/4 concrete thickness, as follows below.
  - 2. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.
  - 3. Sidewalks shall be scored at 5-foot intervals unless otherwise indicated.
- C. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for a period of more than 1/2-hour, except where such placements terminate at expansion joints.
- D. Expansion Joints:
  - 1. Provide expansion joints with premolded joint filler at locations abutting concrete curbs, catch basins, manholes, inlets, structures, walks and other fixed objects, unless otherwise indicated.
  - 2. Extend joint fillers full-width and depth of joint.
  - 3. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together.
  - 4. Expansion joints for sidewalks shall be placed at 30-foot maximum intervals and along all intersections with other walks, steps, curbs, or other vertical surfaces.
- E. Fillers and Sealants: Comply with the requirements of Section 07 9000 - "Joint Protection", for preparation of joints, materials, installation and performance.

### 3.6 CONCRETE FINISHING

- A. After striking-off and consolidating concrete, smooth surface by screeding and floating. Using hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
- B. After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.
- C. Work edges of slabs and formed joints with an edging tool, and round to 1/4" radius, unless otherwise indicated. Eliminate tool marks on concrete surface.
- D. After completion of floating and troweling, when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
  - 1. Light and smooth broom finish, by drawing a fine-hair broom across concrete surface, perpendicular to line of traffic. Repeat operation as required to provide a fine line texture acceptable to Architect.
  - 2. Stamped pattern (if any), only at locations indicated on the Drawings, as indicated, or if not indicated, as selected from manufacturer's standard patterns by the Architect after bidding.
  - 3. Lightly rework slab edges and all joints with 2-inch wide flat edging tool, so as to remove approximately half of the broom finish relief, leaving a light broom finish and a 2-inch wide pattern framing slab panels at all edges and joint locations.
    - a. Provide above 2-inch wide pattern framing slab panels at all edges and joint locations, at all locations of concrete sidewalks, pads and paving, including areas of stamped, unstamped, integrally colored and natural colored concrete, etc.



- E. On inclined slab surfaces, provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic.
- F. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Architect.
  - 1. Provide rubbed finish for exposed edges of concrete work and apply light and smooth broom finish.

### **3.7 PATTERNED AND/OR COLORED CONCRETE**

- A. Provide colored hardener, any stamp patterns, joint patterns, and sealer in compliance with current written instructions and recommendations of the manufacturer of each product or system.
  - 1. Walking surface shall be flat, and flush with adjacent concrete walks and paving.

### **3.8 CURING**

- A. Protect and cure finished concrete paving, complying with applicable requirements of Division 3 Section "Cast-In-Place Concrete". Use curing and sealing compound or approved moist-curing methods.
- B. Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue curing by use of moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until forms are removed. Provide protections as required to prevent damage to exposed concrete surfaces.

### **3.9 REPAIRS AND PROTECTIONS**

- A. Repair or replace broken or defective concrete, as directed by Architect.
- B. Drill test cores where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy resin grout.
- C. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
  - 1. Sweep concrete pavement and wash free of stains, discolorations, dirt and other foreign material just prior to final inspection.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 32 13 16 - DECORATIVE CONCRETE PAVING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Extent of decorative portland cement concrete paving is shown on drawings, including exterior walks and paving areas.
  - 1. Integrally colored concrete exterior walks, with shake-on color hardener/curing compound only at locations where indicated in the Drawings.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
  - 2. Section 321313 "Concrete Paving" for cast-in-place concrete paving with other finishes, curbs and gutters, and stamped detectable warnings.
  - 3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within decorative concrete paving and in joints between decorative concrete paving and other paving or adjacent construction.

**1.3 DEFINITIONS**

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

**1.4 SUBMITTALS**

- A. Product Data: Include manufacturer's complete current product data, material descriptions, chemical composition, physical properties, test data, and mixing and application instructions.
  - 1. Include manufacturer's current color charts for integrally colored concrete.
  - 2. Include manufacturer's current color charts for shake-on color hardeners.
  - 3. Include manufacturer's current selections for any locations indicated to receive concrete pattern stamps.
- B. Samples for Verification: Cured samples of each color and pattern selection, approximately 2-feet x 2-feet in size, for acceptance, and for us in verifying the completed work.
- C. Product Certificates: Signed by manufacturers certifying that products furnished comply with requirements that are recommended by manufacturer for uses indicated.
- D. Qualification Data:
- E. Coordinate "Qualification Data" Paragraph below with qualification requirements in Section 014000 "Quality Requirements" and as may be supplemented in "Quality Assurance" Article.

- F. Qualification Data: For installers and manufacturers, to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other specified information.
  - 1. For products required to be installed by workers approved by product manufacturers, include letters of acceptance by product manufacturers certifying that installers are approved to apply their products.
- G. Material Certificates: For the following, from manufacturer:
  - 1. Cementitious materials.
  - 2. Steel reinforcement and reinforcement accessories.
  - 3. Fiber reinforcement.
  - 4. Admixtures.
  - 5. Curing compounds.
  - 6. Applied finish materials.
  - 7. Bonding agent or epoxy adhesive.
  - 8. Joint fillers.
  - 9. Concrete mix designs.
- H. Material Test Reports: For each of the following:
  - 1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- I. Field quality-control reports.

### **1.5 QUALITY ASSURANCE**

- A. Codes and Standards: Comply with "Alabama Highway Department Standard Specifications for Highway Construction" (ALDOT), latest edition, and local governing regulations if more stringent than herein specified.
- B. Comply with the more stringent requirements of at least the following, either the latest edition or latest adopted edition of the locality, and all revisions and amendments thereto:
  - 1. Uniform Federal Accessibility Standards (UFAS).
  - 2. Americans With Disabilities Act of 1990 (ADA) "Accessibility Guidelines" (ADA-AG), and all revisions and amendments thereto.
  - 3. U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA "Accessibility Guidelines" (ADA-AG), Published in the Federal Register July 23, 2024, and revisions and amendments thereto.
  - 4. American National Standards Institute (ANSI), ANSI A 117.1, 2003.
  - 5. International Building Code, as applicable at the project locale.
- C. Testing: All laboratory and field testing required to ensure compliance with these specifications will be performed by a qualified independent testing laboratory. Refer to Division 1 for additional information and requirements.
- D. Refer to Division 1 Section "Special Procedures" for additional information and minimum experience requirements.

### **1.6 PRECONSTRUCTION TESTING**

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on decorative concrete paving mixtures.

## 1.7 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
  - 1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- C. Hot-Weather Concrete Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:
  - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
  - 3. Fog-spray forms[, **steel reinforcement**,] and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

## PART 2 - PRODUCTS

### 2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with **ACI 301 (ACI 301M)** unless otherwise indicated.

### 2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
  - 1. Use flexible or uniformly curved forms for curves of a radius of **100 feet (30.5 m)** or less. [ **Do not use notched and bent forms.**]
- B. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration indicated. Provide solid backing and form supports to ensure stability of textured form liners.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

### 2.3 STEEL REINFORCEMENT

- A. [<Double click to insert sustainable design text for recycled content of steel products.>](#)
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from as-drawn steel wire into flat sheets.

- C. Reinforcing Bars: ASTM A615/A615M, **Grade 60 (Grade 420)**; deformed.
- D. Steel Bar Mats: ASTM A184/A184M; with ASTM A615/A615M, **Grade 60 (Grade 420)** deformed bars; assembled with clips.
- E. Plain-Steel Wire: ASTM A1064/A1064M, as drawn.
- F. Joint Dowel Bars: ASTM A615/A615M, **Grade 60 (Grade 420)** plain-steel bars. Cut bars true to length with ends square and free of burrs.
- G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
  - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

## 2.4 CONCRETE MATERIALS

- A. [<Double click to insert sustainable design text for regional materials \(concrete\).>](#)
- B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- C. Cementitious Materials:
  - 1. Portland Cement: ASTM C150/C150M, [**gray**] [**white**] portland cement [**Type I**] [**Type II**] [**Type I/II**] [**Type III**] [**Type V**].
  - 2. Fly Ash: ASTM C618, Class C or F.
  - 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
  - 4. Blended Hydraulic Cement: ASTM C595/C595M, [**Type IS, portland blast-furnace slag**] [**Type IP, portland-pozzolan**] [**Type IL, Portland-limestone**] [**Type IT, ternary blended**] cement.
- D. Normal-Weight Aggregates: ASTM C33/C33M, [**Class 4S**] [**Class 4M**] [**Class 1N**] <Insert class>, uniformly graded. Provide aggregates from a single source[ **with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials**].
  - 1. Maximum Coarse-Aggregate Size: [**1-1/2 inches (38 mm)**] [**1 inch (25 mm)**] [**3/4 inch (19 mm)**] <Insert dimension> nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- E. Air-Entraining Admixture: ASTM C260/C260M.
- F. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
  - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A[, **colored**].
  - 2. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D[, **colored**].
  - 3. Water-Reducing and Accelerating Admixture: ASTM C494/C494M, Type E.

- G. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, [ **free of carbon black,**] nonfading, and resistant to lime and other alkalis.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- H. Water: Potable and complying with ASTM C94/C94M.

## 2.5 FIBER REINFORCEMENT

- A. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C1116/C1116M, Type III, [**1/2 to 1-1/2 inches (13 to 38 mm)**] **<Insert dimensions>** long.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C1116/C1116M, Type III, [**1/2 to 1-1/2 inches (13 to 38 mm)**] **<Insert dimensions>** long.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

## 2.6 SURFACE COLORING MATERIALS

- A. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Pigmented Powder Release Agent: Factory-packaged, dry combination of surface-conditioning and dispersing agents interground with color pigments that facilitates release of stamp mats. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Liquid Release Agent: Manufacturer's standard, clear, evaporating formulation that facilitates release of stamp mats and texture rollers.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

## 2.7 CURING AND SEALING MATERIALS

- A. Curing Paper: Nonstaining, waterproof paper, consisting of two layers of kraft paper cemented together and reinforced with fiber, and complying with ASTM C171.
- B. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, nondissipating, non-yellowing, manufactured for use with colored concrete.
1. Curing compound shall be pigmented type matching color of integrally colored concrete and shall be approved by coloring admixture manufacturer.
  2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.
  3. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

- D. High-Solids, Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, 18 to 25 percent solids, nondissipating, non-yellowing, manufactured for use with colored concrete..
1. Curing compound shall be pigmented type matching color of integrally colored concrete and shall be approved by coloring admixture manufacturer.
  2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.
  3. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- E. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A, manufactured for use with colored concrete.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. [<Double click to insert sustainable design text for floor treatment products.>](#)
- F. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A, manufactured for use with colored concrete.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. [<Double click to insert sustainable design text for floor treatment products.>](#)
- G. Clear Acrylic Sealer, Low-to-Medium Gloss: Manufacturer's standard, waterborne, non-yellowing and UV-resistant, membrane-forming, acrylic copolymer emulsion or epoxy-modified acrylic emulsion, manufactured for colored concrete, containing not less than 15 percent solids by volume.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- H. Clear Acrylic Sealer, High Gloss: Manufacturer's standard, waterborne, non-yellowing and UV-resistant, membrane-forming, high-gloss, acrylic copolymer emulsion solution, manufactured for colored concrete, containing not less than 25 percent solids by volume.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- I. Slip-Resistance-Enhancing Additive: Manufacturer's standard finely graded aggregate or polymer additive, designed to be added to clear acrylic sealer to enhance slip resistance of sealed paving surface.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

## 2.8 RELATED MATERIALS

- A. Joint Fillers: **[ASTM D1751, asphalt-saturated cellulosic fiber]** [or] **[ASTM D1752, cork or self-expanding cork]** in preformed strips.
- B. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy-Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
1. **[Types I and II, nonload bearing]** **[Types IV and V, load bearing]**, for bonding hardened or freshly mixed concrete to hardened concrete.
- D. Polyethylene Film: ASTM D4397, **1 mil (0.025 mm)** thick, clear.



## 2.9 CONCRETE MIXTURES

- A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties.
- B. Prepare design mixtures, proportioned according to **ACI 301 (ACI 301M)**, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
- C. Cementitious Materials: **[ Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.][ Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:]**
1. Fly Ash or Pozzolan: 25 percent.
  2. Slag Cement: 50 percent.
  3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- D. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content: **[5-1/2] [4-1/2] [2-1/2]** percent plus or minus 1.5 percent for **1-1/2-inch (38-mm)** nominal maximum aggregate size.
  2. Air Content: **[6] [4-1/2] [3]** percent plus or minus 1.5 percent for **1-inch (25-mm)** nominal maximum aggregate size.
  3. Air Content: **[6] [5] [3-1/2]** percent plus or minus 1.5 percent for **3/4-inch (19-mm)** nominal maximum aggregate size.
- E. Limit water-soluble, chloride-ion content in hardened concrete to **[0.15] [0.30]** percent by weight of cement.
- F. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use **[water-reducing admixture] [water-reducing and retarding admixture] [water-reducing and accelerating admixture]** in concrete as required for placement and workability.
  2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- G. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than **[1.0 lb/cu. yd. (0.60 kg/cu. m)] <Insert requirement>**.
- H. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.
- I. Concrete Mixtures: Normal-weight concrete.
1. Compressive Strength (28 Days): **[4500 psi (31 MPa)] [4000 psi (27.6 MPa)] [3500 psi (24.1 MPa)] [3000 psi (20.7 MPa)] <Insert strength>**.
  2. Maximum W/C Ratio at Point of Placement: **[0.45] [0.50] <Insert ratio>**.
  3. Slump Limit: **[4 inches (100 mm)] [5 inches (125 mm)] <Insert dimension>**, plus or minus **1 inch (25 mm)**.

## 2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M[ **and ASTM C1116/C1116M**]. Furnish batch certificates for each batch discharged and used in the Work.
  - 1. When air temperature is between **85 and 90 deg F (30 and 32 deg C)**, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above **90 deg F (32 deg C)**, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
  - 1. For concrete batches of **1 cu. yd. (0.76 cu. m)** or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
  - 2. For concrete batches larger than **1 cu. yd. (0.76 cu. m)**, increase mixing time by 15 seconds for each additional **1 cu. yd. (0.76 cu. m)**.
  - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below [**decorative concrete paving**] <Insert locations> to identify soft pockets and areas of excess yielding.
  - 1. Completely proof-roll subbase in one direction[ **and repeat in perpendicular direction**]. Limit vehicle speed to **3 mph (5 km/h)**.
  - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than **15 tons (13.6 tonnes)**.
  - 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of [**1/2 inch (13 mm)**] <Insert dimension> according to requirements in Section 312000 "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.
- B. Protect adjacent construction from discoloration and spillage during application of color hardeners, release agents, stains, curing compounds, and sealers.

### 3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

### 3.4 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum **2-inch (50-mm)** overlap to adjacent mats.

### 3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
  - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
  - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
  - 2. Butt Joints: Use **[bonding agent] [epoxy-bonding adhesive]** at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 3. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least **1-1/2 inches (38 mm)** into concrete.
  - 4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
  - 1. Locate expansion joints at intervals of **[50 feet (15.25 m)] <Insert dimension>** unless otherwise indicated.
  - 2. Extend joint fillers full width and depth of joint.
  - 3. Terminate joint filler not less than **1/2 inch (13 mm)** or more than **1 inch (25 mm)** below finished surface if joint sealant is indicated.
  - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
  - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows[, **to match jointing of existing adjacent decorative concrete paving**]:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a [**1/4-inch (6-mm)**] [**3/8-inch (10-mm)**] radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
    - a. Tolerance: Ensure that grooved joints are within [**3 inches (75 mm)**] **<Insert dimension>** either way from centers of dowels.
  2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut **1/8-inch- (3-mm-)** wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
    - a. Tolerance: Ensure that sawed joints are within [**3 inches (75 mm)**] **<Insert dimension>** in both directions from centers of dowels.
  3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a [**1/4-inch (6-mm)**] [**3/8-inch (10-mm)**] radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

### 3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation[, **steel reinforcement**,] and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface[ **and steel reinforcement**] before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with **ACI 301 (ACI 301M)** requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to **ACI 301 (ACI 301M)** by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
  1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies[, **reinforcement**,] or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating [**reinforcement**] [**dowels**] [**and**] joint devices.

- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

### 3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

### 3.8 INTEGRALLY COLORED CONCRETE FINISH

- A. Integrally Colored Concrete Finish: After final floating, apply the following finish:
  - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
  - 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
  - 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface **1/16 to 1/8 inch (1.6 to 3 mm)** deep with a stiff-bristled broom, perpendicular to line of traffic.

### 3.9 STENCILING

- A. Cut stencils to slab width and lay on wet concrete. Overlap "mortar joint" on trailing edge of each section of stencil onto leading "mortar joint" of previous section.
- B. Trim stencils to fit slab and adjacent patterns.
- C. Slightly embed stencil into concrete by rolling with stencil roller.
- D. Apply pigmented mineral dry-shake hardener materials to concrete surfaces according to manufacturer's written instructions.
- E. Stencil Rolling:
  - 1. Apply [**pigmented powder release agent**] [**liquid release agent**] according to manufacturer's written instructions prior to applying texture roller to surface of concrete.
  - 2. Perform rolling operation to produce required texture on concrete surface.
- F. Remove stencils when concrete has sufficiently cured to bear weight. Do not leave stencils in concrete overnight.
- G. Remove debris with mechanical blower prior to application of curing compound. If release agent is applied, delay removal of debris for 24 hours, then flood area with low-pressure water hose, wetting release agent, and follow by cleaning surface with pressure washer.

**3.10 PIGMENTED MINERAL DRY-SHAKE HARDENER APPLICATION**

- A. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to paving surfaces according to manufacturer's written instructions and as follows:
1. Uniformly apply dry-shake hardener at a rate of [100 lb/100 sq. ft. (49 kg/10 sq. m)] <Insert rate of application> unless greater amount is recommended by manufacturer to match paving color required.
  2. Uniformly distribute approximately two-thirds of dry-shake hardener over the concrete surface with mechanical spreader; allow hardener to absorb moisture and embed it by power floating. Follow power floating with a second application of pigmented mineral dry-shake hardener, uniformly distributing remainder of material at right angles to first application to ensure uniform color, and embed hardener by final power floating.
  3. After final power floating, apply the following finish:
    - a. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
    - b. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
    - c. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.
- B. Pigmented Powder Release Agent: Uniformly distribute onto dry-shake-hardened and still-plastic concrete at a rate of 3 to 4 lb/100 sq. ft. (1.5 to 2 kg/10 sq. m).
- C. Liquid Release Agent: Uniformly mist surface of dry-shake-hardened and still-plastic concrete at a rate of 5 gal/1000 sq. ft. (0.2 L/sq. m).

**3.11 STAMPING**

- A. Mat Stamping: After floating and while concrete is plastic, apply mat-stamped finish.
1. Pigmented Powder Release Agent: Uniformly distribute onto concrete at a rate of 3 to 4 lb/100 sq. ft. (1.5 to 2 kg/10 sq. m).
  2. Liquid Release Agent: Apply liquid release agent to the concrete surface and the stamp mat. Uniformly mist surface of concrete at a rate of 5 gal/1000 sq. ft. (0.2 L/sq. m).
  3. After application of release agent, accurately align and place stamp mats in sequence.
  4. Uniformly load mats and press into concrete to produce required imprint pattern and depth of imprint on concrete surface. Gently remove stamp mats. Hand stamp edges and surfaces unable to be imprinted by stamp mats.
  5. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.
- B. Tool Stamping: After floating and while concrete is plastic, apply tool-stamped finish.
1. Cover surface with polyethylene film, stretch taut to remove wrinkles, lap sides and ends 3 inches (75 mm), and secure to edge forms. Lightly broom surface to remove air bubbles.

2. Accurately align and place stamp tools in sequence and tamp into concrete to produce required imprint pattern and depth of imprint on concrete surface. Gently remove stamp tools. Hand stamp edges and surfaces unable to be imprinted by stamp tools.
  3. Carefully remove polyethylene film immediately after tool stamping.
- C. Roller Stamping: After floating and while concrete is plastic, apply roller-stamped finish.
1. Cover surface with polyethylene film, stretch taut to remove wrinkles, lap sides and ends **3 inches (75 mm)**, and secure to edge forms. Lightly broom surface to remove air bubbles.
  2. Accurately align roller and perform rolling operation to produce required imprint pattern and depth of imprint on concrete surface. Hand stamp surfaces inaccessible to roller.
  3. Carefully remove polyethylene film immediately after roller stamping.

### 3.12 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching **0.2 lb/sq. ft. x h (1 kg/sq. m x h)** before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Compound: Apply immediately after final finishing. Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.
1. Cure integrally colored concrete with a **[pigmented]** curing compound.
  2. Cure concrete finished with pigmented mineral dry-shake hardener with a **[pigmented]** curing compound.
- F. Curing and Sealing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating, and repair damage during curing period.
- G. Curing Paper: Cure with unwrinkled curing paper in pieces large enough to cover the entire width and edges of slab. Do not lap sheets. Fold curing paper down over paving edges and secure with continuous banks of earth to prevent displacement or billowing due to wind. Immediately repair holes or tears in paper.

### 3.13 STAINING

- A. Newly placed concrete paving shall be at least **[14] [30] <Insert number>** days old before staining.
- B. Prepare surfaces according to manufacturer's written instructions and as follows:



1. Clean concrete thoroughly by scraping, applying solvents or stripping agents, sweeping and pressure washing, or scrubbing with a rotary floor machine and detergents recommended by stain manufacturer. Rinse until water is clear and allow surface to dry.
    - a. Do not use acidic solutions to clean surfaces.
  2. Test surfaces with droplets of water. If water beads and does not penetrate surface, or penetrates only in some areas, profile surfaces by **[acid etching] [grinding, sanding, or abrasive blasting]**. Retest and continue profiling surface until water droplets immediately darken and uniformly penetrate concrete surfaces.
  3. Apply acidic solution to dampened concrete surfaces, scrubbing with uncolored, acid-resistant nylon-bristle brushes until bubbling stops and concrete surface has texture of 120-grit sandpaper. Do not allow solution to dry on concrete surfaces. Rinse until water is clear. Control, collect, and legally dispose of runoff.
  4. Neutralize concrete surfaces and rinse until water is clear. Test surface for residue with clean white cloth. Test surface according to ASTM F710 to ensure pH is between **[7 and 8]** **<Insert values>**.
- C. Scoring: Score decorative jointing in paving surfaces **1/16 inch (1.6 mm)** deep with diamond blades to match pattern indicated. Rinse until water is clear. Score **[after] [before]** staining.
1. Joint Width: **[3/8 inch (10 mm)]** **<Insert dimension>**.
- D. Allow paving surface to dry before applying stain. Verify readiness of paving to receive stain according to ASTM D4263 by tightly taping **18-by-18-inch (450-by-450-mm), 4-mil- (0.1-mm-)** thick polyethylene sheet to a representative area of paving surface. Apply stain only if no evidence of moisture has accumulated under sheet after 16 hours.
- E. Reactive Stain: Apply reactive stain to paving surfaces according to manufacturer's written instructions and as follows:
1. Apply stain by uncolored bristle brush, roller, or high-volume, low-pressure sprayer and immediately scrub into concrete surface with uncolored, acid-resistant nylon-bristle brushes in continuous, circular motion. Do not spread stain after fizzing stops. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
  2. Remove stain residue after four hours by wet scrubbing with commercial-grade detergent recommended by stain manufacturer. Rinse until water is clear. Control, collect, and legally dispose of runoff.
- F. Penetrating Stain: Apply to paving surfaces according to manufacturer's written instructions and as follows:
1. Apply first coat of stain to dry, clean surfaces by airless sprayer or by high-volume, low-pressure sprayer.
  2. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
  3. Rinse until water is clear. Control, collect, and legally dispose of runoff.

### 3.14 SEALER APPLICATION

- A. Clear Acrylic Sealer: Apply uniformly in two coats in continuous operations according to manufacturer's written instructions. Allow first coat to dry before applying second coat, at 90 degrees to the direction of the first coat, using same application methods and rates.



1. Begin sealing dry surface no sooner than [14] <Insert number> days after concrete placement.
2. Allow stained concrete surfaces to dry before applying sealer.
3. Thoroughly mix slip-resistance-enhancing additive into sealer before applying sealer according to manufacturer's written instructions. Stir sealer occasionally during application to maintain even distribution of additive.

### 3.15 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 (ACI 117M) and as follows:
1. Elevation: 3/4 inch (19 mm).
  2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
  3. Surface: Gap below 10-foot- (3-m-) long, unlevelled straightedge not to exceed 1/2 inch (13 mm).
  4. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
  5. Vertical Alignment of Dowels: 1/4 inch (6 mm).
  6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.
  7. Joint Spacing: 3 inches (75 mm).
  8. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
  9. Joint Width: Plus 1/8 inch (3 mm), no minus.

### 3.16 FIELD QUALITY CONTROL

- A. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each [100 cu. yd. (76 cu. m)] [5000 sq. ft. (465 sq. m)] or fraction thereof of each concrete mixture placed each day.
    - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.
  - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Decorative concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

### 3.17 REPAIR AND PROTECTION

- A. Remove and replace decorative concrete paving that is broken or damaged or does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Detailing: Grind concrete "squeeze" left from tool placement. Color ground areas with slurry of color hardener mixed with water and bonding agent. Remove excess release agent with high-velocity blower.
- C. Protect decorative concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain decorative concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

### 3.18 DECORATIVE CONCRETE PAVING SCHEDULE

- A. Patterned Decorative Concrete Paving <Insert drawing designation>:
  1. Locations: Install at [drives] [parking lots] [walks] [patios] [and] [swimming pool decks] <Insert location>.
  2. Coloring Method: [Integrally colored] [Pigmented mineral dry-shake hardener].

- a. Color: **[As indicated by manufacturer's designation] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>**.
3. Field Patterning Method: **[Stamped] [Stenciled]**.
    - a. Texture and Pattern: **[Keystone installed at 45-degrees diagonal to main lines of building] <Insert requirement>**.
    - b. Pigmented Mineral Dry-Shake Hardener: **<Insert color>**.
    - c. Release Agent: **[Match pigmented mineral dry-shake hardener] <Insert color>**.
  4. Border and Accent Strip Patterning Method: **[Stamped] [Stenciled]**.
    - a. Texture and Pattern: **<Insert requirement>**.
    - b. Pigmented Mineral Dry-Shake Hardener: **<Insert color>**.
    - c. Release Agent: **[Match pigmented mineral dry-shake hardener] <Insert color>**.
- B. Stained Decorative Concrete Paving **<Insert drawing designation>**:
1. Locations: Install at **[drives] [parking lots] [walks] [patios] [and] [swimming pool decks] <Insert location>**.
  2. Staining Method: **[Reactive] [Penetrating] stain**.
  3. Color: **[As indicated by manufacturer's designation] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>**.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 32 13 73 - CONCRETE PAVING JOINT SEALANTS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Cold-applied joint sealants.
  - 2. Hot-applied joint sealants.
  - 3. Cold-applied, fuel-resistant joint sealants.
  - 4. Hot-applied, fuel-resistant joint sealants.
  - 5. Joint-sealant backer materials.
  - 6. Primers.
- B. Related Requirements:
  - 1. Section 079200 "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at **[Project site]** <Insert location>.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in **1/2-inch- (13-mm-)** wide joints formed between two **6-inch- (150-mm-)** long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Paving-Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For **[Installer]** **[testing agency]**.
- B. Product Certificates: For each type of joint sealant and accessory.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

- B. Product Testing: Test joint sealants using a qualified testing agency.

## 1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer[ or are below 40 deg F (5 deg C)].
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

### 2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893/D5893M, Type NS.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D5893/D5893M, Type SL.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use T.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- D. Single Component, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type S, Grade P, Class 25, for Use T.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- E. Multicomponent, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade P, Class 25, for Use T.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

### 2.3 HOT-APPLIED JOINT SEALANTS

- A. Hot-Applied, Single-Component Joint Sealant: ASTM D6690, Type I.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Hot-Applied, Single-Component Joint Sealant: ASTM D6690, Type I or Type II.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

- C. Hot-Applied, Single-Component Joint Sealant: ASTM D6690, Type I, II, or III.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- D. Hot-Applied, Single-Component Joint Sealant: ASTM D6690, Type IV.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

#### 2.4 COLD-APPLIED, FUEL-RESISTANT JOINT SEALANTS

- A. Fuel-Resistant, Single-Component, Pourable, Modified-Urethane, Elastomeric Joint Sealant: ASTM C920, Type S, Grade P, Class 25, for Use T.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Fuel-Resistant, Multicomponent, Pourable, Modified-Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade P, Class 12-1/2 or 25, for Use T.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

#### 2.5 HOT-APPLIED, FUEL-RESISTANT JOINT SEALANTS

- A. Hot-Applied, Fuel-Resistant, Single-Component Joint Sealants: ASTM D7116, Type I or Type II.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Hot-Applied, Fuel-Resistant, Single-Component Joint Sealants: ASTM D7116, Type III.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

#### 2.6 JOINT-SEALANT BACKER MATERIALS

- A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

#### 2.7 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

**3.3 INSTALLATION OF JOINT SEALANTS**

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.
- C. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of joint-sealant backings.
  - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
  - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:
  - 1. Place joint sealants so they fully contact joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
  - 1. Remove excess joint sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.



- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

### 3.4 CLEANING AND PROTECTION

- A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.
- B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

### 3.5 PAVING-JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Joints within concrete paving[ <PJS-#>].
  - 1. Joint Location:
    - a. Expansion and isolation joints in concrete paving.
    - b. Contraction joints in concrete paving.
    - c. Other joints as indicated.
  - 2. Joint Sealant: [Single-component, nonsag, silicone joint sealant] [Single-component, self-leveling, silicone joint sealant] [Multicomponent, nonsag, urethane, elastomeric joint sealant] [Single component, pourable, urethane, elastomeric joint sealant] [Multicomponent, pourable, urethane, elastomeric joint sealant] [Hot-applied, single-component joint sealant] <Insert joint sealant>.
  - 3. Joint-Sealant Color: [Manufacturer's standard] <Insert color>.
- B. Joint-Sealant Application: Joints within concrete paving and between concrete and asphalt paving[ <PJS-#>].
  - 1. Joint Location:
    - a. Joints between concrete and asphalt paving.
    - b. Joints between concrete curbs and asphalt paving.
    - c. Other joints as indicated.
  - 2. Joint Sealant: [Hot-applied, single-component joint sealant] <Insert joint sealant>.
  - 3. Joint-Sealant Color: [Manufacturer's standard] <Insert color>.
- C. Joint-Sealant Application: Fuel-resistant joints within concrete paving[ <PJS-#>].
  - 1. Joint Location:
    - a. Expansion and isolation joints in concrete paving.
    - b. Contraction joints in concrete paving.
    - c. Other joints as indicated.
  - 2. Joint Sealant: [Fuel-resistant, single-component, pourable, modified-urethane, elastomeric joint sealant] [Fuel-resistant, multicomponent, pourable, modified-urethane, elastomeric joint sealant] [Hot-applied, fuel-resistant, single-component joint sealant] <Insert joint sealant>.

3. Joint-Sealant Color: **[Manufacturer's standard]** <Insert color>.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 32 14 00 - UNIT PAVING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS:**

- A. The general provisions of the contract, including General and Supplementary conditions and General Requirements apply to the work of this Section.
- B. Section 31 2000 – Earth Moving.

**1.2 DESCRIPTION:**

- A. Extent of masonry paving is shown on Drawings and includes:

1. Clay Brick Pavers: Pine Hall 2 ¼"x4"x8" English Edge F/R pavers, ASTM C-902 Class SX, Type 1, Application PX and C-67.
  - a. ungrouted on limestone fines over slab.
  - b. grouted header and stretchers in mortar bed over slab.

**1.3 RELATED WORK:**

- A. Provide Work in full accordance with applicable Division 3 and 4 section.

**1.4 QUALITY ASSURANCE:**

- A. Installer: Subcontract masonry paving work to a firm with not less than 5 years of successful experience in the required types of paving.
- B. Do not change source or brands for masonry units, setting materials, or grout during progress of work.
- C. Codes and Standards:
  1. Applicable Section of Alabama Highway department (AHD) Standard Specifications for Highway Construction, Latest Edition.
  2. ASTM C902 - Standard Specification for Pedestrian and Light Traffic Paving Brick.
  3. Brick Institute of America (BIA) applicable standards.
  4. Southern Building Code, applicable section.
- D. Job Mock-up:
  1. Prior to installation of paving, provide sample panel at site of each pattern and material called for as masonry paving, minimum 5' x 5' square, over slab and specified setting bed.
  2. Provide jointing as specified.
  3. Obtain Architect's acceptance of visual qualities of mock-up panels before start of finished paving.
  4. Replace unsatisfactory mock-up work, as directed, until acceptable to Landscape Architect.
  5. Retain sample panels during construction as a standard for judging completed paving work.
  6. Do not alter, move, or destroy mock-up until Work is completed. Unless otherwise directed, accepted mock-up panel may be incorporated into the finished work.

E. Allowable Tolerances:

1. Variation from Plumb: For lines, surfaces and steps, do not exceed 1/8' in 10'.

**1.5 SUBMITTALS:**

- A. Product Data: Submit manufacturer's technical data for each manufactured product, including certification that each product complies with specified requirements.
- B. Samples:
  1. Submit set of samples (minimum 5/set) of each size of each clay brick required.
  2. Include in each set full range of exposed color and texture to be expected in completed Work.
  3. Submit cured samples of each type of grout and mortar, showing range of color.
  4. Submit prior to mock-up panels construction.

**1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:**

- A. Protect paving materials during storage and construction against moisture, soiling, staining and physical damage.
- B. Handle brick and pavers to prevent chipping, breakage, soiling. Do not use pinch or wrecking bars without protecting edges of brick and pavers with wood or other rigid materials. Lift with wide-belt type slings wherever possible; do not use wire rope or ropes containing tar or other substances which might cause staining. If required, use wood rollers and provide cushion at the end of wood slides.
- C. Store brick and pavers on wood skids or pallets, covered with non-staining, waterproof membrane. Place and stack skids and brick or pavers to distribute weight evenly and to prevent breakage or cracking of pavers. Protect stored brick and pavers from weather with waterproof, non-staining, cover or enclosures, but allow air to circulate around stored materials.
- D. Protect mortar materials and accessories from weather, moisture and contamination with earth and other foreign materials.

**1.7 JOB CONDITIONS:**

- A. Installer shall review installation procedure and coordination with other work, with Contractor, and other contractors and subcontractors whose work will be affected.
- B. Cold Weather Protection:
  1. Do not use frozen materials or materials mixed or coated with ice or frost. Do not use salt to thaw ice. Do not lower the freezing point of mortar by use of admixtures or anti-freeze agents, and do not use calcium chloride in mortar or grout.
  2. Do not build on frozen work; remove and replace masonry paving damaged by frost or freezing.
  3. During all seasons, protect partially complete masonry paving against weather when work is not in progress. Cover with strong waterproof, non-staining membrane extending at least 2' beyond edge of paving and anchor securely in place.
  4. Comply with requirements of Brick Institute of America (BIA) Technical Notes, N. 1A "Cold weather Masonry construction - construction and Protection Recommendations."

**1.8 ADDITIONAL WARRANTY**

- A. In addition to one-year material and workmanship guarantee, provide two-year warranty against settlement of all masonry work of this Section:

1. During the period of the warranty, maintain masonry paving even, at correct elevation and flush with adjacent pavement surface.
2. Make repairs within two weeks of notice from Owner or Architect than pavers are 1/8" or more below or above adjacent pavers or surface.
3. Should the Contractor fail to make repairs within two weeks of notice, Owner may undertake repairs at Contractor's expense.

## PART 2 - PRODUCTS

### 2.1 MATERIALS:

- A. Brick Paver (brick headers, stretchers and herringbone pavement):
  1. Meeting the requirements of ASTM C902 for Class SX, Type I brick for all clay brick pavers in pedestrian areas. Clay brick pavers in heavy vehicular traffic load areas shall meet C1272-Heavy Vehicular Traffic. Dimensional tolerances and maximum permissible extent of chippage from edges and corners will meet limits for type PX Application method.
  2. Refer to hardscape drawings for brick type and locations. Submit Brick sample for review by Landscape Architect.
- B. Concrete Paver: Heavyweight, hydraulically pressed concrete units, square edged, factory cast for use as landscape pavers; absorption not greater than 5 percent, ASTM C 140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C 67; and as follows:
  1. Hanover Architectural Products: [www.hanoverproducts.com](http://www.hanoverproducts.com).
    - a. Substitutions: See Section 01 6000-Product Requirements.
  2. Compressive Strength: 8500 PSI
  3. Colors and Textures: 80% Natural and 20% random Limestone Grey. Match roof pavers nearby as specified in section 07 5416.
  4. See hardscape drawings for locations.
- C. Setting Materials:
  1. Mortar Mix: Per ASTM C-270, Type M for below grade and ground contact masonry; use portland cement-lime only.
  2. Limestone Fines: #8910 or #810 Crushed Limestone in accordance with AHD 801.11 (d), compacted for setting and leveling bed.
  3. Crusher Run: 3/4" and smaller well-graded crushed limestone, compacted for setting bed.
  4. Sand: Concrete sand complying with ASTM C33.
  5. Slab, Porous Fill and Compacted Subgrade specified elsewhere.
- D. Edge Restraint: See hardscape drawings for specification.

## PART 3 - EXECUTION

### 3.1 GENERAL:

- A. Coordinate with other work to make provisions for the installation of required adjacent work to avoid cutting and patching.
- B. Execute masonry paving using skilled masons, experienced in laying flat masonry work.
- C. Install no mortared work when ambient temperature is below 35 degrees F., or when there is a danger of freezing before mortar is set. Protect masonry from freezing for 48 hours after being laid.

- D. Lay masonry paving only over well compacted subgrade and slab of acceptable, dimension and elevations. Test compaction and depth before commencing masonry paving.
- E. Only lay masonry units which are clean, and without chips or cracks. Cracked, chipped or broken units will be rejected.
- F. Provide specified job mock-ups. Do not proceed without acceptance of mock-ups for visual quality.

### 3.2 INSTALLATION

- A. A. UngROUTED Mortarless Masonry Paving:
  - 1. Place Crusher Run for compacted base over properly prepared and compacted subgrade. Provide compacted thickness of base indicated to allow for thickness of setting and leveling bed and brick masonry paving units. Compact base to 95% Modified Proctor as determined in accordance with ASTM D 1557.
  - 2. Place Limestone Fines for setting and leveling bed over crusher run (as drawn) and screed loose to a thickness which will compact to thickness drawn, taking care to ensure it remains loose until paving units are set and compacted.
  - 3. Treat leveling base with suitable soil sterilizer to prohibit growth of grass and weeds.
  - 4. Set paving units hand tight in the pattern specified on plan, being careful not to disturb leveling base. Use string lines to keep straight lines. Saw-cut edges when full-size units cannot be used. Select units from at least three (3) pallets or cubes to blend color and texture variations.
  - 5. Vibrate paving units into leveling bed with a plate vibrator or hand tamper. Perform this operation on installed areas of paving at end of each day or before any rain.
  - 6. Fill joints after vibration with sharp sand. Sweep and reapply sand as many times as necessary throughout warranty period to fill and secure joints.
- B. Mortar Applications:
  - 1. Install paving units in setting bed of Type S mortar with full joints.
  - 2. Remove excess mortar promptly as work progresses.
  - 3. Lay paving units in pattern shown with straight, uniform joints.
  - 4. Level surface to the elevation shown.
  - 5. Strike 3/8" joints flush with top surfaces and tool slightly concave.
  - 6. Cure mortar by maintaining in damp condition for 7 days.

### 3.3 ADJUSTING, POINTING AND CLEANING:

- A. When mortar has set and hardened, wet all exposed surfaces and clean with Shur-Clean, or equal, following manufacturer's instructions.
- B. Leave all paver surfaces clean, free of mortar daubs, smears or stains, with tight uniform joints throughout.
- C. Remove and replace masonry units which are broken, chipped, stained, or otherwise damaged. Provide new matching units, install as specified and point-up joints to eliminate evidence of replacement. Repoint defective and unsatisfactory joints as required to provide a neat, uniform appearance. Re-clean where necessary. Eliminate evidence of replacement.
- D. Adjust pavers to flush should settlement occur. Continue adjustment throughout warranty period, immediately upon settlement occurring.
- E. Provide final protection and maintain conditions in a manner acceptable to Installer, which ensures masonry paving being without damage, discolorations, or deterioration during subsequent construction and until time of Substantial Completion.



END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 32 17 26 - TACTILE WARNING SURFACING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Cast-in-place detectable warning tiles.
  - 2. Surface-applied detectable warning tiles.
  - 3. Detectable warning mats.
  - 4. Cast-in-place detectable warning metal tiles.
  - 5. Surface-applied detectable warning metal tiles.
  - 6. Detectable warning unit pavers.
- B. Related Requirements:
  - 1. Section 321313 "Concrete Paving" for concrete walkways serving as substrates for tactile warning surfacing.
  - 2. Section 321400 "Unit Paving" for unit paving installations incorporating detectable warning unit pavers specified in this Section.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
  - 1. [<Double click to insert sustainable design text for recycled content.>](#)
  - 2. [<Double click to insert sustainable design text for regional materials.>](#)
- C. Samples for Initial Selection: For each type of exposed finish requiring color selection.
- D. Samples for Verification: For each type of tactile warning surface, in manufacturer's standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, color, and cross section; with fasteners and anchors.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

**1.5 QUALITY ASSURANCE**

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.6 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at **[Project site]** <Insert location>.

**1.7 PROJECT CONDITIONS**

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Weather Limitations for Adhesive Application:
1. Apply adhesive only when ambient temperature is above **50 deg F (10 deg C)** and when temperature has not been below **35 deg F (2 deg C)** for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.
- C. Weather Limitations for Mortar and Grout:
1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of **100 deg F (38 deg C)** and higher.
    - a. When ambient temperature exceeds **100 deg F (38 deg C)**, or when wind velocity exceeds **8 mph (13 km/h)** and ambient temperature exceeds **90 deg F (32 deg C)**, set unit pavers within 1 minute of spreading setting-bed mortar.

**1.8 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering and wear.
    - b. Separation or delamination of materials and components.
  2. Warranty Period: **[Five]** <Insert number> years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 TACTILE WARNING SURFACING, GENERAL**

- A. Accessibility Requirements: Comply with applicable provisions in **[the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities]** [and] **[ICC A117.1]** for tactile warning surfaces.
1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.
- B. [<Double click to insert sustainable design text for recycled content.>](#)
- C. [<Double click to insert sustainable design text for regional materials.>](#)

- D. Source Limitations: Obtain each type of tactile warning surfacing[, **joint material**] [, **setting material**] [, **anchor**] [, **and**] [**fastener**] from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

## 2.2 DETECTABLE WARNING TILES

- A. Cast-in-Place Detectable Warning Tiles: Accessible truncated-dome detectable warning tiles[ **with replaceable surface**] configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Material: [**Cast-fiber-reinforced polymer concrete tile**] [**Molded glass- and carbon-fiber-reinforced polyester**].
3. Color: [**Safety yellow**] [**Red brick**] [**Black**] [**Gray**] [**As selected by Architect from manufacturer's full line**].
4. Shapes and Sizes:
  - a. Rectangular panel, [**12 by 12 inches (305 by 305 mm)**] [**24 by 24 inches (610 by 610 mm)**] [**24 by 36 inches (610 by 914 mm)**] [**24 by 48 inches (610 by 1219 mm)**] [**24 by 60 inches (610 by 1524 mm)**] [**36 by 48 inches (914 by 1219 mm)**] [**36 by 60 inches (914 by 1524 mm)**] <Insert dimensions>.
  - b. Radius panel, nominal **24 inches (610 mm)** deep by [**6-foot (1829-mm)**] [**8-foot (2438-mm)**] [**10-foot (3048-mm)**] [**12-foot (3658-mm)**] [**15-foot (4572-mm)**] <Insert dimension> outside radius.
5. Dome Spacing and Configuration: [**1.67-inch (42.4-mm) spacing**] [**2.35-inch (59.7-mm) spacing**] [**Manufacturer's standard compliant spacing**] <Insert spacing>, in [**square**] [**diamond**] [**manufacturer's standard**] pattern.
6. Mounting:
  - a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.
  - b. Detectable warning tile set into formed recess in concrete and adhered with [**mortar**] [**adhesive**].
  - c. Replaceable detectable warning tile wet-set into freshly poured concrete and surface-fastened to permanently embedded anchors.

- B. Surface-Applied Detectable Warning Tiles: Accessible truncated-dome detectable warning concrete tiles configured for surface application on existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of tile, and beveled outside edges.

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Material: [**Cast-fiber-reinforced polymer concrete tile**] [**Molded glass- and carbon-fiber-reinforced polyester**].
3. Color: [**Safety yellow**] [**Red brick**] [**Black**] [**Gray**] [**As selected by Architect from manufacturer's full line**].
4. Shapes and Sizes:
  - a. Rectangular panel, [**12 by 12 inches (305 by 305 mm)**] [**24 by 24 inches (610 by 610 mm)**] [**24 by 36 inches (610 by 914 mm)**] [**24 by 48 inches (610 by 1219 mm)**] [**24 by 60 inches (610 by 1524 mm)**] [**36 by 48 inches (914 by 1219 mm)**] [**36 by 60 inches (914 by 1524 mm)**] <Insert dimensions>.
  - b. Radius panel, nominal **24 inches (610 mm)** deep by [**6-foot (1829-mm)**] [**8-foot (2438-mm)**] [**10-foot (3048-mm)**] [**12-foot (3658-mm)**] [**15-foot (4572-mm)**] <Insert dimension> outside radius.

5. Dome Spacing and Configuration: [1.67-inch (42.4-mm) spacing] [2.35-inch (59.7-mm) spacing] [Manufacturer's standard compliant spacing] <Insert spacing>, in [square] [diamond] [manufacturer's standard] pattern.
  6. Mounting: Adhered[ and fastened] to existing concrete walkway.
- C. Cast-in-Place Detectable Warning Metal Tiles: Accessible truncated-dome detectable warning metal tiles[ with replaceable surface] configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Material:
    - a. Stainless-Steel Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, [Type 304] [Type 316L].
      - 1) Finish and Color:
        - a) Manufacturer's standard powder coat, [safety yellow] [red brick] [black] [gray] [color as selected by Architect from manufacturer's full line].
        - b) Mill finish.
    - b. Cast Iron: Gray iron, ASTM A 48/A 48M, CL 35.
  3. Shapes and Sizes:
    - a. Rectangular panel, [12 by 12 inches (305 by 305 mm)] [18 by 24 inches (457 by 610 mm)] [24 by 24 inches (610 by 610 mm)] [24 by 36 inches (610 by 914 mm)] [24 by 48 inches (610 by 1219 mm)] [24 by 60 inches (610 by 1524 mm)] [36 by 48 inches (914 by 1219 mm)] [36 by 60 inches (914 by 1524 mm)] <Insert dimensions>.
    - b. Radius panel, nominal 24 inches (610 mm) deep by [6-foot (1829-mm)outside radius] [8-foot (2438-mm)outside radius] [10-foot (3048-mm)outside radius] [12-foot (3658-mm)outside radius] [15-foot (4572-mm) outside radius] [17.5-foot (5334-mm)outside radius] [outside radius indicated on Drawings] <Insert dimension>.
  4. Dome Spacing and Configuration: [1.67-inch (42.4-mm) spacing] [2.35-inch (59.7-mm) spacing] [Manufacturer's standard compliant spacing] <Insert spacing>, in [square] [diamond] [manufacturer's standard] pattern.
  5. Mounting:
    - a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.
    - b. Permanently embedded detectable warning tile set into formed recess in concrete and adhered with [mortar] [adhesive].
    - c. Replaceable embedded detectable warning tile fastened to permanently installed anchors.
- D. Surface-Applied Detectable Warning Metal Tiles: Accessible truncated-dome detectable warning metal tiles or plates configured for fastening to surface of existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of tile, and beveled outside edges.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

2. Material: Stainless-Steel Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, [Type 304] [Type 316L].
3. Finish and Color:
  - a. Manufacturer's standard powder coat, [safety yellow] [red brick] [black] [gray] [color as selected by Architect from manufacturer's full line].
  - b. Mill finish.
4. Shapes and Sizes:
  - a. Rectangular panel, [24 by 24 inches (610 by 610 mm)] [24 by 36 inches (610 by 914 mm)] [24 by 48 inches (610 by 1219 mm)] [24 by 60 inches (610 by 1524 mm)] <Insert dimensions>.
5. Dome Spacing and Configuration: [1.67-inch (42.4-mm) spacing] [2.35-inch (59.7-mm) spacing] [Manufacturer's standard compliant spacing] <Insert spacing>, in [square] [diamond] [manufacturer's standard] pattern.
6. Mounting:
  - a. Replaceable surface-applied detectable warning tile fastened with permanently installed anchors to existing concrete walkway.
  - b. Permanently fixed detectable warning tile adhered[ and fastened] to existing concrete walkway.

### 2.3 DETECTABLE WARNING MATS

- A. Surface-Applied Detectable Warning Mats: Accessible truncated-dome detectable warning resilient mats, UV resistant, manufactured for adhering to existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of mat, and beveled outside edges.
  1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
  2. Material: Modified rubber compound, UV resistant.
  3. Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.
  4. Shapes and Sizes:
    - a. Rectangular panel, [24 by 36 inches (610 by 914 mm)] [24 by 48 inches (610 by 1219 mm)] [24 by 60 inches (610 by 1524 mm)] <Insert dimensions>.
  5. Dome Spacing and Configuration: [1.67-inch (42.4-mm) spacing] [2.35-inch (59.7-mm) spacing] [Manufacturer's standard compliant spacing] <Insert spacing>, in [square] [diamond] [manufacturer's standard] pattern.
  6. Mounting: Adhered to pavement surface with adhesive[ and fastened with fasteners].

### 2.4 DETECTABLE WARNING UNIT PAVERS

- A. Detectable Warning Concrete Unit Pavers: Solid paving units, made from normal-weight concrete with a compressive strength of not less than 5000 psi (34 MPa) <Insert value>, water absorption of not more than 5 percent according to ASTM C 140, and no breakage and not more than 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67, with accessible detectable warning truncated domes on exposed surface of units.
  1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
  2. Shapes and Sizes:

- a. Thickness: **[2 inches (51 mm)] [2-1/2 inches (63 mm)]** <Insert dimension> at field of tile.
  - b. Face Size: Nominal **[12 by 12 inches (305 by 305 mm)] [24 by 24 inches (610 by 610 mm)]** <Insert dimensions>.
- 3. Dome Spacing and Configuration: **[1.67-inch (42.4-mm) spacing] [2.35-inch (59.7-mm) spacing]** **[Manufacturer's standard compliant spacing]** <Insert spacing>, in **[square]** **[diamond]** **[manufacturer's standard]** pattern.
  - 4. Color: **[As indicated by manufacturer's designations]** **[Match Architect's sample]** **[As selected by Architect from manufacturer's full range]** <Insert color>.
- B. Setting Bed: Comply with requirements in Section 321400 "Unit Paving."
  - C. Aggregate Setting Bed:
    - 1. Graded Aggregate for Base: Sound, crushed stone or gravel complying with ASTM D 448 for Size No. 8.
    - 2. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33/C 33M for fine aggregate.
    - 3. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing **No. 16 (1.18-mm)** sieve and no more than 10 percent passing **No. 200 (0.075-mm)** sieve.
  - D. Mortar Setting Bed:
    - 1. Portland Cement: ASTM C 150/C 150M, Type I or Type II.
    - 2. Sand: ASTM C 33/C 33M.
    - 3. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.
    - 4. Thinset Mortar: Latex-modified portland cement mortar complying with ANSI A118.4.
    - 5. Water: Potable.

## 2.5 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:
  - 1. Furnish **[Type 304]** **[Type 316]** stainless-steel fasteners for exterior use.
  - 2. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.
- B. Adhesive: As recommended by manufacturer for adhering tactile warning surfacing unit to pavement.
- C. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.



**3.2 INSTALLATION OF TACTILE WARNING SURFACING**

- A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.
- B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

**3.3 INSTALLATION OF DETECTABLE WARNING TILES**

- A. Cast-in-Place Detectable Warning Tiles:
  - 1. Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of tile.
  - 2. Set each detectable warning tile accurately and firmly in place and completely seat tile back and embedments in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
  - 3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus **1/8 inch (3 mm)** from flush.
  - 4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
  - 5. Clean tiles using methods recommended in writing by manufacturer.
- B. Removable Cast-in-Place Detectable Warning Tiles:
  - 1. Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of removable tile.
  - 2. Set each detectable warning tile accurately and firmly in place with embedding anchors and fasteners attached, and firmly seat tile back in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
  - 3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus **1/8 inch (3 mm)** from flush.
  - 4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
  - 5. Clean tiles using methods recommended in writing by manufacturer.
- C. Surface-Applied Detectable Warning Tiles:
  - 1. Lay out detectable warning tiles as indicated and mark concrete pavement.
  - 2. Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.
    - a. Cut perimeter kerf in existing concrete pavement to receive metal tile flange.
  - 3. Apply adhesive to back of tiles in amounts and pattern recommended by manufacturer, and set tiles in place. Firmly seat tiles in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
  - 4. Install anchor devices through face of tiles and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with top surface of mat.
  - 5. Mask perimeter of tiles and adjacent concrete, and apply sealant in continuous bead around perimeter of tile installation.

6. Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning tiles and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.
7. Protect installed tiles from traffic until adhesive has set.

### 3.4 INSTALLATION OF DETECTABLE WARNING MATS

- A. Lay out detectable warning mats as indicated and mark concrete pavement at edges of mats.
- B. Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.
- C. Apply adhesive to back of mat in amounts and pattern recommended by manufacturer, and set mat in place. Firmly seat mat in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to mat to ensure full contact with adhesive.
- D. Install anchor devices through face of mat and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with mat surface.
- E. Mask mat perimeter and adjacent concrete, and apply sealant in continuous bead around perimeter of mat.
- F. Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning mat and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.
- G. Protect installed mat from traffic until adhesive has set.

### 3.5 INSTALLATION OF DETECTABLE WARNING UNIT PAVERS

- A. Unit Paver Installation, General:
  1. Setting-Bed and Unit Paver Installation: Comply with installation requirements in Section 321400 "Unit Paving."
  2. Mix unit pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
  3. Cut unit pavers with motor-driven masonry saw equipment to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible.
  4. Tolerances: Do not exceed **1/4 inch in 10 feet (6 mm in 3 m)** from level, or indicated slope, for finished surface of paving.
- B. Aggregate Setting-Bed Applications:
  1. Place aggregate base, compact by tamping with plate vibrator, and screed to depth indicated.
  2. Place leveling course and screed to a thickness of **1 to 1-1/2 inches (25 to 38 mm)**, taking care that moisture content remains constant and density is loose and uniform until unit pavers are set and compacted.
  3. Treat leveling course with herbicide to inhibit growth of grass and weeds.
  4. Set unit pavers with a minimum joint width of **1/16 inch (1.5 mm)** and a maximum of **1/8 inch (3 mm)**, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines.
  5. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a **3500- to 5000-lbf (16- to 22-kN)** compaction force at 80 to 90 Hz.
  6. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.
- C. Mortar Setting-Bed Applications:
  1. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

2. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing mortar bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed **1/16-inch (1.6-mm)** thickness for bond coat.
3. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
4. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.
5. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform **1/16-inch- (1.5-mm-)** thick bond coat to mortar bed or to back of each paver with a flat trowel.
6. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.
7. Spaced Joint Widths: Provide [**3/8-inch (10-mm)**] [**1/2-inch (13-mm)**] nominal joint width with variations not exceeding plus or minus [**1/16 inch (1.5 mm)**] [**1/8 inch (3 mm)**].
8. Grouted Joints: Grout paver joints complying with ANSI A108.10. Grout joints as soon as possible after initial set of setting bed.
  - a. Force grout into joints, taking care not to smear grout on adjoining surfaces.
  - b. Tool exposed joints slightly concave when thumbprint hard.
  - c. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.
9. Remove excess grout from exposed paver surfaces; wash and scrub clean.
10. Protect installation from traffic until grout has set.

### **3.6 CLEANING AND PROTECTION**

- A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.
- B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 32 31 16 - WELDED WIRE FENCES AND GATES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
1. Metallic-coated-steel, welded-wire fences.
  2. Swing gates.
  3. Horizontal-slide gates.
  4. Gate operators, including controls.
- B. Related Requirements:
1. Section 033053 "Miscellaneous Cast-in-Place Concrete" for concrete [**bases for gate operators, drives, and controls**] [**and**] [**post concrete fill**].
  2. Section 281500 "Access Control Hardware Devices" for access control devices installed at gates and provided as part of a security system.
  3. Section 312000 "Earth Moving" for site excavation, fill, and backfill where welded-wire fences and gates are located.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at [**Project site**] <Insert location>.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For fencing and gates.
1. Include plans, elevations, sections, gate locations, post spacing, [**and**] [**mounting**] [**attachment**] details[, **and grounding details**].
  2. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
  3. Wiring Diagrams: Include diagrams for power, signal, and control wiring.
- C. Samples: For each fence material and for each color specified.
1. Provide Samples [**12 inches (300 mm)**] <Insert dimension> in length for linear materials.
  2. Provide Samples [**12 inches (300 mm)**] <Insert dimension> square for wire mesh.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

**1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For gate operators to include in maintenance manuals.

**1.7 QUALITY ASSURANCE**

- A. Installer Qualifications: Fabricator of products.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
1. Include **[10-foot (3-m)]** <Insert dimension> length of fence complying with requirements.
  2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Wind Loading:
1. Fence Height: **[0 to 15 feet (0 to 4.57 m)]** **[15 to 20 feet (4.57 to 6.10 m)]**.
  2. Wind Exposure Category: **[B]** **[C]** **[D]**.
  3. Design Wind Speed: **[105 mph (169 kph)]** **[110 mph (177 kph)]** **[120 mph (193 kph)]** **[130 mph (209 kph)]** **[140 mph (225 kph)]** **[150 mph (241 kph)]** **[160 mph (257 kph)]** **[170 mph (274 kph)]** <Insert wind speed>.
  4. Design Wind Pressure: <Insert wind pressure>.
- B. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

**2.2 METALLIC-COATED-STEEL, WELDED-WIRE FENCES**

- A. Metallic-Coated-Steel, Welded-Wire Fences:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Fence Fabric: Metallic-coated-steel wire.
1. Spacing of Vertical Wires: **[1-3/4 inches (44 mm)]** **[2 inches (51 mm)]** **[3-1/2 inches (89 mm)]** **[4 inches (102 mm)]** **[As indicated]** <Insert spacing>.
  2. Vertical Wire Size: **[0.187 inch (4.76 mm)]** **[0.192 inch (4.88 mm)]** **[0.225 inch (5.72 mm)]** **[0.25 inch (6.35 mm)]** **[0.262 inch (6.67 mm)]** <Insert size>.
  3. Spacing of Horizontal Wires: **[1-3/4 inches (44 mm)]** **[2 inches (51 mm)]** **[4 inches (102 mm)]** **[8 inches (203 mm)]** **[As indicated]** <Insert spacing>.
  4. Horizontal Wire Size: **[0.187 inch (4.76 mm)]** **[0.192 inch (4.88 mm)]** **[0.225 inch (5.72 mm)]** **[0.25 inch (6.35 mm)]** **[0.312 inch (7.94 mm)]** <Insert size>.
- C. Posts:
1. Line Posts: Square tubes **[2 by 2 inches (50 by 50 mm)]** **[2-1/2 by 2-1/2 inches (64 by 64 mm)]** **[3 by 3 inches (76 by 76 mm)]** formed from **[0.064-inch (1.63-mm)]** **[0.079-inch (2.01-mm)]** **[0.108-inch (2.74-mm)]** nominal-thickness, metallic-coated steel sheet or formed from **[0.060-inch (1.52-mm)]** **[0.075-inch (1.90-mm)]** **[0.105-inch (2.66-mm)]** nominal-thickness steel sheet and hot-dip galvanized after fabrication.

2. End and Corner Posts: Square tubes [2-1/2 by 2-1/2 inches (64 by 64 mm)] [3 by 3 inches (76 by 76 mm)] formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication.
  3. Posts at Swing Gate Openings: Square tubes 3 by 3 inches (76 by 76 mm) formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication.
  4. Posts at Swing Gate Openings: Square steel tubing [3 by 3 inches (76 by 76 mm)] [4 by 4 inches (102 by 102 mm)] <Insert dimensions> with [3/16-inch (4.76-mm)] <Insert dimension> wall thickness, hot-dip galvanized.
  5. Posts at Horizontal-Slide Gate Openings up to 12 Feet (3.7 m): Square steel tubing [3 by 3 inches (76 by 76 mm)] [4 by 4 inches (102 by 102 mm)] <Insert dimensions> with [3/16-inch (4.76-mm)] <Insert dimension> wall thickness, hot-dip galvanized.
  6. Posts at Horizontal-Slide Gate Openings Wider Than 12 Feet (3.7 m): Square steel tubing 4 by 4 inches (102 by 102 mm) with [3/16-inch (4.76-mm)] <Insert dimension> wall thickness, hot-dip galvanized.
  7. Guide Posts for Class 1 Horizontal-Slide Gates: Square tubes 3 by 3 inches (76 by 76 mm) formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication; installed adjacent to gate post to permit gate to slide in space between.
  8. Guide Posts for Class 1 Horizontal-Slide Gates: Square steel tubing [3 by 3 inches (76 by 76 mm)] [4 by 4 inches (102 by 102 mm)] <Insert dimensions> with [3/16-inch (4.76-mm)] <Insert dimension> wall thickness, hot-dip galvanized; installed adjacent to gate post to permit gate to slide in space between.
- D. Post Caps: [Formed from steel sheet and hot-dip galvanized after forming] [UV-resistant plastic] [Aluminum castings] [Aluminum castings with round ball finials].
- E. Rails: Rectangular tubes.
1. Size: [1-3/16 by 1-1/2 inches (30 by 38 mm)] [1-3/8 by 1-1/2 inches (35 by 38 mm)] or 1-1/2 by 1-1/2 inches (38 by 38 mm)].
  2. Metal and Thickness: [0.064-inch (1.63-mm)] [0.079-inch (2.01-mm)] nominal-thickness, metallic-coated steel sheet or [0.060-inch (1.52-mm)] [0.075-inch (1.90-mm)] nominal-thickness, uncoated steel sheet, hot-dip galvanized after fabrication.
- F. Fasteners: Manufacturer's standard [tamperproof, ]corrosion-resistant, color-coated fasteners matching fence components[ with resilient polymer washers or clips].
- G. Finish: [Organic coating complying with requirements in ASTM F2408] [Powder coating].

### 2.3 SWING GATES

- A. Gate Configuration: [Single leaf] [Double leaf] [As indicated].
- B. Gate Frame Height: [72 inches (1830 mm)] [As indicated] <Insert height>.
- C. Gate Opening Width: [36 inches (914 mm)] [As indicated] <Insert width>.
- D. Automated vehicular gates shall comply with ASTM F2200, [Class I] [Class II] [Class III] [Class IV].
- E. Galvanized-Steel Frames and Bracing: Fabricate members from square tubes [1-1/2 by 1-1/2 inches (38 by 38 mm)] [1-3/4 by 1-3/4 inches (45 by 45 mm)] [2 by 2 inches (50 by 50 mm)] [2-1/2 by 2-1/2 inches (64 by 64 mm)] formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication.
- F. Frame Corner Construction: [Welded] [or] [assembled with corner fittings] [and 5/16-inch-(7.9-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider].



- G. Additional Rails: Provide as indicated, complying with requirements for fence rails.
- H. Infill: Welded-wire fence fabric matching adjacent fence.
- I. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than **5 feet (1.52 m)** wide. Provide **[center gate stops] [and] [cane bolts]** for pairs of gates. **[Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.]**
1. **<Insert requirements for padlocks and chains if not Owner furnished>.**
- J. Spring Hinges: BHMA A156.17, Grade 1, suitable for exterior use.
1. Function: **[320 - Gate spring pivot hinge. Adjustable tension] [321 - Gate spring pivot hinge. Fixed tension].**
  2. Material: Malleable iron; galvanized.
- K. Hinges: BHMA A156.1, Grade 1, suitable for exterior use.
1. Function: 39 - Full surface, triple weight, antifriction bearing.
  2. Material: Wrought steel, forged steel, cast steel, or malleable iron; galvanized.
- L. Rim Locks: BHMA A156.5, Grade 1, suitable for exterior use.
1. Function: **[621 - Latchbolt by key from outside and by turn from inside. Latchbolt is held retracted by device from inside] [622 - Deadbolt by key from outside and by turn from inside] [626 - Interlocking deadbolt operated by key from either side] [627 - Interlocking deadbolt operated by key from outside and by turn from inside] [629 - Deadlocking latchbolt by key from outside and by turn from inside] <Insert function>.**
  2. Material: Cast, forged, or extruded brass or bronze.
  3. Mounting Plate: Configuration necessary for mounting locks. Fabricate from **1/8-inch- (3.2-mm-)** thick, steel plate; hot-dip galvanize after fabrication.
- M. Mortise Locks: BHMA A156.13, Grade 1, suitable for exterior use.
1. Function: **[F06 - Holdback lock] [F07 - Storeroom or closet lock] [F09 - Apartment, exit, or public toilet lock] [F16 - Double-cylinder deadlock] [F17 - Deadlock] <Insert function>.**
  2. Material: Brass or bronze.
  3. Levers: Cast, forged, or extruded brass or bronze.
  4. Mounting Box: Configuration necessary to enclose locks. Fabricate from **1/8-inch- (3.2-mm-)** thick, steel plate; hot-dip galvanize after fabrication.
- N. Electric Strikes: BHMA A156.31, Grade 1, of configuration required for use with lock specified, fail**[-safe] [-secure]**, and suitable for exterior use.
1. Mounting Plate: Configuration necessary for mounting electric strikes. Fabricate from **1/8-inch- (3.2-mm-)** thick, steel plate; hot-dip galvanize after fabrication.
  2. Mounting: Mortise into post.
- O. Exit Hardware: BHMA A156.3, Grade 1, Type 1 (rim exit device), with push pad actuating bar, suitable for exterior use.
1. Function: **[01 - Exit only, no trim or blank escutcheon] [04 - Entrance by trim when latch bolt is released by key or set in a retracted position by key] [08 - Entrance by lever. Key locks or unlocks lever] [09 - Entrance by lever only when released by key. Key removable only when locked] <Insert function>.**
  2. Mounting Channel: Bent-plate channel formed from **1/8-inch- (3.2-mm-)** thick, steel plate; hot-dip galvanized after fabrication. Channel spans gate frame. Exit device is mounted on



channel web, recessed between flanges, with flanges extending **1/8 inch (3.2 mm)** beyond push pad surface.

- P. Cane Bolts: Provide for inactive leaf of pairs of gates. Fabricated from [**1/2-inch- (12.7-mm-)**] [**3/4-inch- (19-mm-)**] diameter, round steel bars, hot-dip galvanized after fabrication. Finish to match gates. Provide galvanized-steel pipe strikes to receive cane bolts in [**closed position**] [**both open and closed positions**].
- Q. Finish exposed welds to comply with NOMMA Guideline 1, [**Finish #2 - completely sanded joint, some undercutting and pinholes okay**] [**Finish #3 - partially dressed weld with splatter removed**] [**Finish #4 - good-quality, uniform undressed weld with minimal splatter**].
- R. Metallic-Coated-Steel Finish: [**High-performance coating**] [**Galvanized finish**].

## 2.4 HORIZONTAL-SLIDE GATES

- A. Gate Configuration: [**Single leaf**] [**Double leaf**] [**As indicated**].
  - 1. Type: Overhead slide.
  - 2. Type: Cantilever slide, with [**external**] [**internal**] roller assemblies.
- B. Gate Frame Height: [**72 inches (1830 mm)**] [**As indicated**] <Insert height>.
- C. Gate Opening Width: [**36 inches (914 mm)**] [**As indicated**] <Insert width>.
- D. Automated vehicular gates shall comply with ASTM F2200, [**Class I**] [**Class II**] [**Class III**] [**Class IV**].
- E. Galvanized-Steel Frames and Bracing: Fabricate members from square tubing.
  - 1. Frame Members: Square tubes [**1-1/2 by 1-1/2 inches (38 by 38 mm)**] [**1-3/4 by 1-3/4 inches (45 by 45 mm)**] [**2 by 2 inches (50 by 50 mm)**] [**2-1/2 by 2-1/2 inches (64 by 64 mm)**] formed from **0.108-inch (2.74-mm)** nominal-thickness, metallic-coated steel sheet or formed from **0.105-inch (2.66-mm)** nominal-thickness steel sheet and hot-dip galvanized after fabrication.
  - 2. Bracing Members: Square tubes [**1-1/2 by 1-1/2 inches (38 by 38 mm)**] [**1-3/4 by 1-3/4 inches (45 by 45 mm)**] [**2 by 2 inches (50 by 50 mm)**] [**2-1/2 by 2-1/2 inches (64 by 64 mm)**] formed from **0.108-inch (2.74-mm)** nominal-thickness, metallic-coated steel sheet or formed from **0.105-inch (2.66-mm)** nominal-thickness steel sheet and hot-dip galvanized after fabrication.
- F. Frame Corner Construction:
  - 1. Welded frame [**with panels assembled with bolted or riveted corner fittings**] [**and 5/16-inch- (7.9-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider**].
  - 2. Overhead Slide Gates: Welded or assembled with corner fittings[ **including 5/16-inch- (7.9-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider**].
- G. Additional Rails: Provide as indicated, complying with requirements for fence rails.
- H. Infill: Comply with requirements for adjacent fence.
- I. Overhead Track Assembly: Manufacturer's standard track, with overhead framing supports, bracing, and accessories, engineered to support size, weight, width, operation, and design of gate and roller assemblies.
- J. Hardware: Latches permitting operation from both sides of gate, [**locking devices**] [**hangers**] [**roller assemblies**] <Insert hardware items and accessories> and stops fabricated from [**galvanized steel**] [**galvanized malleable iron**] [**mill-finished, Grade 319 aluminum-alloy casting with stainless-steel fasteners**]. [**Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.**]

1. <Insert requirements for padlocks and chains if not Owner furnished>.
- K. Finish exposed welds to comply with NOMMA Guideline 1, [Finish #2 - completely sanded joint, some undercutting and pinholes okay] [Finish #3 - partially dressed weld with splatter removed] [Finish #4 - good-quality, uniform undressed weld with minimal splatter].
- L. Metallic-Coated-Steel Finish: [High-performance coating] [Galvanized finish].

## 2.5 GATE OPERATORS

- A. Gate Operators:
  1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- B. Provide factory-assembled automatic operating system designed for gate size, type, weight, and operation frequency. Provide operation control system with characteristics suitable for Project conditions, with remote-control stations, safety devices, and weatherproof enclosures; coordinate electrical requirements with building electrical system.
  1. Provide operator designed so motor may be removed without disturbing limit-switch adjustment and without affecting auxiliary emergency operator.
  2. Provide operator with UL [approval][approved components].
  3. Provide electronic components with built-in troubleshooting diagnostic feature.
  4. Provide unit designed and wired for both right-hand/left-hand opening, permitting universal installation.
- C. Comply with NFPA 70.
- D. UL Standard: Manufacturer and label gate operators to comply with UL 325.
- E. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators on gates that must provide emergency access.
- F. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1 and the following:
  1. Voltage: [12-V dc] [24-V dc] [120 V] [208-220 V] [NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected] <Insert voltage>.
  2. Horsepower: Not less than [1/4] [1/3] [1/2] [3/4] <Insert value>.
  3. Enclosure: [Open dripproof] [Totally enclosed] [Manufacturer's standard].
  4. Duty: Continuous duty at ambient temperature of 105 deg F (40 deg C) and at altitude of 3300 feet (1005 m) above sea level.
  5. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
  6. Phase: [One] [Polyphase].
- G. Gate Operators: [Gate] [Concrete base] [Post] [In-ground] mounted and as follows:
  1. Hydraulic [Swing] [Slide] Gate Operators:
    - a. Duty: [Light] [Medium] [Heavy] duty, [residential] [commercial/industrial].
    - b. Gate Speed: Minimum [45 feet (13.7 m)] [60 feet (18.2 m)] per minute.
    - c. Maximum Gate Weight: [800 lb (363 kg)] <Insert value>.
    - d. Frequency of Use: [10 cycles per hour] [25 cycles per hour] [Continuous duty].
    - e. Operating Type: Wheel-and-rail drive[ with manual release].
    - f. Hydraulic Fluid: Of viscosity required for gate operation at ambient temperature range for Project.
    - g. Locking: Hydraulic in both directions.

- h. Heater: Manufacturer's standard track and roller heater with thermostatic control.
2. Mechanical **[Swing]** **[Slide]** Gate Operators:
- a. Duty: **[Light]** **[Medium]** **[Heavy]** duty, **[residential]** **[commercial/industrial]**.
  - b. Gate Speed: Minimum **[45 feet (13.7 m) per minute]** **[60 feet (18.2 m) per minute]** **[variable speed]** **<Insert speed>**.
  - c. Maximum Gate Weight: **[600 lb (272 kg)]** **[800 lb (363 kg)]** **[3000 lb (1360 kg)]** **<Insert value>**.
  - d. Frequency of Use: **[10 cycles per hour]** **[25 cycles per hour]** **[60 cycles per hour]** **[Continuous duty]**.
  - e. Operating Type: **[Crank arm]** **[Wheel-and-rail drive]** **[Roller chain]**, **with manual release**.
  - f. Drive Type: Enclosed worm gear **and chain-and-sprocket** reducers, roller-chain drive.
  - g. Drive Type: V-belt and **[worm gear]** **[chain-and-sprocket]** reducers, roller-chain drive.
  - h. **<Insert feature>**.
- H. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with **[NEMA ICS 6, Type 1]** **[NEMA ICS 6, Type 4]** **<Insert type of enclosure>** enclosure for **[surface]** **[recessed or flush]** **[concrete base]** **[pedestal]** **<Insert mounting>** mounting, and with space for additional optional equipment. Provide the following remote-control device(s):
1. Control Station: Keyed, **[two]** **[three]**-position switch with open **[, stop,]** and close function; located remotely from gate. Provide two keys per station.
  2. Control Station: Momentary-contact, **[single]** **[three]**-button-operated with open **[, stop,]** and close function; located remotely from gate. **[Key switch to lock out open and close buttons.]**
  3. Card Reader: Functions only when authorized card is presented. Programmable, **[multiple]** **[single]**-code system **[, permitting four different access periods]**; **face-lighted unit fully visible at night**.
    - a. Reader Type: **[Touch plate]** **[Swipe]** **[Insertion]** **[Proximity]**.
    - b. Features: **[Timed antipassback]** **[Limited-time usage]** **[Capable of monitoring and auditing gate activity]**.
  4. Digital Keypad Entry Unit: **[Programmable, ]**multiple-code capability of not less than **[five]** **[500]** **[2500]** **<Insert number>** possible individual codes, consisting of **[1- to 7]** **[4]** **[5]**-digit codes **[, and permitting four different access periods]**.
    - a. Features: **[Timed antipassback]** **[Limited-time usage]** **[Capable of monitoring and auditing gate activity]**.
    - b. Face-lighted unit with **[metal-keyed]** **[keyless-membrane]** keypad fully visible at night.
  5. Radio Control: Digital system consisting of code-compatible universal receiver for each gate, located where indicated, with remote antenna with coaxial cable and mounting brackets designed to operate gates. Provide **[one]** **[two]** **<Insert number>** programmable transmitter(s) with multiple-code capability permitting validating or voiding of not less than **[1000]** **[10,000]** **<Insert number>** codes per channel configured for the following functions:
    - a. Transmitters: **[Single]** **[Three]**-button operated, with open **[and close ]**function.

- b. Channel Settings: **[Two] [Three] [Four] <Insert number>** independent channel settings controlling separate receivers for operating more than one gate from each transmitter.
- 6. Telephone Entry System: Hands-free, voice-communication system for connection to building telephone system with digital-entry code activation of gate operator[ **and auxiliary keypad entry**].
  - a. Residential System: Designed to be wired to same line with telephone.
  - b. Multiunit System: Designed to be wired to a dedicated telephone line, with capacity to access **[20] [100] <Insert number>** telephones[, **and with electronic directory**].
- I. Vehicle Loop Detector: System includes automatic closing timer with adjustable time delay[, **timer cutoff switch,**] and loop detector designed to **[open and close gate] [hold gate open until traffic clears] [reverse gate] <Insert functions>**. System includes electronic detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. System includes number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement, as recommended in writing by detection system manufacturer for function indicated, at location indicated on Drawings.
- J. Vehicle Presence Detector: System includes automatic closing timer with adjustable time delay[, **timer cutoff switch,**] and presence detector designed to **[open and close gate] [hold gate open until traffic clears] [reverse gate] <Insert functions>**. System includes **[retroreflective] [emitter/receiver]** detector with adjustable detection zone pattern and sensitivity, designed to detect the presence or transit of a vehicle in gate pathway when infrared beam in zone pattern is interrupted, and to emit a signal activating the gate operator.
- K. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:
  - 1. Action: Reverse gate in both opening and closing cycles, and hold until clear of obstruction.
  - 2. Action: Stop gate in opening cycle and reverse gate in closing cycle, and hold until clear of obstruction.
  - 3. Internal Sensor: Built-in torque or current monitor senses gate is obstructed.
  - 4. Sensor Edge: Contact-pressure-sensitive safety edge, profile, and sensitivity designed for type of gate and component indicated, in locations as follows. Connect to control circuit using **[take-up cable reel] [self-coiling cable] [gate edge transmitter and operator receiver system]**.
    - a. Along entire gate leaf leading edge.
    - b. Along entire gate leaf trailing edge.
    - c. Across entire gate leaf bottom edge.
    - d. Consider retaining first subparagraph below for slide gates; revise for sensor edge at pinch point post of swing gates.
    - e. Along entire length of gate posts.
    - f. Retain first subparagraph below for Type II Cantilever Slide, Class 1 gates.
    - g. Along entire length of gate guide posts.
    - h. Where indicated on Drawings.
    - i. **<Insert extent and location>**.
- 5. Photoelectric/Infrared Sensor System: Designed to detect an obstruction in gate's path when infrared beam in the zone pattern is interrupted.

- L. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully retracted and fully extended positions.
- M. Emergency Release Mechanism: Quick-disconnect release of operator drive system of the following type, permitting manual operation if operator fails. Design system so control-circuit power is disconnected during manual operation.
  - 1. Type: [**Integral fail-safe release, allowing gate to be pushed open without mechanical devices, keys, cranks, or special knowledge**] [**Mechanical device, key, or crank-activated release**].
- N. Operating Features:
  - 1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features[ **with capability for monitoring and auditing gate activity**]. Provide unit that is isolated from voltage spikes and surges.
  - 2. System Integration: With controlling circuit board capable of accepting any type of input from external devices.
  - 3. Master/Slave Capability: Control stations designed and wired for gate pair operation.
  - 4. Automatic Closing Timer: With adjustable time delay before closing[ **and timer cutoff switch**].
  - 5. Open Override Circuit: Designed to override closing commands.
  - 6. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions.
  - 7. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded.
  - 8. Clock Timer: [**24-hour**] [**Seven-day**] <Insert time> programmable for regular events.
- O. Accessories:
  - 1. Warning Module: [**Audio**] [**Visual**], [**constant**] [**strobe**]-light alarm sounding three to five seconds in advance of gate operation and continuing until gate stops moving; compliant with the United States Access Board's ADA-ABA Accessibility Guidelines.
  - 2. Battery Backup System: Battery-powered drive and access-control system, independent of primary drive system.
    - a. Fail-Safe: Gate opens and remains open until power is restored.
    - b. Fail-Secure: Gate cycles on battery power, then fail-safe when battery is discharged.
  - 3. External electric-powered [**solenoid**] [**magnetic**] lock with delay timer allowing time for lock to release before gate operates.
  - 4. [**Fire**] [**Postal**] box.
  - 5. Fire [**strobe**] [**siren**] sensor.
  - 6. Intercom System: <Insert requirements>.
  - 7. Instructional, Safety, and Warning Labels and Signs: [**According to UL 325**] [**Manufacturer's standard for components and features specified**] [**As indicated on Drawings**] <Insert requirements>.
  - 8. Equipment Bases/Pads: Precast concrete, [**depth not less than 12 inches (300 mm)**] <Insert depth>, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.

## 2.6 FENCE AND GATE MATERIALS

- A. Metallic-Coated-Steel Wire: Welded-wire fence fabric, hot-dip galvanized after fabrication. Weight of zinc coating shall be not less than **1.0 oz./sq. ft. (305 g/sq. m)**.

- B. Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Tubing: ASTM A500/A500M, cold-formed steel tubing.
- D. Uncoated Steel Sheet: [**Hot-rolled steel sheet, ASTM A1011/A1011M, Structural Steel, Grade 45 (Grade 310)**] [or] [**cold-rolled steel sheet, ASTM A1008/A1008M, Structural Steel, Grade 50 (Grade 340)**].
  - 1. Interior surface of tubes formed from uncoated steel sheet shall be [**hot-dip zinc coated same as exterior**] [or] [**coated with zinc-rich thermosetting coating to comply with ASTM F2408**].
- E. Metallic-Coated Steel Sheet: Galvanized-steel sheet or aluminum-zinc, alloy-coated steel sheet.
- F. Galvanized-Steel Sheet: ASTM A653/A653M, structural quality, **Grade 50 (Grade 340)**, with [**G90 (Z275)**] [**G60 (Z180)**] coating.
- G. Aluminum-Zinc, Alloy-Coated Steel Sheet: ASTM A792/A792M, structural quality, **Grade 50 (Grade 340)**, with **AZ60 (AZM180)** coating.
- H. Iron Castings: Either gray or malleable iron unless otherwise indicated.
  - 1. Gray Iron: ASTM A48/A48M, Class 30.
  - 2. Malleable Iron: ASTM A47/A47M.
- I. Aluminum Castings: ASTM B26/B26M, Alloy A356.0-T6.
- J. Galvanizing: For components indicated to be galvanized and for which galvanized coating is unspecified, hot-dip galvanize to comply with ASTM A123/A123M. For hardware items, hot-dip galvanize to comply with ASTM A153/A153M.

## 2.7 COATING MATERIALS

- A. Epoxy Primer for Galvanized Steel: Epoxy primer recommended in writing by topcoat manufacturer.
  - 1. Products: Subject to compliance with requirements, [**provide the following**] [**provide one of the following**] [**available products that may be incorporated into the Work include, but are not limited to, the following**]:
    - a. **<Insert manufacturer's name; product name or designation>**.
- B. Polyurethane Intermediate Coat and Topcoat: Complying with MPI #72 and compatible with undercoat.
  - 1. Products: Subject to compliance with requirements, [**provide the following**] [**provide one of the following**] [**available products that may be incorporated into the Work include, but are not limited to, the following**]:
    - a. **<Insert manufacturer's name; product name or designation>**.

## 2.8 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
  - 1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for strength and compatibility in fabricated items.
- B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of **3000 psi (20 MPa)**, **3-inch (75-mm)** slump, and **1-inch (25-mm)** maximum aggregate size[ **or dry**,

**packaged, normal-weight concrete mix complying with ASTM C387/C387M mixed with potable water according to manufacturer's written instructions].**

- C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M and specifically recommended by manufacturer for exterior applications.

## 2.9 GROUNDING MATERIALS

- A. Comply with requirements of Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Grounding Conductors: Size as indicated on Drawings. Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
1. Material above Finished Grade: **[Copper] [Aluminum]**.
  2. Material on or below Finished Grade: Copper.
  3. Bonding Jumpers: Braided copper tape, **1-5/8 inch (41 mm)** wide and **1/16 inch (1.6 mm)** thick, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- C. Grounding Connectors and Grounding Rods: Comply with UL 467.
1. Connectors for Below-Grade Use: Exothermic-welded type.
  2. Grounding Rods: Copper-clad steel.
    - a. Size: **5/8 by 96 inches (16 by 2440 mm)**.

## 2.10 METALLIC-COATED-STEEL FINISHES

- A. Galvanized Finish: Clean welds, mechanical connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.
- B. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a **[zinc-phosphate]** conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A780/A780M.
- C. Powder Coating: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat finish consisting of **[zinc-rich]** epoxy prime coat and TGIC polyester topcoat to a minimum dry film thickness of **2 mils (0.05 mm)**. Comply with coating manufacturer's written instructions to achieve a minimum total dry film thickness of **4 mils (0.10 mm)**.
1. Color and Gloss: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>**.
  2. Comply with surface finish testing requirements in ASTM F2408 **[except change corrosion-resistance requirement to 3000 hours without failure]**.
- D. High-Performance Coating: Apply epoxy primer, polyurethane intermediate coat, and polyurethane topcoat to prepared surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
1. Match approved Samples for color, texture, and coverage. Remove and refinish, or recoat work that does not comply with specified requirements.



### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of **500 feet (152.5 m)** or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
  1. Construction layout and field engineering are specified in Section 017300 "Execution."

#### 3.3 FENCE INSTALLATION

- A. Install fences according to manufacturer's written instructions.
- B. Install fences by setting posts as indicated and fastening **[rails] [and] [infill panels]** to posts. **[Peen threads of bolts after assembly to prevent removal.]**
- C. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than **24 inches (600 mm)** plus **3 inches (75 mm)** for each **foot (300 mm)** or fraction of a **foot (300 mm)** that fence height exceeds **4 feet (1.2 m)**.
- D. Post Setting: Set posts **[in concrete] [with mechanical anchors] [by mechanically driving into soil]** at indicated spacing into firm, undisturbed soil.
  1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
  2. Concrete Fill: Place concrete around **[posts] [and] [sleeves]** and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
    - a. Exposed Concrete: Extend **2 inches (50 mm)** above grade. Finish and slope top surface to drain water away from post.
    - b. Concealed Concrete: Top **[2 inches (50 mm)] <Insert dimension>** below grade **[as indicated on Drawings]** to allow covering with surface material. Slope top surface of concrete to drain water away from post.
  3. Posts Set in Concrete: Extend post to within **6 inches (150 mm)** of specified excavation depth, but not closer than **3 inches (75 mm)** to bottom of concrete.
  4. Posts Set into Concrete in Sleeves: Use galvanized-steel pipe sleeves with inside diameter at least **3/4 inch (20 mm)** larger than outside diagonal dimension of post, preset and anchored into concrete for installing posts.
    - a. Extend posts at least **5 inches (125 mm)** into sleeve.
    - b. After posts have been inserted in sleeves, fill annular space between post and sleeve with nonshrink grout, mixed and placed to comply with grout manufacturer's written instructions; shape and smooth to shed water. Finish and slope top surface of grout to drain water away from post.



5. Posts Set into Voids in Concrete: Form or core drill holes not less than **3/4 inch (20 mm)** larger than outside diagonal dimension of post.
  - a. Extend posts at least **5 inches (125 mm)** into concrete.
  - b. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink grout, mixed and placed to comply with grout manufacturer's written instructions. Finish and slope top surface of grout to drain water away from post.
6. Mechanically Driven Posts: Drive into soil to depth of [**30 inches (762 mm)**] [**36 inches (914 mm)**] <Insert dimension>. Protect post top to prevent distortion.
7. Space posts uniformly at [**6 feet (1.83 m)**] [**8 feet (2.44 m)**] <Insert dimension> o.c.

### 3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

### 3.5 GATE OPERATOR INSTALLATION

- A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.
- B. Excavation for [**Support Posts**] [**Pedestals**] [**Concrete Bases**]: Hand-excavate holes for bases in firm, undisturbed soil to dimensions and depths and at locations as required by gate operator component manufacturer's written instructions and as indicated.
- C. Concrete Bases: Cast-in-place or precast concrete, [**depth not less than 12 inches (300 mm)**] <Insert depth>, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.
- D. Vehicle Loop Detector System: [**Cut grooves in pavement and**] bury and seal wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.
- E. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

### 3.6 GROUNDING AND BONDING

- A. Comply with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fence Grounding: Install at maximum intervals of [**1500 feet (450 m)**] <Insert a lesser distance if grounding resistance is high> except as follows:
  1. Fences within **100 Feet (30 m)** of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of [**750 feet (225 m)**] <Insert a lesser distance if grounding resistance is high>.
    - a. Gates and Other Fence Openings: Ground fence on each side of opening.
      - 1) Bond metal gates to gate posts.
      - 2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least **18 inches (460 mm)** below finished grade.
- C. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of **150 feet (45 m)** on each side of crossing.

- D. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.
- E. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is **6 inches (150 mm)** below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- F. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- G. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- H. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
  - 1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
  - 2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
  - 3. Report: Prepare test reports of grounding resistance at each test location, certified by a testing agency. Include observations of weather and other phenomena that may affect test results.

### 3.8 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Automatic Gate Operators: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices, **[alarms,]** and limit switches.
  - 1. Hydraulic Operators: Purge operating system, adjust pressure and fluid levels, and check for leaks.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls[, **alarms,**] and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Lubricate hardware[, **gate operators,**] and other moving parts.

### 3.9 DEMONSTRATION

- A. **[Engage a factory-authorized service representative to train]** [Train] Owner's personnel to adjust, operate, and maintain gates.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK.**

**SECTION 32 31 19 - DECORATIVE METAL FENCES AND GATES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
1. Decorative metallic-coated-steel tubular picket fences.
  2. Decorative steel fences.
  3. Decorative aluminum fences.
  4. Swing gates.
  5. Horizontal-slide gates.
  6. Gate operators, including controls.
- B. Related Requirements:
1. Section 033053 "Miscellaneous Cast-in-Place Concrete" for concrete **[bases for gate operators, drives, and controls] [and] [post concrete fill]**.
  2. Section 281500 "Access Control Hardware Devices" for access control devices installed at gates and provided as part of a security system.
  3. Division 26 Sections for electrical service and connections for system disconnect switches and powered devices including, but not limited to, motor operators, controls, and limit switches.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at **[Project site] <Insert location>**.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For fencing and gates.
1. Include plans, elevations, sections, gate locations, post spacing, **[and] [mounting] [attachment] details[, and grounding details]**.
  2. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
  3. Wiring Diagrams: Include diagrams for power, signal, and control wiring.
- C. Samples: For each fence material and for each color specified.

1. Provide Samples [**12 inches (300 mm)**] <Insert dimension> in length for linear materials.
2. Provide Samples [**12 inches (300 mm)**] <Insert dimension> square for [**bar grating**] [**and**] [**sheet or plate materials**].

### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Product Test Reports: For decorative metallic-coated-steel tubular picket fences, including finish, indicating compliance with referenced standard[ **and other specified requirements**].

### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For gate operators to include in maintenance manuals.

### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  1. Include [**10-foot (3-m)**] <Insert dimension> length of fence complying with requirements.
  2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Wind Loading:
  1. Fence Height: [**0 to 15 feet (0 to 4.57 m)**] [**15 to 20 feet (4.57 to 6.10 m)**].
  2. Wind Exposure Category: [**B**] [**C**] [**D**].
  3. Design Wind Speed: [**105 mph (169 kph)**] [**110 (mph (177 kph))**] [**120 mph (193 kph)**] [**130 mph (209 kph)**] [**140 mph (225 kph)**] [**150 mph (241 kph)**] [**160 mph (257 kph)**] [**170 mph (274 kph)**] <Insert wind speed>.
  4. Design Wind Pressure: <Insert wind pressure>.
- B. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

### 2.2 DECORATIVE METALLIC-COATED-STEEL TUBULAR PICKET FENCES

- A. Decorative Metallic-Coated-Steel Tubular Picket Fences: Comply with ASTM F2408 for [**residential**] [**light-industrial (commercial)**] [**industrial**] application (class) unless otherwise indicated.
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

## B. Posts:

1. End and Corner Posts: Square tubes [2-1/2 by 2-1/2 inches (64 by 64 mm)] [3 by 3 inches (76 by 76 mm)] formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication.
2. Posts at Swing Gate Openings: Square tubes 3 by 3 inches (76 by 76 mm) formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication.
3. Posts at Swing Gate Openings: Square steel tubing [3 by 3 inches (76 by 76 mm)] [4 by 4 inches (102 by 102 mm)] <Insert dimensions> with [3/16-inch (4.76-mm)] <Insert dimension> wall thickness, hot-dip galvanized.
4. Posts at Horizontal-Slide Gate Openings up to 12 Feet (3.7 m): Square steel tubing [3 by 3 inches (76 by 76 mm)] [4 by 4 inches (102 by 102 mm)] <Insert dimensions> with [3/16-inch (4.76-mm)] <Insert dimension> wall thickness, hot-dip galvanized.
5. Posts at Horizontal-Slide Gate Openings Wider Than 12 Feet (3.7 m): Square steel tubing 4 by 4 inches (102 by 102 mm) with [3/16-inch (4.76-mm)] <Insert dimension> wall thickness, hot-dip galvanized.
6. Guide Posts for Class 1 Horizontal-Slide Gates: Square tubes 3 by 3 inches (76 by 76 mm) formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication; installed adjacent to gate post to permit gate to slide in space between.
7. Guide Posts for Class 1 Horizontal-Slide Gates: Square steel tubing [3 by 3 inches (76 by 76 mm)] [4 by 4 inches (102 by 102 mm)] <Insert dimensions> with [3/16-inch (4.76-mm)] <Insert dimension> wall thickness, hot-dip galvanized; installed adjacent to gate post to permit gate to slide in space between.

C. Post Caps: [Formed from steel sheet and hot-dip galvanized after forming] [UV-resistant plastic] [Aluminum castings] [Aluminum castings with round ball finials].

D. Rails: [Square tubes] [Double-wall channels].

1. Size: [1-1/2 by 1-1/2 inches (38 by 38 mm)] [1-3/4 by 1-3/4 inches (45 by 45 mm)].
2. Metal and Thickness: 0.079-inch (2.01-mm) nominal-thickness, metallic-coated steel sheet or 0.075-inch (1.90-mm) nominal-thickness, uncoated steel sheet, hot-dip galvanized after fabrication.

E. Pickets: Square tubes.

1. [Terminate tops of pickets at top rail for flush top appearance] [Extend pickets beyond top rail as indicated and terminate with UV-resistant plastic caps] [Extend pickets beyond top rail as indicated and terminate with galvanized-steel caps] [Extend pickets beyond top rail as indicated and press flat and trim to produce spear point shape].
2. Picket Spacing: [6 inches (152.4 mm)] [4 inches (101.6 mm)] [1-3/4 inches (44 mm)] <Insert dimension> clear, maximum.

F. Fasteners: Manufacturer's standard concealed fastening system.

G. Fasteners: Manufacturer's standard [tamperproof,] corrosion-resistant, color-coated fasteners matching fence components [with resilient polymer washers].

- H. Metallic-Coated Steel Sheet: Galvanized-steel sheet or aluminum-zinc, alloy-coated steel sheet.
- I. Interior surface of tubes formed from uncoated steel sheet shall be **[hot-dip zinc coated same as exterior]** **[or]** **[coated with zinc-rich thermosetting coating to comply with ASTM F2408]**.
- J. Galvanizing: For components indicated to be galvanized and for which galvanized coating is not specified in ASTM F2408, hot-dip galvanize to comply with ASTM A123/A123M. For hardware items, hot-dip galvanize to comply with ASTM A153/A153M.
- K. Finish: **[Organic coating complying with requirements in ASTM F2408]** **[Powder coating]**.

### 2.3 DECORATIVE STEEL FENCES

- A. Decorative Steel Fences: Fences made from steel tubing **[bars]** and shapes **[, hot-dip galvanized]**.
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Posts: Square steel tubing.
  1. Line Posts: **[2 by 2 inches (51 by 51 mm)]** **[2-1/2 by 2-1/2 inches (64 by 64 mm)]** **[3 by 3 inches (76 by 76 mm)]** **<Insert dimensions>** with **[1/8-inch (3.2-mm)]** **[3/16-inch (4.76-mm)]** **<Insert dimension>** wall thickness.
  2. End and Corner Posts: **[2-1/2 by 2-1/2 inches (64 by 64 mm)]** **[3 by 3 inches (76 by 76 mm)]** **[4 by 4 inches (102 by 102 mm)]** **<Insert dimensions>** with **[1/8-inch (3.2-mm)]** **[3/16-inch (4.76-mm)]** **<Insert dimension>** wall thickness.
  3. Swing Gate Posts: **[3 by 3 inches (76 by 76 mm)]** **[4 by 4 inches (102 by 102 mm)]** **<Insert dimensions>** with **[3/16-inch (4.76-mm)]** **<Insert dimension>** wall thickness.
  4. Horizontal-Slide Gate Post, Openings up to **12 Feet (3.7 m)**: **[3 by 3 inches (76 by 76 mm)]** **[4 by 4 inches (102 by 102 mm)]** **<Insert dimensions>** with **[3/16-inch (4.76-mm)]** **<Insert dimension>** wall thickness.
  5. Horizontal-Slide Gate Post, Openings Wider Than **12 Feet (3.7 m)**: **4 by 4 inches (102 by 102 mm)** with **[3/16-inch (4.76-mm)]** **<Insert dimension>** wall thickness.
  6. Guide Posts for Class 1 Horizontal-Slide Gates: **[3 by 3 inches (76 by 76 mm)]** **[4 by 4 inches (102 by 102 mm)]** **<Insert dimensions>** with **[3/16-inch (4.76-mm)]** **<Insert dimension>** wall thickness; installed adjacent to gate post to permit gate to slide in space between.
- C. Post Caps: **[Formed from steel sheet]** **[Formed from steel sheet and hot-dip galvanized after forming]** **[Aluminum castings]** **[Aluminum castings with round ball finials]**.
- D. Rails:
  1. Steel Tube Rails: Square steel tubing **[2 by 2 inches (51 by 51 mm)]** **[2-1/2 by 2-1/2 inches (64 by 64 mm)]** **<Insert dimensions>** with **[1/8-inch (3.2-mm)]** **<Insert dimension>** wall thickness.
  2. Steel Channel Rails: Steel channels **[2 by 1 inch (51 by 25 mm)]** **[1-1/2 by 3/4 inch (38 by 19 mm)]** **[1-1/2 by 1/2 inch (38 by 13 mm)]** **<Insert dimensions>**.
- E. Pickets: **[1/2-inch- (13-mm-) square steel bars]** **[3/4-inch- (19-mm-) square steel bars]** **[Decorative steel bars of pattern and size indicated]** **[5/8 inch (16 mm) square by 0.065-inch (1.65-mm) steel tubes]** **[5/8 inch (16 mm) square by 0.083-inch (2.11-mm) steel tubes]** **[3/4 inch (19 mm) square by 0.065-inch (1.65-mm) steel tubes]** **[3/4 inch (19 mm) square by**



**0.083-inch (2.11-mm) steel tubes] [1 inch (25 mm) square by 0.065-inch (1.65-mm) steel tubes] [1 inch (25 mm) square by 0.083-inch (2.11-mm) steel tubes].**

1. [Terminate tops of pickets at top rail for flush top appearance] [Extend pickets beyond top rail as indicated and mill ends to pyramid-shaped points] [Extend pickets beyond top rail as indicated and press flat and trim to produce spear point shape] [Extend pickets beyond top rail as indicated and cap with metal spear point finial] [Extend pickets beyond top rail as indicated and cap with metal tripoint finial].
  2. Picket Spacing: **[6 inches (152.4 mm)] [4 inches (101.6 mm)] [1-3/4 inches (44 mm)]** <Insert dimension> clear, maximum.
  3. Treillage: Provide iron castings of pattern indicated between each pair of pickets.
- F. Infill: Forge-welded-steel bar grating.
1. Perimeter Bars: Steel flat bars **[1 by 1/8 inch (25 by 3.2 mm)]** <Insert dimensions>.
  2. Vertical Main Bars: Steel flat bars **[1 by 1/8 inch (25 by 3.2 mm)] [1-3/16 by 5/32 inch (30 by 4 mm)]** <Insert dimensions>.
  3. Vertical Main Bar Spacing: **[1-21/32 inches (42 mm)] [1-7/8 inches (48 mm)] [2-7/16 inches (62 mm)]** <Insert dimension> o.c.
  4. Horizontal Cross Rods: **[3/16-inch- (4.8-mm-)] [1/4-inch- (6.4-mm-)]** diameter, steel rods.
  5. Horizontal Cross Rod Spacing: **[1-3/4 inches (45 mm)] [2-19/32 inches (66 mm)] [5-3/16 inches (132 mm)]** <Insert dimension> o.c.
- G. Infill: Custom design as indicated on Drawings.
1. Bars: **[1/2-inch- (12.7-mm-) square steel bars] [3/4-inch- (19-mm-) square steel bars] [1/2-inch- (12.7-mm-) diameter, round steel bars] [3/4-inch- (19-mm-) diameter, round steel bars] [1-by-1/8-inch (25-by-3.2-mm) steel flat bars] [1-by-1/4-inch (25-by-6.4-mm) steel flat bars] [1-by-1/2-inch (25-by-12.7-mm) steel flat bars]** [unless otherwise indicated].
  2. Square Tubes: Square steel tubing **[2 by 2 inches (51 by 51 mm)] [2-1/2 by 2-1/2 inches (64 by 64 mm)]** <Insert dimensions> with **[1/8-inch (3.2-mm)]** <Insert dimension> wall thickness[ **unless otherwise indicated**].
  3. Round Tubes: **[1-inch- (25-mm-)] [1-1/2-inch- (38-mm-)] [2-inch- (51-mm-)] [2-1/2-inch- (64-mm-)]** <Insert dimension> diameter, round steel tubing with **[1/8-inch (3.2-mm)]** <Insert dimension> wall thickness[ **unless otherwise indicated**].
  4. Steel Plate: **[1/8 inch (3.2 mm)] [3/16 inch (4.8 mm)] [1/4 inch (6.4 mm)]** thick[ **unless otherwise indicated**].
  5. Perforated Metal Sheet: Uncoated steel sheet, perforated as indicated, **[0.060-inch (1.52-mm)] [0.075-inch (1.90-mm)] [0.105-inch (2.66-mm)]** <Insert dimension> nominal thickness.
- H. Fasteners: Stainless-steel carriage bolts and **[tamperproof]** nuts.
- I. Fabrication: Assemble fences into sections by welding pickets to rails.
1. Fabricate sections with clips welded to rails for field fastening to posts.
  2. Drill posts and clips for fasteners before finishing to maximum extent possible.
- J. Fabrication: Fabricate bar grating infill into sections of size indicated.
1. Fabricate rails with clips welded to rails for field fastening to posts.

2. Drill posts[, **clips**,] and bar grating for fasteners before finishing to maximum extent possible.
- K. Finish exposed welds to comply with NOMMA Guideline 1, [**Finish #2 - completely sanded joint, some undercutting and pinholes okay**] [**Finish #3 - partially dressed weld with splatter removed**] [**Finish #4 - good-quality, uniform undressed weld with minimal splatter**].
- L. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A123/A123M. For hardware items, hot-dip galvanize to comply with ASTM A153/A153M.
  1. Hot-dip galvanize posts[ **and rails**].
  2. Hot-dip galvanize rail and picket assemblies after fabrication.
  3. Hot-dip galvanize bar grating infill after fabrication.
  4. Hot-dip galvanize custom-design rail and infill assemblies after fabrication.
- M. Finish for Bar Grating Infill: Powder coating.
- N. Finish for Steel Items[ **Other Than Bar Grating Infill**]: [**Primed**] [**Shop painted**] [**High-performance coating**].
- O. Finish for Metallic-Coated-Steel Items[ **Other Than Bar Grating Infill**]: [**High-performance coating**] [**Galvanized finish**].

## 2.4 DECORATIVE ALUMINUM FENCES

- A. Decorative Aluminum Fences: Fences made from aluminum extrusions.
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Posts: Square extruded tubes.
  1. Line Posts: [**2 by 2 inches (51 by 51 mm)**] [**2-1/2 by 2-1/2 inches (64 by 64 mm)**] [**3 by 3 inches (76 by 76 mm)**] <Insert dimensions> with [**0.062-inch (1.57-mm)**] [**0.080-inch (2.03-mm)**] [**0.093-inch (2.36-mm)**] [**0.100-inch (2.54-mm)**] [**0.125-inch (3.18-mm)**] <Insert dimension> wall thickness.
  2. End and Corner Posts: [**2 by 2 inches (51 by 51 mm)**] [**2-1/2 by 2-1/2 inches (64 by 64 mm)**] [**3 by 3 inches (76 by 76 mm)**] <Insert dimensions> with [**0.062-inch (1.57-mm)**] [**0.080-inch (2.03-mm)**] [**0.093-inch (2.36-mm)**] [**0.100-inch (2.54-mm)**] [**0.125-inch (3.18-mm)**] <Insert dimension> wall thickness.
  3. Swing Gate Posts: [**2-1/2 by 2-1/2 inches (64 by 64 mm)**] [**3 by 3 inches (76 by 76 mm)**] [**4 by 4 inches (102 by 102 mm)**] <Insert dimensions> with [**0.125-inch (3.18-mm)**] [**0.250-inch (6.35-mm)**] <Insert dimension> wall thickness.
  4. Horizontal-Slide Gate Post, Openings up to **12 Feet (3.7 m)**: [**2-1/2 by 2-1/2 inches (64 by 64 mm)**] [**3 by 3 inches (76 by 76 mm)**] [**4 by 4 inches (102 by 102 mm)**] <Insert dimensions> with [**0.125-inch (3.18-mm)**] [**0.250-inch (6.35-mm)**] <Insert dimension> wall thickness.
  5. Horizontal-Slide Gate Post, Openings Wider Than **12 Feet (3.7 m)**: [**3 by 3 inches (76 by 76 mm)**] [**4 by 4 inches (102 by 102 mm)**] [**6 by 6 inches (152 by 152 mm)**] <Insert dimensions> with [**0.125-inch (3.18-mm)**] [**0.250-inch (6.35-mm)**] <Insert dimension> wall thickness.
  6. Guide Posts for Class 1 Horizontal-Slide Gates: [**2 by 2 inches (51 by 51 mm)**] [**2-1/2 by 2-1/2 inches (64 by 64 mm)**] [**3 by 3 inches (76 by 76 mm)**] <Insert dimensions> with

[0.062-inch (1.57-mm)] [0.093-inch (2.36-mm)] [0.125-inch (3.18-mm)] <Insert dimension> wall thickness; installed adjacent to gate post to permit gate to slide in space between.

- C. Post Caps: Aluminum castings that [cover entire top of posts] [project at least 1/4 inch (6 mm) beyond posts] [with round ball finial].
- D. Rails: Extruded-aluminum channels, [1-1/2 by 1-1/2 inches (38 by 38 mm), with 0.100-inch- (2.54-mm-) thick sidewalls and 0.070-inch- (1.78-mm-) thick top] [1 by 1-1/2 inches (25 by 38 mm), with 0.082-inch- (2.08-mm-) thick sidewalls and 0.055-inch- (1.40-mm-) thick top] [1-1/4 by 1-1/4 inches (32 by 32 mm), with 0.078-inch- (1.98-mm-) thick sidewalls and 0.062-inch- (1.57-mm-) thick top] [1 by 1 inch (25 by 25 mm), with 0.080-inch- (2.03-mm-) thick sidewalls and 0.055-inch- (1.40-mm-) thick top] [1 by 1 inch (25 by 25 mm), with 0.078-inch- (1.98-mm-) thick sidewalls and 0.062-inch- (1.57-mm-) thick top].
- E. Pickets: Extruded-aluminum tubes, [1 inch (25 mm) square, with 0.062-inch (1.57-mm) wall thickness] [1 inch (25 mm) square, with 0.060-inch (1.52-mm) wall thickness] [3/4 inch (19 mm) square, with 0.050-inch (1.27-mm) wall thickness] [1 by 5/8 inch (25 by 16 mm), with 0.050-inch (1.27-mm) wall thickness] [5/8 inch (16 mm) square, with 0.050-inch (1.27-mm) wall thickness].
1. [Terminate tops of pickets at top rail for flush top appearance] [Extend pickets beyond top rail as indicated and terminate with UV-resistant plastic caps] [Extend pickets beyond top rail as indicated and terminate with cast-aluminum caps] [Extend pickets beyond top rail as indicated and press flat and trim to produce spear point shape] [Extend pickets beyond top rail as indicated and terminate with cast-aluminum spear point finial] [Extend pickets beyond top rail as indicated and terminate with cast-aluminum tripoint finial].
  2. Picket Spacing: [6 inches (152.4 mm)] [4 inches (101.6 mm)] [1-3/4 inches (44 mm)] <Insert dimension> clear, maximum.
- F. Fasteners: Manufacturer's standard concealed fastening system.
- G. Fasteners: Manufacturer's standard [tamperproof,] corrosion-resistant, color-coated fasteners matching fence components [with resilient polymer washers].
- H. Fabrication: Assemble fences into sections by [welding] [fastening] pickets to rails.
1. Fabricate sections with clips welded to rails for field fastening to posts.
  2. Drill clips for fasteners before finishing.
- I. Finish exposed welds to comply with NOMMA Guideline 1, [Finish #2 - completely sanded joint, some undercutting and pinholes okay] [Finish #3 - partially dressed weld with splatter removed] [Finish #4 - good-quality, uniform undressed weld with minimal splatter].
- J. Finish: Baked enamel or powder coating.

## 2.5 SWING GATES

- A. Gate Configuration: [Single leaf] [Double leaf] [As indicated].
- B. Gate Frame Height: [72 inches (1830 mm)] [As indicated] <Insert height>.

- C. Gate Opening Width: **[36 inches (914 mm)] [As indicated] <Insert width>**.
- D. Automated vehicular gates shall comply with ASTM F2200, **[Class I] [Class II] [Class III] [Class IV]**.
- E. Galvanized-Steel Frames and Bracing: Fabricate members from square tubes **[1-1/2 by 1-1/2 inches (38 by 38 mm)] [1-3/4 by 1-3/4 inches (45 by 45 mm)] [2 by 2 inches (51 by 51 mm)] [2-1/2 by 2-1/2 inches (64 by 64 mm)]** formed from **0.108-inch (2.74-mm)** nominal-thickness, metallic-coated steel sheet or formed from **0.105-inch (2.66-mm)** nominal-thickness steel sheet and hot-dip galvanized after fabrication.
- F. Steel Frames and Bracing: Fabricate members from square steel tubing **[1-1/2 by 1-1/2 inches (38 by 38 mm)] [2 by 2 inches (51 by 51 mm)] [2-1/2 by 2-1/2 inches (64 by 64 mm)] <Insert dimensions>** with **[1/8-inch (3.2-mm)] <Insert dimension>** wall thickness. **[ Hot-dip galvanize frames after fabrication.]**
- G. Aluminum Frames and Bracing: Fabricate members from square extruded-aluminum tubes **[1-1/2 by 1-1/2 inches (38 by 38 mm)] [2 by 2 inches (51 by 51 mm)] [2-1/2 by 2-1/2 inches (64 by 64 mm)] <Insert dimensions>** with **[0.100-inch (2.54-mm)] [0.125-inch (3.18-mm)] [0.140-inch (3.56-mm)] [0.154-inch (3.91-mm)] <Insert dimension>** wall thickness.
- H. Frame Corner Construction: **[Welded] [or] [assembled with corner fittings] [and 5/16-inch- (7.9-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider]**.
- I. Additional Rails: Provide as indicated, complying with requirements for fence rails.
- J. Infill: Comply with requirements for adjacent fence.
- K. Picket Size, Configuration, and Spacing: Comply with requirements for adjacent fence.
1. Treillage: Provide iron castings of pattern indicated between each pair of pickets. Finish as specified for **[adjacent fence] [gates]**.
- L. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than **5 feet (1.52 m)** wide. Provide **[center gate stops] [and] [cane bolts]** for pairs of gates. **[ Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.]**
1. **<Insert requirements for padlocks and chains if not Owner furnished>**.
- M. Spring Hinges: BHMA A156.17, Grade 1, suitable for exterior use.
1. Function: **[320 - Gate spring pivot hinge. Adjustable tension] [321 - Gate spring pivot hinge. Fixed tension]**.
  2. Material: Malleable iron; galvanized.
- N. Hinges: BHMA A156.1, Grade 1, suitable for exterior use.
1. Function: 39 - Full surface, triple weight, antifriction bearing.
  2. Material: Wrought steel, forged steel, cast steel, or malleable iron; galvanized.
- O. Rim Locks: BHMA A156.5, Grade 1, suitable for exterior use.
1. Function: **[621 - Latchbolt by key from outside and by turn from inside. Latchbolt is held retracted by device from inside] [622 - Deadbolt by key from outside and by**

- turn from inside] [626 - Interlocking deadbolt operated by key from either side] [627 - Interlocking deadbolt operated by key from outside and by turn from inside] [629 - Deadlocking latchbolt by key from outside and by turn from inside] <Insert function>.
2. Material: Cast, forged, or extruded brass or bronze.
  3. Mounting Plate: Configuration necessary for mounting locks. Fabricate from 1/8-inch- (3.2-mm-) thick, [steel plate; galvanized] [aluminum plate].
- P. Mortise Locks: BHMA A156.13, Grade 1, suitable for exterior use.
1. Function: [F06 - Holdback lock] [F07 - Storeroom or closet lock] [F09 - Apartment, exit, or public toilet lock] [F16 - Double-cylinder deadlock] [F17 - Deadlock] <Insert function>.
  2. Material: Brass or bronze.
  3. Levers: Cast, forged, or extruded brass or bronze.
  4. Mounting Box: Configuration necessary to enclose locks. Fabricate from 1/8-inch- (3.2-mm-) thick, [steel plate; galvanized] [aluminum plate].
- Q. Electric Strikes: BHMA A156.31, Grade 1, of configuration required for use with lock specified, fail[-safe][-secure], and suitable for exterior use.
1. Mounting Plate: Configuration necessary for mounting electric strikes. Fabricate from 1/8-inch- (3.2-mm-) thick, [steel plate; galvanized] [aluminum plate].
  2. Mounting: Mortise into post.
- R. Exit Hardware: BHMA A156.3, Grade 1, Type 1 (rim exit device), with push pad actuating bar, suitable for exterior use.
1. Function: [01 - Exit only, no trim or blank escutcheon] [04 - Entrance by trim when latch bolt is released by key or set in a retracted position by key] [08 - Entrance by lever. Key locks or unlocks lever] [09 - Entrance by lever only when released by key. Key removable only when locked] <Insert function>.
  2. Mounting Channel: Bent-plate channel formed from 1/8-inch- (3.2-mm-) thick, [steel] [aluminum] plate. Channel spans gate frame. Exit device is mounted on channel web, recessed between flanges, with flanges extending 1/8 inch (3.2 mm) beyond push pad surface.
- S. Cane Bolts: Provide for inactive leaf of pairs of gates. Fabricated from [1/2-inch- (12.7-mm-)] [3/4-inch- (19-mm-)] diameter, round steel bars, hot-dip galvanized after fabrication. Finish to match gates. Provide galvanized-steel pipe strikes to receive cane bolts in [closed position] [both open and closed positions].
- T. Finish exposed welds to comply with NOMMA Guideline 1, [Finish #2 - completely sanded joint, some undercutting and pinholes okay] [Finish #3 - partially dressed weld with splatter removed] [Finish #4 - good-quality, uniform undressed weld with minimal splatter].
- U. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A123/A123M. For hardware items, hot-dip galvanize to comply with ASTM A153/A153M.
- V. Metallic-Coated-Steel Finish: [High-performance coating] [Galvanized finish].
- W. Steel Finish: [Primed] [Shop painted] [High-performance coating].

- X. Aluminum Finish: Baked enamel or powder coating.

## 2.6 HORIZONTAL-SLIDE GATES

- A. Gate Configuration: **[Single leaf]** **[Double leaf]** **[As indicated]**.
1. Type: Overhead slide.
  2. Type: Cantilever slide, with **[external]** **[internal]** roller assemblies.
- B. Gate Frame Height: **[72 inches (1830 mm)]** **[As indicated]** **<Insert height>**.
- C. Gate Opening Width: **[36 inches (914 mm)]** **[As indicated]** **<Insert width>**.
- D. Automated vehicular gates shall comply with ASTM F2200, **[Class I]** **[Class II]** **[Class III]** **[Class IV]**.
- E. Galvanized-Steel Frames and Bracing: Fabricate members from square tubing.
1. Frame Members: Square tubes **[1-1/2 by 1-1/2 inches (38 by 38 mm)]** **[1-3/4 by 1-3/4 inches (45 by 45 mm)]** **[2 by 2 inches (51 by 51 mm)]** **[2-1/2 by 2-1/2 inches (64 by 64 mm)]** formed from **0.108-inch (2.74-mm)** nominal-thickness, metallic-coated steel sheet or formed from **0.105-inch (2.66-mm)** nominal-thickness steel sheet and hot-dip galvanized after fabrication.
  2. Bracing Members: Square tubes **[1-1/2 by 1-1/2 inches (38 by 38 mm)]** **[1-3/4 by 1-3/4 inches (45 by 45 mm)]** **[2 by 2 inches (51 by 51 mm)]** **[2-1/2 by 2-1/2 inches (64 by 64 mm)]** formed from **0.108-inch (2.74-mm)** nominal-thickness, metallic-coated steel sheet or formed from **0.105-inch (2.66-mm)** nominal-thickness steel sheet and hot-dip galvanized after fabrication.
- F. Steel Frames and Bracing: Fabricate members from square tubing. **[Hot-dip galvanize frames after fabrication.]**
1. Frame Members: Steel tubing **[1-1/2 by 1-1/2 inches (38 by 38 mm)]** **[2 by 2 inches (51 by 51 mm)]** **[2-1/2 by 2-1/2 inches (64 by 64 mm)]** **<Insert dimensions>** with **[1/8-inch (3.2-mm)]** **<Insert thickness>** wall thickness.
  2. Bracing Members: Steel tubing **[1-1/2 by 1-1/2 inches (38 by 38 mm)]** **[2 by 2 inches (51 by 51 mm)]** **[2-1/2 by 2-1/2 inches (64 by 64 mm)]** **<Insert dimensions>** with **[1/8-inch (3.2-mm)]** **<Insert dimension>** wall thickness.
- G. Aluminum Frames and Bracing: Fabricate members from square tubing.
1. Frame Members: Extruded-aluminum tubes **[1-1/2 by 1-1/2 inches (38 by 38 mm)]** **[2 by 2 inches (51 by 51 mm)]** **[2-1/2 by 2-1/2 inches (64 by 64 mm)]** **<Insert dimensions>** with **[0.100-inch (2.54-mm)]** **[0.125-inch (3.18-mm)]** **[0.140-inch (3.56-mm)]** **[0.154-inch (3.91-mm)]** **<Insert dimension>** wall thickness.
  2. Bracing Members: Extruded-aluminum tubes **[1-1/2 by 1-1/2 inches (38 by 38 mm)]** **[2 by 2 inches (51 by 51 mm)]** **[2-1/2 by 2-1/2 inches (64 by 64 mm)]** **<Insert dimensions>** with **[0.100-inch (2.54-mm)]** **[0.125-inch (3.18-mm)]** **[0.140-inch (3.56-mm)]** **[0.154-inch (3.91-mm)]** **<Insert dimension>** wall thickness.
- H. Frame Corner Construction:



1. Welded frame [with panels assembled with bolted or riveted corner fittings] [and 5/16-inch- (7.9-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider].
  2. Overhead Slide Gates: Welded or assembled with corner fittings[ including 5/16-inch- (7.9-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider].
- I. Additional Rails: Provide as indicated, complying with requirements for fence rails.
- J. Infill: Comply with requirements for adjacent fence.
- K. Picket Size, Configuration, and Spacing: Comply with requirements for adjacent fence.
1. Treillage: Provide iron castings of pattern indicated between each pair of pickets. Finish as specified for [adjacent fence] [gates].
- L. Overhead Track Assembly: Manufacturer's standard track, with overhead framing supports, bracing, and accessories, engineered to support size, weight, width, operation, and design of gate and roller assemblies.
- M. Hardware: Latches permitting operation from both sides of gate, [locking devices] [hangers] [roller assemblies] <Insert hardware items and accessories> and stops fabricated from [galvanized steel] [galvanized malleable iron] [mill-finished, Grade 319 aluminum-alloy casting with stainless-steel fasteners].[ Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.]
1. <Insert requirements for padlocks and chains if not Owner furnished>.
- N. Finish exposed welds to comply with NOMMA Guideline 1, [Finish #2 - completely sanded joint, some undercutting and pinholes okay] [Finish #3 - partially dressed weld with splatter removed] [Finish #4 - good-quality, uniform undressed weld with minimal splatter].
- O. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A123/A123M. For hardware items, hot-dip galvanize to comply with ASTM A153/A153M.
- P. Metallic-Coated-Steel Finish: [High-performance coating] [Galvanized finish].
- Q. Steel Finish: [Primed] [Shop painted] [High-performance coating].
- R. Aluminum Finish: Baked enamel or powder coating.

## 2.7 GATE OPERATORS

- A. Gate Operators:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Provide factory-assembled automatic operating system designed for gate size, type, weight, and operation frequency. Provide operation control system with characteristics suitable for Project conditions, with remote-control stations, safety devices, and weatherproof enclosures; coordinate electrical requirements with building electrical system.

1. Provide operator designed so motor may be removed without disturbing limit-switch adjustment and without affecting auxiliary emergency operator.
  2. Provide operator with UL **[approval]****[-approved components]**.
  3. Provide electronic components with built-in troubleshooting diagnostic feature.
  4. Provide unit designed and wired for both right-hand/left-hand opening, permitting universal installation.
- C. Comply with NFPA 70.
- D. UL Standard: Manufacturer and label gate operators to comply with UL 325.
- E. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators on gates that must provide emergency access.
- F. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1 and the following:
1. Voltage: **[12-V dc]** **[24-V dc]** **[120 V]** **[208-220 V]** **[NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected]** **<Insert voltage>**.
  2. Horsepower: Not less than **[1/4]** **[1/3]** **[1/2]** **[3/4]** **<Insert value>**.
  3. Enclosure: **[Open dripproof]** **[Totally enclosed]** **[Manufacturer's standard]**.
  4. Duty: Continuous duty at ambient temperature of **105 deg F (40 deg C)** and at altitude of **3300 feet (1005 m)** above sea level.
  5. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
  6. Phase: **[One]** **[Polyphase]**.
- G. Gate Operators: **[Gate]** **[Concrete base]** **[Post]** **[In-ground]** mounted and as follows:
1. Hydraulic **[Swing]** **[Slide]** Gate Operators:
    - a. Duty: **[Light]** **[Medium]** **[Heavy]** duty, **[residential]** **[commercial/industrial]**.
    - b. Gate Speed: Minimum **[45 feet (13.7 m)]** **[60 feet (18.2 m)]** per minute.
    - c. Maximum Gate Weight: **[800 lb (363 kg)]** **<Insert value>**.
    - d. Frequency of Use: **[10 cycles per hour]** **[25 cycles per hour]** **[Continuous duty]**.
    - e. Operating Type: Wheel-and-rail drive **[with manual release]**.
    - f. Hydraulic Fluid: Of viscosity required for gate operation at ambient temperature range for Project.
    - g. Locking: Hydraulic in both directions.
    - h. Heater: Manufacturer's standard track and roller heater with thermostatic control.
  2. Mechanical **[Swing]** **[Slide]** Gate Operators:
    - a. Duty: **[Light]** **[Medium]** **[Heavy]** duty, **[residential]** **[commercial/industrial]**.
    - b. Gate Speed: Minimum **[45 feet (13.7 m) per minute]** **[60 feet (18.2 m) per minute]** **[variable speed]** **<Insert speed>**.
    - c. Maximum Gate Weight: **[600 lb (272 kg)]** **[800 lb (363 kg)]** **[3000 lb (1360 kg)]** **<Insert value>**.
    - d. Frequency of Use: **[10 cycles per hour]** **[25 cycles per hour]** **[60 cycles per hour]** **[Continuous duty]**.
    - e. Operating Type: **[Crank arm]** **[Wheel-and-rail drive]** **[Roller chain]**, **[with manual release]**.
    - f. Drive Type: Enclosed worm gear **[and chain-and-sprocket]** reducers, roller-chain drive.



- g. Drive Type: V-belt and **[worm gear] [chain-and-sprocket]** reducers, roller-chain drive.
  - h. **<Insert feature>**.
- H. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with **[NEMA ICS 6, Type 1] [NEMA ICS 6, Type 4] <Insert type of enclosure>** enclosure for **[surface] [recessed or flush] [concrete base] [pedestal] <Insert mounting>** mounting, and with space for additional optional equipment. Provide the following remote-control device(s):
1. Control Station: Keyed, **[two] [three]-**position switch with open[, **stop,**] and close function; located remotely from gate. Provide two keys per station.
  2. Control Station: Momentary-contact, **[single] [three]-**button-operated with open[, **stop,**] and close function; located remotely from gate. **[Key switch to lock out open and close buttons.]**
  3. Card Reader: Functions only when authorized card is presented. Programmable, **[multiple] [single]-**code system[, **permitting four different access periods] [; face-lighted unit fully visible at night]**.
    - a. Reader Type: **[Touch plate] [Swipe] [Insertion] [Proximity]**.
    - b. Features: **[Timed antipassback] [Limited-time usage] [Capable of monitoring and auditing gate activity]**.
  4. Digital Keypad Entry Unit: **[Programmable, ]**multiple-code capability of not less than **[five] [500] [2500] <Insert number>** possible individual codes, consisting of **[1 to 7] [4] [5]-**digit codes[, **and permitting four different access periods]**.
    - a. Features: **[Timed antipassback] [Limited-time usage] [Capable of monitoring and auditing gate activity]**.
    - b. Face-lighted unit with **[metal-keyed] [keyless-membrane]** keypad fully visible at night.
  5. Radio Control: Digital system consisting of code-compatible universal receiver for each gate, located where indicated, with remote antenna with coaxial cable and mounting brackets designed to operate gates. Provide **[one] [two] <Insert number>** programmable transmitter(s) with multiple-code capability permitting validating or voiding of not less than **[1000] [10,000] <Insert number>** codes per channel configured for the following functions:
    - a. Transmitters: **[Single] [Three]** button operated, with open **[and close ]**function.
    - b. Channel Settings: **[Two] [Three] [Four] <Insert number>** independent channel settings controlling separate receivers for operating more than one gate from each transmitter.
  6. Telephone Entry System: Hands-free, voice-communication system for connection to building telephone system with digital-entry code activation of gate operator **[ and auxiliary keypad entry]**.
    - a. Residential System: Designed to be wired to same line with telephone.
    - b. Multiunit System: Designed to be wired to a dedicated telephone line, with capacity to access **[20] [100] <Insert number>** telephones[, **and with electronic directory]**.
- I. Vehicle Loop Detector: System includes automatic closing timer with adjustable time delay[, **timer cutoff switch,**] and loop detector designed to **[open and close gate] [hold gate open until traffic clears] [reverse gate] <Insert functions>**. System includes electronic detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. System includes number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement, as recommended in writing by detection system manufacturer for function indicated, at location indicated on Drawings.

- J. Vehicle Presence Detector: System includes automatic closing timer with adjustable time delay[, **timer cutoff switch**,] and presence detector designed to **[open and close gate] [hold gate open until traffic clears] [reverse gate] <Insert functions>**. System includes **[retroreflective] [emitter/receiver]** detector with adjustable detection zone pattern and sensitivity, designed to detect the presence or transit of a vehicle in gate pathway when infrared beam in zone pattern is interrupted, and to emit a signal activating the gate operator.
- K. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:
1. Action: Reverse gate in both opening and closing cycles, and hold until clear of obstruction.
  2. Action: Stop gate in opening cycle and reverse gate in closing cycle, and hold until clear of obstruction.
  3. Internal Sensor: Built-in torque or current monitor senses gate is obstructed.
  4. Sensor Edge: Contact-pressure-sensitive safety edge, profile, and sensitivity designed for type of gate and component indicated, in locations as follows. Connect to control circuit using **[take-up cable reel] [self-coiling cable] [gate edge transmitter and operator receiver system]**.
    - a. Along entire gate leaf leading edge.
    - b. Along entire gate leaf trailing edge.
    - c. Across entire gate leaf bottom edge.
    - d. Along entire length of gate posts.
    - e. Along entire length of gate guide posts.
    - f. Where indicated on Drawings.
    - g. **<Insert extent and location>**.
  5. Photoelectric/Infrared Sensor System: Designed to detect an obstruction in gate's path when infrared beam in the zone pattern is interrupted.
- L. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully retracted and fully extended positions.
- M. Emergency Release Mechanism: Quick-disconnect release of operator drive system of the following type, permitting manual operation if operator fails. Design system so control-circuit power is disconnected during manual operation.
1. Type: **[Integral fail-safe release, allowing gate to be pushed open without mechanical devices, keys, cranks, or special knowledge] [Mechanical device, key, or crank-activated release]**.
- N. Operating Features:
1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features[ **with capability for monitoring and auditing gate activity**]. Provide unit that is isolated from voltage spikes and surges.

2. System Integration: With controlling circuit board capable of accepting any type of input from external devices.
  3. Master/Slave Capability: Control stations designed and wired for gate pair operation.
  4. Automatic Closing Timer: With adjustable time delay before closing[ **and timer cutoff switch**].
  5. Open Override Circuit: Designed to override closing commands.
  6. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions.
  7. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded.
  8. Clock Timer: **[24-hour] [Seven-day]** <Insert time> programmable for regular events.
- O. Accessories:
1. Warning Module: **[Audio] [Visual], [constant] [strobe]**-light alarm sounding three to five seconds in advance of gate operation and continuing until gate stops moving; compliant with the United States Access Board's ADA-ABA Accessibility Guidelines.
  2. Battery Backup System: Battery-powered drive and access-control system, independent of primary drive system.
    - a. Fail-Safe: Gate opens and remains open until power is restored.
    - b. Fail-Secure: Gate cycles on battery power, then fail-safe when battery is discharged.
  3. External electric-powered **[solenoid] [magnetic]** lock with delay timer allowing time for lock to release before gate operates.
  4. **[Fire] [Postal]** box.
  5. Fire **[strobe] [siren]** sensor.
  6. Intercom System: <Insert requirements>.
  7. Instructional, Safety, and Warning Labels and Signs: **[According to UL 325] [Manufacturer's standard for components and features specified] [As indicated on Drawings]** <Insert requirements>.
  8. Equipment Bases/Pads: Precast concrete, **[depth not less than 12 inches (305 mm)]** <Insert depth>, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.

## 2.8 ALUMINUM

- A. Aluminum, General: Provide alloys and tempers with not less than the strength and durability properties of alloy and temper designated in paragraphs below for each aluminum form required.
- B. Extrusions: **ASTM B221 (ASTM B221M)**, Alloy 6063-T5.
- C. Tubing: ASTM B429/B429M, Alloy 6063-T6.
- D. Plate and Sheet: **ASTM B209 (ASTM B209M)**, Alloy 6061-T6.
- E. Die and Hand Forgings: **ASTM B247 (ASTM B247M)**, Alloy 6061-T6.
- F. Castings: ASTM B26/B26M, Alloy A356.0-T6.

## 2.9 STEEL AND IRON

- A. Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Bars (Pickets): Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.
- C. Tubing: ASTM A500/A500M, cold-formed steel tubing.
- D. Bar Grating: NAAMM MBG 531.
  - 1. Bars: Hot-rolled steel strip, ASTM A1011/A1011M, Commercial Steel, Type B.
  - 2. Wire Rods: ASTM A510/A510M.
- E. Uncoated Steel Sheet: [Hot-rolled steel sheet, ASTM A1011/A1011M, Structural Steel, Grade 45 (Grade 310)] [or] [cold-rolled steel sheet, ASTM A1008/A1008M, Structural Steel, Grade 50 (Grade 340)].
- F. Galvanized-Steel Sheet: ASTM A653/A653M, structural quality, Grade 50 (Grade 340), with [G90 (Z275)] [G60 (Z180)] coating.
- G. Aluminum-Zinc, Alloy-Coated Steel Sheet: ASTM A792/A792M, structural quality, Grade 50 (Grade 340), with AZ60 (AZM180) coating.
- H. Castings: Either gray or malleable iron unless otherwise indicated.
  - 1. Gray Iron: ASTM A48/A48M, Class 30.
  - 2. Malleable Iron: ASTM A47/A47M.

## 2.10 COATING MATERIALS

- A. Shop Primers for Steel: Provide primers that comply with [Section 099113 "Exterior Painting."] [Section 099600 "High-Performance Coatings."]
- B. Shop Primer for Steel: Manufacturer's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- C. Epoxy Zinc-Rich Primer for Uncoated Steel: Complying with MPI #20 and compatible with coating specified to be applied over it.
  - 1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
    - a. <Insert manufacturer's name; product name or designation>.
- D. Epoxy Primer for Galvanized Steel: Epoxy primer recommended in writing by topcoat manufacturer.
  - 1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
    - a. <Insert manufacturer's name; product name or designation>.

- E. Epoxy Intermediate Coat for Uncoated Steel: Complying with MPI #77 and compatible with primer and topcoat.
1. Products: Subject to compliance with requirements, **[provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:**
    - a. **<Insert manufacturer's name; product name or designation>.**
- F. Intermediate Coat for Uncoated Steel: Epoxy or polyurethane intermediate recommended in writing by primer and topcoat manufacturer.
1. Products: Subject to compliance with requirements, **[provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:**
    - a. **<Insert manufacturer's name; product name or designation>.**
- G. Polyurethane[ **Intermediate Coat and**] Topcoat: Complying with MPI #72 and compatible with undercoat.
1. Products: Subject to compliance with requirements, **[provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:**
    - a. **<Insert manufacturer's name; product name or designation>.**

## 2.11 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for strength and compatibility in fabricated items.
- B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of **3000 psi (20 MPa)**, **3-inch (75-mm)** slump, and **1-inch (25-mm)** maximum aggregate size[ **or dry, packaged, normal-weight concrete mix complying with ASTM C387/C387M mixed with potable water according to manufacturer's written instructions**].
- C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M and specifically recommended by manufacturer for exterior applications.

## 2.12 GROUNDING MATERIALS

- A. Comply with requirements of Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Grounding Conductors: Size as indicated on Drawings. Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
1. Material above Finished Grade: **[Copper] [Aluminum]**.

2. Material on or below Finished Grade: Copper.
  3. Bonding Jumpers: Braided copper tape, 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- C. Grounding Connectors and Grounding Rods: Comply with UL 467.
1. Connectors for Below-Grade Use: Exothermic-welded type.
  2. Grounding Rods: Copper-clad steel.
    - a. Size: 5/8 by 96 inches (16 by 2440 mm).

## 2.13 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 2 mils (0.05 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
1. Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.

## 2.14 STEEL FINISHES

- A. Surface Preparation: Clean surfaces according to [SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."] [SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."] After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.
- B. Powder Coating: Immediately after cleaning, apply manufacturer's standard two-coat finish consisting of epoxy primer and TGIC polyester topcoat to a minimum total dry film thickness of not less than 8 mils (0.20 mm). Comply with coating manufacturer's written instructions.
1. Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.
- C. Primer Application: Apply zinc-rich epoxy primer immediately after cleaning, to provide a minimum dry film thickness of 2 mils (0.05 mm) per applied coat, to surfaces that are exposed after assembly and installation, and to concealed surfaces.
- D. Shop-Painted Finish: Comply with [Section 099113 "Exterior Painting."] [Section 099600 "High-Performance Coatings."]
- E. High-Performance Coating: Apply intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
1. Match approved Samples for color, texture, and coverage. Remove and refinish, or recoat work that does not comply with specified requirements.

**2.15 METALLIC-COATED-STEEL FINISHES**

- A. Galvanized Finish: Clean welds, mechanical connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.
- B. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a [zinc-phosphate] conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A780/A780M.
- C. Powder Coating: Immediately after cleaning and pretreating, apply manufacturer's standard TGIC polyester powder-coat finish to a minimum dry film thickness of 2 mils (0.05 mm).
  - 1. Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.
- D. Powder Coating: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat finish consisting of [zinc-rich] epoxy prime coat and TGIC polyester topcoat to a minimum dry film thickness of 2 mils (0.05 mm). Comply with coating manufacturer's written instructions to achieve a minimum total dry film thickness of 4 mils (0.10 mm).
  - 1. Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.
  - 2. Comply with surface finish testing requirements in ASTM F2408 [except change corrosion-resistance requirement to 3000 hours without failure].
- E. High-Performance Coating: Apply epoxy primer, polyurethane intermediate coat, and polyurethane topcoat to prepared surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
  - 1. Match approved Samples for color, texture, and coverage. Remove and refinish, or recoat work that does not comply with specified requirements.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of **500 feet (152.5 m)** or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
1. Construction layout and field engineering are specified in Section 017300 "Execution."

### 3.3 DECORATIVE FENCE INSTALLATION

- A. Install fences according to manufacturer's written instructions.
- B. Install fences by setting posts as indicated and fastening **[rails] [and] [infill panels]** to posts. **[Peen threads of bolts after assembly to prevent removal.]**
- C. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than **24 inches (600 mm)** plus **3 inches (75 mm)** for each **foot (300 mm)** or fraction of a **foot (300 mm)** that fence height exceeds **4 feet (1.2 m)**.
- D. Post Setting: Set posts **[in concrete] [with mechanical anchors] [by mechanically driving into soil]** at indicated spacing into firm, undisturbed soil.
1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
  2. Concrete Fill: Place concrete around **[posts] [and] [sleeves]** and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
    - a. Exposed Concrete: Extend **2 inches (51 mm)** above grade. Finish and slope top surface to drain water away from post.
    - b. Concealed Concrete: Top **[2 inches (51 mm)] <Insert dimension>** below grade **[as indicated on Drawings]** to allow covering with surface material. Slope top surface of concrete to drain water away from post.
  3. Posts Set in Concrete: Extend post to within **6 inches (150 mm)** of specified excavation depth, but not closer than **3 inches (75 mm)** to bottom of concrete.
  4. Posts Set into Concrete in Sleeves: Use galvanized-steel pipe sleeves with inside diameter at least **3/4 inch (20 mm)** larger than outside diagonal dimension of post, preset and anchored into concrete for installing posts.
    - a. Extend posts at least **5 inches (125 mm)** into sleeve.
    - b. After posts have been inserted in sleeves, fill annular space between post and sleeve with nonshrink grout, mixed and placed to comply with grout manufacturer's written instructions; shape and smooth to shed water. Finish and slope top surface of grout to drain water away from post.
  5. Posts Set into Voids in Concrete: Form or core drill holes not less than **3/4 inch (20 mm)** larger than outside diagonal dimension of post.
    - a. Extend posts at least **5 inches (125 mm)** into concrete.
    - b. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink grout, mixed and placed to comply with grout manufacturer's written instructions. Finish and slope top surface of grout to drain water away from post.



6. Mechanically Driven Posts: Drive into soil to depth of [30 inches (762 mm)] [36 inches (914 mm)] <Insert dimension>. Protect post top to prevent distortion.
7. Space posts uniformly at [6 feet (1.83 m)] [8 feet (2.44 m)] <Insert dimension> o.c.

### 3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

### 3.5 GATE OPERATOR INSTALLATION

- A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.
- B. Excavation for [Support Posts] [Pedestals] [Concrete Bases]: Hand-excavate holes for bases in firm, undisturbed soil to dimensions and depths and at locations as required by gate operator component manufacturer's written instructions and as indicated.
- C. Concrete Bases: Cast-in-place or precast concrete, [depth not less than 12 inches (300 mm)] <Insert depth>, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.
- D. Vehicle Loop Detector System: [Cut grooves in pavement and ]bury and seal wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.
- E. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

### 3.6 GROUNDING AND BONDING

- A. Comply with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fence Grounding: Install at maximum intervals of [1500 feet (450 m)] <Insert a lesser distance if grounding resistance is high> except as follows:
  1. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of [750 feet (225 m)] <Insert a lesser distance if grounding resistance is high>.ol style="list-style-type: none;">  - a. Gates and Other Fence Openings: Ground fence on each side of opening.
    - 1) Bond metal gates to gate posts.
    - 2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches (460 mm) below finished grade.
- C. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet (45 m) on each side of crossing.

- D. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.
- E. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is **6 inches (150 mm)** below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- F. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- G. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- H. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
  - 1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
  - 2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
  - 3. Report: Prepare test reports of grounding resistance at each test location certified by a testing agency. Include observations of weather and other phenomena that may affect test results.

### 3.8 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

- B. Automatic Gate Operators: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices, [alarms,] and limit switches.
  - 1. Hydraulic Operators: Purge operating system, adjust pressure and fluid levels, and check for leaks.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls, [alarms,] and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Lubricate hardware, [gate operators,] and other moving parts.

### 3.9 DEMONSTRATION

- A. [Engage a factory-authorized service representative to train] [Train] Owner's personnel to adjust, operate, and maintain gates.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 32 31 19.53 - DECORATIVE METAL SECURITY FENCES AND GATES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
1. Decorative metallic-coated-steel security fences.
  2. Swing gates.
  3. Horizontal-slide gates.
  4. Gate operators, including controls.
- B. Related Requirements:
1. Section 033053 "Miscellaneous Cast-in-Place Concrete" for concrete **[bases for gate operators, drives, and controls] [and] [post concrete fill]**.
  2. Section 281500 "Access Control Hardware Devices" for access control devices installed at gates and provided as part of a security system.
  3. Division 26 Sections for electrical service and connections for system disconnect switches and powered devices including, but not limited to, motor operators, controls, and limit switches.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at **[Project site] <Insert location>**.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For fencing and gates.
1. Include plans, elevations, sections, gate locations, post spacing, **[and] [mounting] [attachment] details[, and grounding details]**.
  2. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
  3. Wiring Diagrams: Include diagrams for power, signal, and control wiring.
- C. Samples: For each fence material and for each color specified.

1. Provide Samples [**12 inches (300 mm)**] <Insert dimension> in length for linear materials.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For gate operators to include in maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Wind Loading:
  1. Fence Height: [**0 to 15 feet (0 to 4.57 m)**] [**15 to 20 feet (4.57 to 6.10 m)**].
  2. Wind Exposure Category: [**B**] [**C**] [**D**].
  3. Design Wind Speed: [**105 mph (169 kph)**] [**110 mph (177 kph)**] [**120 mph (193 kph)**] [**130 mph (209 kph)**] [**140 mph (225 kph)**] [**150 mph (241 kph)**] [**160 mph (257 kph)**] [**170 mph (274 kph)**] <Insert wind speed>.
  4. Design Wind Pressure: <Insert wind pressure>.
- B. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.
- C. Vehicle Crash Testing: Comply with requirements of ASTM F2656.
  1. Impact Category: [**C**] [**P**] [**M**] [**H**] <Insert designation>
  2. Impact Velocity: [**65 mph (40 km/h)**] [**80 mph (50 km/h)**] [**100 mph (60 km/h)**] <Insert value>.
  3. Penetration Rating: [**P1**] [**P2**] [**P3**] [**P4**] <Insert designation>

### 2.2 DECORATIVE METALLIC-COATED-STEEL SECURITY FENCES

- A. Decorative Metallic-Coated-Steel Security Fences:
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Posts:
  1. Line, End, and Corner Posts: **1-3/4-by-4-inch (45-by-102-mm)** double-thickness, I-shaped sections formed from **0.108-inch (2.74-mm)** nominal-thickness, metallic-coated steel sheet or **0.105-inch (2.66-mm)** nominal-thickness, uncoated steel sheet, hot-dip galvanized after fabrication.
  2. Line, End, and Corner Posts: **4-by-4-inch (102-by-102-mm)** square tubes formed from **0.079-inch (2.01-mm)** nominal-thickness, metallic-coated steel sheet or **0.075-inch (1.90-mm)** nominal-thickness, uncoated steel sheet, hot-dip galvanized after fabrication.

3. Line, End, and Corner Posts: [2-1/2-by-2-1/2-inch (64-by-64-mm)] [3-by-3-inch (76-by-76-mm)] [4-by-4-inch (102-by-102-mm)] square tubes formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or 0.105-inch (2.66-mm) nominal-thickness, uncoated steel sheet, hot-dip galvanized after fabrication.
  4. Posts at Swing Gate Openings: Square tubes 3 by 3 inches (76 by 76 mm) formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication.
  5. Posts at Swing Gate Openings: Square steel tubing [3 by 3 inches (76 by 76 mm)] [4 by 4 inches (102 by 102 mm)] <Insert dimensions> with [3/16-inch (4.76-mm)] <Insert dimension> wall thickness, hot-dip galvanized.
  6. Posts at Horizontal-Slide Gate Openings up to 12 Feet (3.7 m): Square steel tubing [3 by 3 inches (76 by 76 mm)] [4 by 4 inches (102 by 102 mm)] <Insert dimensions> with [3/16-inch (4.76-mm)] <Insert dimension> wall thickness, hot-dip galvanized.
  7. Posts at Horizontal-Slide Gate Openings Wider Than 12 Feet (3.7 m): Square steel tubing 4 by 4 inches (102 by 102 mm) with [3/16-inch (4.76-mm)] <Insert dimension> wall thickness, hot-dip galvanized.
  8. Guide Posts for Class 1 Horizontal-Slide Gates: Square tubes 3 by 3 inches (76 by 76 mm) formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication; installed adjacent to gate post to permit gate to slide in space between.
  9. Guide Posts for Class 1 Horizontal-Slide Gates: Square steel tubing [3 by 3 inches (76 by 76 mm)] [4 by 4 inches (102 by 102 mm)] <Insert dimensions> with [3/16-inch (4.76-mm)] <Insert dimension> wall thickness, hot-dip galvanized; installed adjacent to gate post to permit gate to slide in space between.
- C. Post Caps: Aluminum castings.
- D. Rails: 2-by-2-inch (51-by-51-mm) square tubes.
1. Metal and Thickness: 0.079-inch (2.01-mm) nominal-thickness, metallic-coated steel sheet or 0.075-inch (1.90-mm) nominal-thickness, uncoated steel sheet, hot-dip galvanized after fabrication.
- E. Rails: 1-3/4-by-1-3/4-inch (44-by-44-mm) square tubes.
1. Metal and Thickness: 0.079-inch (2.01-mm) nominal-thickness, metallic-coated steel sheet or 0.075-inch (1.90-mm) nominal-thickness, uncoated steel sheet, hot-dip galvanized after fabrication.
- F. Rails: 2-by-2-1/2-inch (51-by-64-mm) pentagon-shaped box channel designed to shed water and to enclose wire rope reinforcement.
1. Metal and Thickness: 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or 0.105-inch (2.66-mm) nominal-thickness, uncoated steel sheet, hot-dip galvanized after fabrication.
  2. Provide rails with wire rope reinforcement at [34 inches (864 mm)] [41 inches (1041 mm)] [and] [48 inches (1219 mm)] above ground in addition to rails at top and bottom of fence.
  3. Wire Rope Reinforcement: FS RR-W-41-G, 3/4-inch (19-mm) diameter, zinc-coated-steel wire rope.
    - a. Class: [Class 2, 6 by 19] <Insert type>.
    - b. Minimum Breaking Force: [58,800 lb (26 671 kg)] <Insert value>.

- G. Pickets: **3/4-by-2-3/4-inch (19-by-70-mm)** M-shaped pales.
  1. Metal and Thickness: **0.079-inch (2.01-mm)** nominal-thickness, metallic-coated steel sheet or **0.075-inch (1.90-mm)** nominal-thickness, uncoated steel sheet, hot-dip galvanized after fabrication.
  2. Extend pickets beyond top rail as indicated and **[terminate with rounded edge] [cut and split to form three points]**.
  3. Picket Spacing: **6 inches (152.4 mm)** o.c., maximum.
- H. Fasteners: Stainless-steel carriage bolts with tamperproof nuts.
- I. Metallic-Coated Steel Sheet: Galvanized-steel sheet or aluminum-zinc, alloy-coated steel sheet.
- J. Interior surface of tubes formed from uncoated steel sheet shall be **[hot-dip zinc coated same as exterior] [or] [coated with zinc-rich thermosetting coating to comply with ASTM F2408]**.
- K. Galvanizing: For components indicated to be galvanized, hot-dip galvanize to comply with ASTM A123/A123M. For hardware items, hot-dip galvanize to comply with ASTM A153/A153M.
- L. Finish: **[Organic coating complying with requirements in ASTM F2408] [Powder coating]**.

### 2.3 SWING GATES

- A. Gate Configuration: **[Single leaf] [Double leaf] [As indicated]**.
- B. Gate Frame Height: **[72 inches (1830 mm)] [As indicated] <Insert height>**.
- C. Gate Opening Width: **[36 inches (914 mm)] [As indicated] <Insert width>**.
- D. Automated vehicular gates shall comply with ASTM F2200, **[Class I] [Class II] [Class III] [Class IV]**.
- E. Galvanized-Steel Frames and Bracing: Fabricate members from square tubes **[1-1/2 by 1-1/2 inches (38 by 38 mm)] [1-3/4 by 1-3/4 inches (45 by 45 mm)] [2 by 2 inches (51 by 51 mm)] [2-1/2 by 2-1/2 inches (64 by 64 mm)]** formed from **0.108-inch (2.74-mm)** nominal-thickness, metallic-coated steel sheet or formed from **0.105-inch (2.66-mm)** nominal-thickness steel sheet and hot-dip galvanized after fabrication.
- F. Steel Frames and Bracing: Fabricate members from square steel tubing **[1-1/2 by 1-1/2 inches (38 by 38 mm)] [2 by 2 inches (51 by 51 mm)] [2-1/2 by 2-1/2 inches (64 by 64 mm)]** **<Insert dimensions>** with **[1/8-inch (3.2-mm)] <Insert dimension>** wall thickness. **[ Hot-dip galvanize frames after fabrication.]**
- G. Frame Corner Construction: **[Welded] [or] [assembled with corner fittings] [and 5/16-inch- (7.9-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider]**.
- H. Additional Rails: Provide as indicated, complying with requirements for fence rails.
- I. Infill: Comply with requirements for adjacent fence.
- J. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than **5 feet (1.52 m)** wide. Provide **[center gate stops] [and] [cane bolts]** for pairs of gates. **[ Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.]**



1. <Insert requirements for padlocks and chains if not Owner furnished>.
- K. Spring Hinges: BHMA A156.17, Grade 1, suitable for exterior use.
1. Function: [320 - Gate spring pivot hinge. Adjustable tension] [321 - Gate spring pivot hinge. Fixed tension].
  2. Material: Malleable iron; galvanized.
- L. Hinges: BHMA A156.1, Grade 1, suitable for exterior use.
1. Function: 39 - Full surface, triple weight, antifriction bearing.
  2. Material: Wrought steel, forged steel, cast steel, or malleable iron; galvanized.
- M. Rim Locks: BHMA A156.5, Grade 1, suitable for exterior use.
1. Function: [621 - Latchbolt by key from outside and by turn from inside. Latchbolt is held retracted by device from inside] [622 - Deadbolt by key from outside and by turn from inside] [626 - Interlocking deadbolt operated by key from either side] [627 - Interlocking deadbolt operated by key from outside and by turn from inside] [629 - Deadlocking latchbolt by key from outside and by turn from inside] <Insert function>.
  2. Material: Cast, forged, or extruded brass or bronze.
  3. Mounting Plate: Configuration necessary for mounting locks. Fabricate from 1/8-inch- (3.2-mm-) thick, [steel plate; galvanized] [aluminum plate].
- N. Mortise Locks: BHMA A156.13, Grade 1, suitable for exterior use.
1. Function: [F06 - Holdback lock] [F07 - Storeroom or closet lock] [F09 - Apartment, exit, or public toilet lock] [F16 - Double-cylinder deadlock] [F17 - Deadlock] <Insert function>.
  2. Material: Brass or bronze.
  3. Levers: Cast, forged, or extruded brass or bronze.
  4. Mounting Box: Configuration necessary to enclose locks. Fabricate from 1/8-inch- (3.2-mm-) thick, [steel plate; galvanized] [aluminum plate].
- O. Electric Strikes: BHMA A156.31, Grade 1, of configuration required for use with lock specified, fail[-safe][-secure], and suitable for exterior use.
1. Mounting Plate: Configuration necessary for mounting electric strikes. Fabricate from 1/8-inch- (3.2-mm-) thick, [steel plate; galvanized] [aluminum plate].
  2. Mounting: Mortise into post.
- P. Exit Hardware: BHMA A156.3, Grade 1, Type 1 (rim exit device), with push pad actuating bar, suitable for exterior use.
1. Function: [01 - Exit only, no trim or blank escutcheon] [04 - Entrance by trim when latch bolt is released by key or set in a retracted position by key] [08 - Entrance by lever. Key locks or unlocks lever] [09 - Entrance by lever only when released by key. Key removable only when locked] <Insert function>.
  2. Mounting Channel: Bent-plate channel formed from 1/8-inch- (3.2-mm-) thick, [steel] [aluminum] plate. Channel spans gate frame. Exit device is mounted on channel web, recessed between flanges, with flanges extending 1/8 inch (3.2 mm) beyond push pad surface.

- Q. Cane Bolts: Provide for inactive leaf of pairs of gates. Fabricated from [1/2-inch- (12.7-mm-)] [3/4-inch- (19-mm-)] diameter, round steel bars, hot-dip galvanized after fabrication. Finish to match gates. Provide galvanized-steel pipe strikes to receive cane bolts in [closed position] [both open and closed positions].
- R. Finish exposed welds to comply with NOMMA Guideline 1, [Finish #2 - completely sanded joint, some undercutting and pinholes okay] [Finish #3 - partially dressed weld with splatter removed] [Finish #4 - good-quality, uniform undressed weld with minimal splatter].
- S. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A123/A123M. For hardware items, hot-dip galvanize to comply with ASTM A153/A153M.
- T. Metallic-Coated-Steel Finish: [High-performance coating] [Galvanized finish].
- U. Steel Finish: [Primed] [Shop painted] [High-performance coating].

## 2.4 HORIZONTAL-SLIDE GATES

- A. Gate Configuration: [Single leaf] [Double leaf] [As indicated].
  - 1. Type: Overhead slide.
  - 2. Type: Cantilever slide, with [external] [internal] roller assemblies.
- B. Gate Frame Height: [72 inches (1830 mm)] [As indicated] <Insert height>.
- C. Gate Opening Width: [36 inches (914 mm)] [As indicated] <Insert width>.
- D. Automated vehicular gates shall comply with ASTM F2200, [Class I] [Class II] [Class III] [Class IV].
- E. Galvanized-Steel Frames and Bracing: Fabricate members from square tubing.
  - 1. Frame Members: Square tubes [1-1/2 by 1-1/2 inches (38 by 38 mm)] [1-3/4 by 1-3/4 inches (45 by 45 mm)] [2 by 2 inches (51 by 51 mm)] [2-1/2 by 2-1/2 inches (64 by 64 mm)] formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication.
  - 2. Bracing Members: Square tubes [1-1/2 by 1-1/2 inches (38 by 38 mm)] [1-3/4 by 1-3/4 inches (45 by 45 mm)] [2 by 2 inches (51 by 51 mm)] [2-1/2 by 2-1/2 inches (64 by 64 mm)] formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication.
- F. Steel Frames and Bracing: Fabricate members from square tubing. [Hot-dip galvanize frames after fabrication.]
  - 1. Frame Members: Steel tubing [1-1/2 by 1-1/2 inches (38 by 38 mm)] [2 by 2 inches (51 by 51 mm)] [2-1/2 by 2-1/2 inches (64 by 64 mm)] <Insert dimensions> with [1/8-inch (3.2-mm)] <Insert thickness> wall thickness.
  - 2. Bracing Members: Steel tubing [1-1/2 by 1-1/2 inches (38 by 38 mm)] [2 by 2 inches (51 by 51 mm)] [2-1/2 by 2-1/2 inches (64 by 64 mm)] <Insert dimensions> with [1/8-inch (3.2-mm)] <Insert dimension> wall thickness.

- G. Frame Corner Construction:
1. Welded frame [**with panels assembled with bolted or riveted corner fittings**] [**and 5/16-inch- (7.9-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider**].
  2. Overhead Slide Gates: Welded or assembled with corner fittings[ **including 5/16-inch- (7.9-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider**].
- H. Additional Rails: Provide as indicated, complying with requirements for fence rails.
- I. Infill: Comply with requirements for adjacent fence.
- J. Overhead Track Assembly: Manufacturer's standard track, with overhead framing supports, bracing, and accessories, engineered to support size, weight, width, operation, and design of gate and roller assemblies.
- K. Hardware: Latches permitting operation from both sides of gate, [**locking devices**] [**hangers**] [**roller assemblies**] <Insert hardware items and accessories> and stops fabricated from [**galvanized steel**] [**galvanized malleable iron**] [**mill-finished, Grade 319 aluminum-alloy casting with stainless-steel fasteners**]. [**Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.**]
1. <Insert requirements for padlocks and chains if not Owner furnished>.
- L. Finish exposed welds to comply with NOMMA Guideline 1, [**Finish #2 - completely sanded joint, some undercutting and pinholes okay**] [**Finish #3 - partially dressed weld with splatter removed**] [**Finish #4 - good-quality, uniform undressed weld with minimal splatter**].
- M. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A123/A123M. For hardware items, hot-dip galvanize to comply with ASTM A153/A153M.
- N. Metallic-Coated-Steel Finish: [**High-performance coating**] [**Galvanized finish**].
- O. Steel Finish: [**Primed**] [**Shop painted**] [**High-performance coating**].

## 2.5 GATE OPERATORS

- A. Gate Operators:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Provide factory-assembled automatic operating system designed for gate size, type, weight, and operation frequency. Provide operation control system with characteristics suitable for Project conditions, with remote-control stations, safety devices, and weatherproof enclosures; coordinate electrical requirements with building electrical system.
1. Provide operator designed so motor may be removed without disturbing limit-switch adjustment and without affecting auxiliary emergency operator.
  2. Provide operator with UL[ **approval**][**-approved components**].
  3. Provide electronic components with built-in troubleshooting diagnostic feature.
  4. Provide unit designed and wired for both right-hand/left-hand opening, permitting universal installation.

- C. Comply with NFPA 70.
- D. UL Standard: Manufacturer and label gate operators to comply with UL 325.
- E. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators on gates that must provide emergency access.
- F. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1 and the following:
1. Voltage: [12-V dc] [24-V dc] [120 V] [208-220 V] [NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected] <Insert voltage>.
  2. Horsepower: Not less than [1/4] [1/3] [1/2] [3/4] <Insert value>.
  3. Enclosure: [Open dripproof] [Totally enclosed] [Manufacturer's standard].
  4. Duty: Continuous duty at ambient temperature of 105 deg F (40 deg C) and at altitude of 3300 feet (1005 m) above sea level.
  5. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
  6. Phase: [One] [Polyphase].
- G. Gate Operators: [Gate] [Concrete base] [Post] [In-ground] mounted and as follows:
1. Hydraulic [Swing] [Slide] Gate Operators:
    - a. Duty: [Light] [Medium] [Heavy] duty, [residential] [commercial/industrial].
    - b. Gate Speed: Minimum [45 feet (13.7 m)] [60 feet (18.2 m)] per minute.
    - c. Maximum Gate Weight: [800 lb (363 kg)] <Insert value>.
    - d. Frequency of Use: [10 cycles per hour] [25 cycles per hour] [Continuous duty].
    - e. Operating Type: Wheel-and-rail drive [with manual release].
    - f. Hydraulic Fluid: Of viscosity required for gate operation at ambient temperature range for Project.
    - g. Locking: Hydraulic in both directions.
    - h. Heater: Manufacturer's standard track and roller heater with thermostatic control.
  2. Mechanical [Swing] [Slide] Gate Operators:
    - a. Duty: [Light] [Medium] [Heavy] duty, [residential] [commercial/industrial].
    - b. Gate Speed: Minimum [45 feet (13.7 m) per minute] [60 feet (18.2 m) per minute] [variable speed] <Insert speed>.
    - c. Maximum Gate Weight: [600 lb (272 kg)] [800 lb (363 kg)] [3000 lb (1360 kg)] <Insert value>.
    - d. Frequency of Use: [10 cycles per hour] [25 cycles per hour] [60 cycles per hour] [Continuous duty].
    - e. Operating Type: [Crank arm] [Wheel-and-rail drive] [Roller chain], [with manual release].
    - f. Drive Type: Enclosed worm gear [and chain-and-sprocket] reducers, roller-chain drive.
    - g. Drive Type: V-belt and [worm gear] [chain-and-sprocket] reducers, roller-chain drive.
    - h. <Insert feature>.
- H. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with [NEMA ICS 6, Type 1] [NEMA ICS 6, Type 4] <Insert type of enclosure> enclosure for [surface] [recessed or flush] [concrete base] [pedestal] <Insert mounting> mounting, and with space for additional optional equipment. Provide the following remote-control device(s):

1. Control Station: Keyed, **[two] [three]**-position switch with open[, **stop,**] and close function; located remotely from gate. Provide two keys per station.
2. Control Station: Momentary-contact, **[single] [three]**-button-operated with open[, **stop,**] and close function; located remotely from gate. **[ Key switch to lock out open and close buttons.]**
3. Card Reader: Functions only when authorized card is presented. Programmable, **[multiple] [single]**-code system[, **permitting four different access periods] [; face-lighted unit fully visible at night]**.
  - a. Reader Type: **[Touch plate] [Swipe] [Insertion] [Proximity]**.
  - b. Features: **[Timed antipassback] [Limited-time usage] [Capable of monitoring and auditing gate activity]**.
4. Digital Keypad Entry Unit: **[Programmable, ]**multiple-code capability of not less than **[five] [500] [2500] <Insert number>** possible individual codes, consisting of **[1- to 7] [4] [5]**-digit codes[, **and permitting four different access periods]**.
  - a. Features: **[Timed antipassback] [Limited-time usage] [Capable of monitoring and auditing gate activity]**.
  - b. Face-lighted unit with **[metal-keyed] [keyless-membrane]** keypad fully visible at night.
5. Radio Control: Digital system consisting of code-compatible universal receiver for each gate, located where indicated, with remote antenna with coaxial cable and mounting brackets designed to operate gates. Provide **[one] [two] <Insert number>** programmable transmitter(s) with multiple-code capability permitting validating or voiding of not less than **[1000] [10,000] <Insert number>** codes per channel configured for the following functions:
  - a. Transmitters: **[Single] [Three]**-button operated, with open **[and close ]**function.
  - b. Channel Settings: **[Two] [Three] [Four] <Insert number>** independent channel settings controlling separate receivers for operating more than one gate from each transmitter.
6. Telephone Entry System: Hands-free, voice-communication system for connection to building telephone system with digital-entry code activation of gate operator[ **and auxiliary keypad entry]**.
  - a. Residential System: Designed to be wired to same line with telephone.
  - b. Multiunit System: Designed to be wired to a dedicated telephone line, with capacity to access **[20] [100] <Insert number>** telephones[, **and with electronic directory]**.
- I. Vehicle Loop Detector: System includes automatic closing timer with adjustable time delay[, **timer cutoff switch,**] and loop detector designed to **[open and close gate] [hold gate open until traffic clears] [reverse gate] <Insert functions>**. System includes electronic detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. System includes number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement, as recommended in writing by detection system manufacturer for function indicated, at location indicated on Drawings.
- J. Vehicle Presence Detector: System includes automatic closing timer with adjustable time delay[, **timer cutoff switch,**] and presence detector designed to **[open and close gate] [hold gate open until traffic clears] [reverse gate] <Insert functions>**. System includes **[retroreflective] [emitter/receiver]** detector with adjustable detection zone pattern and sensitivity, designed to detect the presence or transit of a vehicle in gate pathway when infrared beam in zone pattern is interrupted, and to emit a signal activating the gate operator.
- K. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:

1. Action: Reverse gate in both opening and closing cycles, and hold until clear of obstruction.
  2. Action: Stop gate in opening cycle and reverse gate in closing cycle, and hold until clear of obstruction.
  3. Internal Sensor: Built-in torque or current monitor senses gate is obstructed.
  4. Sensor Edge: Contact-pressure-sensitive safety edge, profile, and sensitivity designed for type of gate and component indicated, in locations as follows. Connect to control circuit using **[take-up cable reel]** **[self-coiling cable]** **[gate edge transmitter and operator receiver system]**.
    - a. Along entire gate leaf leading edge.
    - b. Along entire gate leaf trailing edge.
    - c. Across entire gate leaf bottom edge.
    - d. Along entire length of gate posts.
    - e. Along entire length of gate guide posts.
    - f. Where indicated on Drawings.
    - g. **<Insert extent and location>**.
  5. Photoelectric/Infrared Sensor System: Designed to detect an obstruction in gate's path when infrared beam in the zone pattern is interrupted.
- L. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully retracted and fully extended positions.
- M. Emergency Release Mechanism: Quick-disconnect release of operator drive system of the following type, permitting manual operation if operator fails. Design system so control-circuit power is disconnected during manual operation.
1. Type: **[Integral fail-safe release, allowing gate to be pushed open without mechanical devices, keys, cranks, or special knowledge]** **[Mechanical device, key, or crank-activated release]**.
- N. Operating Features:
1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features **[with capability for monitoring and auditing gate activity]**. Provide unit that is isolated from voltage spikes and surges.
  2. System Integration: With controlling circuit board capable of accepting any type of input from external devices.
  3. Master/Slave Capability: Control stations designed and wired for gate pair operation.
  4. Automatic Closing Timer: With adjustable time delay before closing **[and timer cutoff switch]**.
  5. Open Override Circuit: Designed to override closing commands.
  6. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions.
  7. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded.

8. Clock Timer: **[24-hour] [Seven-day] <Insert time>** programmable for regular events.

O. Accessories:

1. Warning Module: **[Audio] [Visual], [constant] [strobe]**-light alarm sounding three to five seconds in advance of gate operation and continuing until gate stops moving; compliant with the United States Access Board's ADA-ABA Accessibility Guidelines.
2. Battery Backup System: Battery-powered drive and access-control system, independent of primary drive system.
  - a. Fail-Safe: Gate opens and remains open until power is restored.
  - b. Fail-Secure: Gate cycles on battery power, then fail-safe when battery is discharged.
3. External electric-powered **[solenoid] [magnetic]** lock with delay timer allowing time for lock to release before gate operates.
4. **[Fire] [Postal]** box.
5. Fire **[strobe] [siren]** sensor.
6. Intercom System: **<Insert requirements>**.
7. Instructional, Safety, and Warning Labels and Signs: **[According to UL 325] [Manufacturer's standard for components and features specified] [As indicated on Drawings] <Insert requirements>**.
8. Equipment Bases/Pads: Precast concrete, **[depth not less than 12 inches (305 mm)] <Insert depth>**, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.

## 2.6 STEEL AND IRON

- A. Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Tubing: ASTM A500/A500M, cold-formed steel tubing.
- C. Uncoated Steel Sheet: **[Hot-rolled steel sheet, ASTM A1011/A1011M, Structural Steel, Grade 45 (Grade 310)] [or] [cold-rolled steel sheet, ASTM A1008/A1008M, Structural Steel, Grade 50 (Grade 340)]**.
- D. Galvanized-Steel Sheet: ASTM A653/A653M, structural quality, **Grade 50 (Grade 340)**, with **[G90 (Z275)] [G60 (Z180)]** coating.
- E. Aluminum-Zinc, Alloy-Coated Steel Sheet: ASTM A792/A792M, structural quality, **Grade 50 (Grade 340)**, with **AZ60 (AZM180)** coating.
- F. Castings: Either gray or malleable iron unless otherwise indicated.
  1. Gray Iron: ASTM A48/A48M, Class 30.
  2. Malleable Iron: ASTM A47/A47M.

## 2.7 COATING MATERIALS

- A. Shop Primers for Steel: Provide primers that comply with **[Section 099113 "Exterior Painting.]" [Section 099600 "High-Performance Coatings.]"**

- B. Shop Primer for Steel: Manufacturer's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- C. Epoxy Zinc-Rich Primer for Uncoated Steel: Complying with MPI #20 and compatible with coating specified to be applied over it.
1. Products: Subject to compliance with requirements, **[provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:**
    - a. **<Insert manufacturer's name; product name or designation>.**
- D. Epoxy Primer for Galvanized Steel: Epoxy primer recommended in writing by topcoat manufacturer.
1. Products: Subject to compliance with requirements, **[provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:**
    - a. **<Insert manufacturer's name; product name or designation>.**
- E. Epoxy Intermediate Coat for Uncoated Steel: Complying with MPI #77 and compatible with primer and topcoat.
1. Products: Subject to compliance with requirements, **[provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:**
    - a. **<Insert manufacturer's name; product name or designation>.**
- F. Intermediate Coat for Uncoated Steel: Epoxy or polyurethane intermediate recommended in writing by primer and topcoat manufacturer.
1. Products: Subject to compliance with requirements, **[provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:**
    - a. **<Insert manufacturer's name; product name or designation>.**
- G. Polyurethane[ **Intermediate Coat and**] Topcoat: Complying with MPI #72 and compatible with undercoat.
1. Products: Subject to compliance with requirements, **[provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:**
    - a. **<Insert manufacturer's name; product name or designation>.**

## 2.8 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.



- B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of **3000 psi (20 MPa)**, **3-inch (75-mm)** slump, and **1-inch (25-mm)** maximum aggregate size[ **or dry, packaged, normal-weight concrete mix complying with ASTM C387/C387M mixed with potable water according to manufacturer's written instructions**].
- C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M and specifically recommended by manufacturer for exterior applications.

## 2.9 GROUNDING MATERIALS

- A. Comply with requirements of Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Grounding Conductors: Size as indicated on Drawings. Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
  - 1. Material above Finished Grade: **[Copper] [Aluminum]**.
  - 2. Material on or below Finished Grade: Copper.
  - 3. Bonding Jumpers: Braided copper tape, **1-5/8 inch (41 mm)** wide and **1/16 inch (1.6 mm)** thick, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- C. Grounding Connectors and Grounding Rods: Comply with UL 467.
  - 1. Connectors for Below-Grade Use: Exothermic-welded type.
  - 2. Grounding Rods: Copper-clad steel.
    - a. Size: **5/8 by 96 inches (16 by 2440 mm)**.

## 2.10 STEEL FINISHES

- A. Surface Preparation: Clean surfaces according to **[SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning.]"** **[SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning.]"** After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.
- B. Primer Application: Apply zinc-rich epoxy primer immediately after cleaning, to provide a minimum dry film thickness of **2 mils (0.05 mm)** per applied coat, to surfaces that are exposed after assembly and installation, and to concealed surfaces.
- C. Shop-Painted Finish: Comply with **[Section 099113 "Exterior Painting.]"** **[Section 099600 "High-Performance Coatings.]"**
- D. High-Performance Coating: Apply intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
  - 1. Match approved Samples for color, texture, and coverage. Remove and refinish, or recoat work that does not comply with specified requirements.

**2.11 METALLIC-COATED-STEEL FINISHES**

- A. Galvanized Finish: Clean welds, mechanical connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.
- B. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a **[zinc-phosphate]** conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A780/A780M.
- C. Powder Coating: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat finish consisting of **[zinc-rich]** epoxy prime coat and TGIC polyester topcoat to a minimum dry film thickness of **2 mils (0.05 mm)**. Comply with coating manufacturer's written instructions to achieve a minimum total dry film thickness of **4 mils (0.10 mm)**.
  - 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>**.
  - 2. Comply with surface finish testing requirements in ASTM F2408 **[except change corrosion-resistance requirement to 3000 hours without failure]**.
- D. High-Performance Coating: Apply epoxy primer, polyurethane intermediate coat, and polyurethane topcoat to prepared surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
  - 1. Match approved Samples for color, texture, and coverage. Remove and refinish, or recoat work that does not comply with specified requirements.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of **500 feet (152.5 m)** or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
  - 1. Construction layout and field engineering are specified in Section 017300 "Execution."

### 3.3 DECORATIVE SECURITY FENCE INSTALLATION

- A. Install fences according to manufacturer's written instructions.
- B. Install fences by setting posts as indicated and fastening **[rails]** **[and]** **[infill panels]** to posts. **[Peen threads of bolts after assembly to prevent removal.]**
- C. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than **24 inches (600 mm)** plus **3 inches (75 mm)** for each **foot (300 mm)** or fraction of **a foot (300 mm)** that fence height exceeds **4 feet (1.2 m)**.
- D. Post Setting: Set posts **[in concrete]** **[with mechanical anchors]** **[by mechanically driving into soil]** at indicated spacing into firm, undisturbed soil.
  1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
  2. Concrete Fill: Place concrete around **[posts]** **[and]** **[sleeves]** and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
    - a. Exposed Concrete: Extend **2 inches (51 mm)** above grade. Finish and slope top surface to drain water away from post.
    - b. Concealed Concrete: Top **[2 inches (51 mm)]** **<Insert dimension>** below grade **[as indicated on Drawings]** to allow covering with surface material. Slope top surface of concrete to drain water away from post.
  3. Posts Set in Concrete: Extend post to within **6 inches (150 mm)** of specified excavation depth, but not closer than **3 inches (75 mm)** to bottom of concrete.
  4. Posts Set into Concrete in Sleeves: Use galvanized-steel pipe sleeves with inside diameter at least **3/4 inch (20 mm)** larger than outside diagonal dimension of post, preset and anchored into concrete for installing posts.
    - a. Extend posts at least **5 inches (125 mm)** into sleeve.
    - b. After posts have been inserted in sleeves, fill annular space between post and sleeve with nonshrink grout, mixed and placed to comply with grout manufacturer's written instructions; shape and smooth to shed water. Finish and slope top surface of grout to drain water away from post.
  5. Posts Set into Voids in Concrete: Form or core drill holes not less than **3/4 inch (20 mm)** larger than outside diagonal dimension of post.
    - a. Extend posts at least **5 inches (125 mm)** into concrete.
    - b. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink grout, mixed and placed to comply with grout manufacturer's written instructions. Finish and slope top surface of grout to drain water away from post.
  6. Mechanically Driven Posts: Drive into soil to depth of **[30 inches (762 mm)]** **[36 inches (914 mm)]** **<Insert dimension>**. Protect post top to prevent distortion.
  7. Space posts uniformly at **[6 feet (1.83 m)]** **[8 feet (2.44 m)]** **<Insert dimension>** o.c.

### 3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

### 3.5 GATE OPERATOR INSTALLATION

- A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.
- B. Excavation for **[Support Posts] [Pedestals] [Concrete Bases]**: Hand-excavate holes for bases in firm, undisturbed soil to dimensions and depths and at locations as required by gate operator component manufacturer's written instructions and as indicated.
- C. Concrete Bases: Cast-in-place or precast concrete, **[depth not less than 12 inches (300 mm)] <Insert depth>**, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.
- D. Vehicle Loop Detector System: **[Cut grooves in pavement and ]**bury and seal wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.
- E. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

### 3.6 GROUNDING AND BONDING

- A. Comply with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fence Grounding: Install at maximum intervals of **[1500 feet (450 m)] <Insert a lesser distance if grounding resistance is high>** except as follows:
  - 1. Fences within **100 Feet (30 m)** of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of **[750 feet (225 m)] <Insert a lesser distance if grounding resistance is high>**.
    - a. Gates and Other Fence Openings: Ground fence on each side of opening.
      - 1) Bond metal gates to gate posts.
      - 2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least **18 inches (460 mm)** below finished grade.
  - C. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of **150 feet (45 m)** on each side of crossing.
  - D. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.
  - E. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is **6 inches (150 mm)** below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.

- F. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- G. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- H. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
  - 1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
  - 2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
  - 3. Report: Prepare test reports of grounding resistance at each test location certified by a testing agency. Include observations of weather and other phenomena that may affect test results.

### 3.8 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Automatic Gate Operators: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices, **[alarms,]** and limit switches.
  - 1. Hydraulic Operators: Purge operating system, adjust pressure and fluid levels, and check for leaks.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls[, **alarms,**] and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Lubricate hardware[, **gate operators,**] and other moving parts.

### 3.9 DEMONSTRATION

- A. **[Engage a factory-authorized service representative to train] [Train]** Owner's personnel to adjust, operate, and maintain gates.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 32 32 23 - SEGMENTAL RETAINING WALLS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes [**single-**] [**and**] [**multiple-**]depth segmental retaining walls [**with**] [**and**] [**without**] soil reinforcement.
- B. Related Requirements:
  - 1. Section 312000 "Earth Moving" for excavation for segmental retaining walls.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at [**Project site**] <Insert location>.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
  - 1. <Double click to insert sustainable design text for regional materials.>
- C. Samples: For each color and texture of concrete unit specified. Submit [**full-size units**] [**sections of units not less than 3 inches (75 mm) square**].
- D. Delegated-Design Submittal: For segmental retaining walls.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing agency.
- B. Product Certificates: For each type of segmental retaining wall unit[ **and soil reinforcement**] from manufacturer.
  - 1. Include test data for shear strength between segmental retaining wall units according to ASTM D6916.
  - 2. Include test data for connection strength between segmental retaining wall units and soil reinforcement according to ASTM D6638.
- C. Product Test Reports: For each type of segmental retaining wall unit[ **and soil reinforcement**], for tests performed by a qualified testing agency.
  - 1. Include test data for freeze-thaw durability of segmental retaining wall units.
  - 2. Include test data for shear strength between segmental retaining wall units according to ASTM D6916.
  - 3. Include test data for connection strength between segmental retaining wall units and soil reinforcement according to ASTM D6638.
- D. Research/Evaluation Reports: For segmental retaining wall units[ **and soil reinforcement**], from ICC-ES.

- E. Preconstruction test reports.
- F. Source quality-control reports.
- G. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects.
  - 1. Build mockup of segmental retaining wall [as indicated on Drawings] [approximately **72 inches (1800 mm)** long by not less than **36 inches (900 mm)** high above finished grade at front of wall].
    - a. Include typical soil reinforcement.
    - b. Include typical base and cap or finished top construction.
    - c. Include backfill to typical finished grades at both sides of wall.
    - d. Include typical end construction at one end of mockup.
    - e. Include **36-inch (900-mm)** return at one end of mockup, with typical corner construction.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform the following preconstruction testing:
  - 1. Test soil reinforcement and backfill materials for pullout resistance according to ASTM D6706.
  - 2. Test soil reinforcement and backfill materials for coefficient of friction according to ASTM D5321.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle concrete units and accessories to prevent deterioration or damage due to contaminants, breaking, chipping, or other causes.
- B. Store geosynthetics in manufacturer's original packaging with labels intact. Store and handle geosynthetics to prevent deterioration or damage due to sunlight, chemicals, flames, temperatures above **160 deg F (71 deg C)** or below **32 deg F (0 deg C)**, and other conditions that might damage them. Verify identification of geosynthetics before use, and examine them for defects as material is placed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Basis of Design: Design of segmental retaining walls is based on products indicated. If comparable products of another manufacturer are proposed, engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design segmental retaining walls.

- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design segmental retaining walls.
- C. Compliance Review: Qualified professional engineer responsible for segmental retaining wall design shall review and approve submittals and source and field quality-control reports for compliance of materials and construction with design.
- D. Structural Performance: Engineering design shall be based on the following loads and be according to **[NCMA's "Design Manual for Segmental Retaining Walls.]"** **<Insert applicable requirement.>**
  - 1. Gravity loads due to soil pressures resulting from grades **[ and sloped backfill]** indicated.
  - 2. Superimposed loads (surcharge) indicated on Drawings.
  - 3. Horizontal Peak Ground Acceleration (A) for Project: **<Insert value>**.

## 2.2 SEGMENTAL RETAINING WALL UNITS

- A. Concrete Units: ASTM C1372, Normal Weight, except that **[ maximum water absorption shall not exceed 7 percent by weight and]** units shall not differ in height more than plus or minus **1/16 inch (1.6 mm)** from specified dimension.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  - 2. Provide units that comply with requirements in ASTM C1372 for freeze-thaw durability **[ as determined by testing]**.
  - 3. Provide units that interlock with courses above and below by means of **[integral lugs, lips, or tongues and grooves] [pins] [clips] [splines] [or] [and] [hollow cores filled with drainage fill]**.
- B. [<Double click to insert sustainable design text for regional materials.>](#)
- C. Color: **[As indicated by manufacturer's designations] [Match Architect's samples] [As selected by Architect from manufacturer's full range]**.
- D. Shape and Texture: Provide units with **[machine-split textured] [smooth], [flat exposed face] [shaped exposed face with deeply beveled vertical edges]**.
  - 1. Face Dimensions: **[4 inches (100 mm)] [6 inches (150 mm)] [8 inches (200 mm)]** **<Insert dimension>** high by **[12 inches (300 mm)] [16 inches (400 mm)] [18 inches (460 mm)]** **<Insert dimension>** long.
  - 2. Face Dimensions: Mix of sizes providing appearance of random range ashlar stone masonry.
  - 3. Face Dimensions: As indicated.
- E. Shape and Texture: Provide units matching basic shape, dimensions, and face texture of basis-of-design product.
- F. Shape and Texture: Provide units of any basic shape and dimensions that produce segmental retaining walls of dimensions and profiles indicated without interfering with other elements of the Work and with **[machine-split textured] [smooth], [flat exposed face] [shaped exposed face with deeply beveled vertical edges]**.
- G. Batter: Provide units that offset from course below to provide **[at least] [1:24] [1:16] [1:14] [1:8] [1:5]** batter.
- H. Cap Units: Provide cap units of **[shape indicated] [same shape as other units]** with smooth, as-cast top surfaces without holes or lugs.
- I. Special Units: Provide corner units, end units, and other shapes as needed to produce segmental retaining walls of dimensions and profiles indicated and to provide texture on exposed surfaces **[matching face] [as indicated]**.

### 2.3 INSTALLATION MATERIALS

- A. Pins: Product supplied by segmental retaining wall unit manufacturer for use with units provided, made from nondegrading polymer reinforced with glass fibers.
- B. Clips: Product supplied by segmental retaining wall unit manufacturer for use with units provided, made from nondegrading polymer reinforced with glass fibers.
- C. Cap Adhesive: Product supplied or recommended by segmental retaining wall unit manufacturer for adhering cap units to units below.
- D. Leveling Base: Comply with requirements in Section 312000 "Earth Moving" for [base] [drainage] course.
  - 1. Leveling Course: Lean concrete with a compressive strength of not more than 500 psi (3.4 MPa).
- E. Drainage Fill: Comply with requirements in Section 312000 "Earth Moving" for drainage course.
- F. Reinforced-Soil Fill: Comply with requirements in Section 312000 "Earth Moving" for satisfactory soils.
- G. Reinforced-Soil Fill: ASTM D2487; GW, GP, SW, SP, and SM soil classification groups or a combination of these groups; free of debris, waste, frozen materials, vegetation, and other deleterious matter; complying with the following gradation according to ASTM C136: 20 to 100 percent passing No. 4 (4.75-mm) sieve, zero to 60 percent passing No. 40 (0.425-mm) sieve, zero to 35 percent passing No. 200 (0.075-mm) sieve, and with fine fraction having a plasticity index of less than 20.
- H. Nonreinforced-Soil Fill: Comply with requirements in Section 312000 "Earth Moving" for satisfactory soils.
- I. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.
- J. Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent.
  - 1. Apparent Opening Size: No. 70 to 100 (0.212- to 0.150-mm) sieve, maximum; ASTM D4751.
  - 2. Minimum Grab Tensile Strength: 110 lb (49.9 kg); ASTM D4632.
  - 3. Minimum Weight: 4 oz./sq. yd. (132 g/sq. m).
- K. Soil Reinforcement: Product specifically manufactured for use as soil reinforcement and as follows:
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  - 2. Product Type: [Knitted or woven geogrid made from polyester yarns with a protective coating] [Molded geogrid made from high-density polyethylene] [Woven geotextile made from polyamides, polyesters, or polyolefins].

### 2.4 SOURCE QUALITY CONTROL

- A. Factory test and inspect each roll of soil reinforcement for minimum average roll values for geosynthetic index property tests, including the following:
  - 1. Weight.
  - 2. Grab or single-rib strength.
  - 3. Aperture opening.
  - 4. Rib or yarn size.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for excavation tolerances, condition of subgrades, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 RETAINING WALL INSTALLATION**

- A. General: Place units according to NCMA's "Segmental Retaining Wall Installation Guide" and segmental retaining wall unit manufacturer's written instructions.
  - 1. Lay units in **[running bond] [bond pattern indicated]**.
  - 2. Form corners and ends by **[using special units] [cutting units with motor-driven saw] [or] [splitting units with mason's hammer and chisel]**.
- B. Do not use units with chips, cracks, or other defects that are visible at a distance of **20 feet (6 m)** where such defects are exposed in the completed Work.
- C. Leveling Base: Place and compact base material to thickness indicated and with not less than 95 percent maximum dry unit weight according to ASTM D698.
  - 1. Leveling Course: **[At Contractor's option, unreinforced lean concrete may be substituted for upper 1 to 2 inches (25 to 50 mm) of base] [Place unreinforced lean concrete over leveling base 1 to 2 inches (25 to 50 mm) thick]**. Compact and screed concrete to a smooth, level surface.
- D. First Course: Place first course of segmental retaining wall units for full length of wall. Place units in firm contact with each other, properly aligned and level.
  - 1. Tamp units into leveling base as necessary to bring tops of units into a level plane.
- E. Subsequent Courses: Remove excess fill and debris from tops of units in course below. Place units in firm contact, properly aligned, and directly on course below.
  - 1. For units with lugs designed to fit into holes in adjacent units, lay units so lugs are accurately aligned with holes, and bedding surfaces are firmly seated on beds of units below.
  - 2. For units with lips at front of units, slide units as far forward as possible for firm contact with lips of units below.
  - 3. For units with lips at bottom rear of units, slide units as far forward as possible for firm contact of lips with units below.
  - 4. For units with pins, install pins and align units.
  - 5. For units with clips, install clips and align units.
- F. Cap Units: Place cap units and secure with cap adhesive.

**3.3 FILL PLACEMENT**

- A. General: Comply with requirements in Section 312000 "Earth Moving," with NCMA's "Segmental Retaining Wall Installation Guide," and with segmental retaining wall unit manufacturer's written instructions.
- B. Fill voids between and within units with drainage fill. Place fill as each course of units is laid.
- C. Place, spread, and compact drainage fill and soil fill in uniform lifts for full width and length of embankment as wall is laid. Place and compact fills without disturbing alignment of units. Where

both sides of wall are indicated to be filled, place fills on both sides at same time. Begin at wall, and place and spread fills toward embankment.

1. Use only hand-operated compaction equipment within **48 inches (1200 mm)** of wall, or one-half of height above bottom of wall, whichever is greater.
  2. Compact reinforced-soil fill to not less than 95 percent maximum dry unit weight according to ASTM D698.
    - a. In areas where only hand-operated compaction equipment is allowed, compact fills to not less than 90 percent maximum dry unit weight according to ASTM D698.
    - b. In areas where fill height exceeds **15 feet (4.5 m)**, compact reinforced-soil fill that will be more than **15 feet (4.5 m)** below finished grade to not less than 98 percent maximum dry unit weight according to ASTM D698.
    - c. In areas where fill height exceeds **30 feet (9 m)**, compact reinforced-soil fill that will be more than **30 feet (9 m)** below finished grade to not less than 100 percent maximum dry unit weight according to ASTM D698.
  3. Compact nonreinforced-soil fill to comply with Section 312000 "Earth Moving."
- D. Place drainage geotextile against back of wall, and place layer of drainage fill at least [**12 inches (300 mm)**] [**6 inches (150 mm)**] wide behind drainage geotextile to within **12 inches (300 mm)** of finished grade. Place another layer of drainage geotextile between drainage fill and soil fill.
  - E. Place a layer of drainage fill at least [**12 inches (300 mm)**] [**6 inches (150 mm)**] wide behind wall to within **12 inches (300 mm)** of finished grade. Place a layer of drainage geotextile between drainage fill and soil fill.
  - F. Wrap subdrainage pipe with filter fabric and place in drainage fill as indicated[, **sloped not less than 0.5 percent to drain**].
  - G. Place impervious fill over top edge of drainage fill layer.
  - H. Slope grade at top of wall away from wall unless otherwise indicated. Slope grade at wall base away from wall. Provide uniform slopes that prevent ponding.
  - I. Place soil reinforcement in horizontal joints of retaining wall where indicated and according to soil-reinforcement manufacturer's written instructions. Embed reinforcement a minimum of **8 inches (200 mm)** into retaining wall and stretch tight over compacted backfill. Anchor soil reinforcement before placing fill.
    1. Place additional soil reinforcement at corners and curved walls to provide continuous reinforcement.
    2. Place geosynthetics with seams, if any, oriented perpendicular to segmental retaining walls.
    3. Do not dump fill material directly from trucks onto geosynthetics.
    4. Place at least **6 inches (150 mm)** of fill over reinforcement before compacting with tracked vehicles or **4 inches (100 mm)** before compacting with rubber-tired vehicles.
    5. Do not turn vehicles on fill until first layer of fill is compacted and second layer is placed over each soil-reinforcement layer.

### 3.4 CONSTRUCTION TOLERANCES

- A. Variation from Level: For bed-joint lines along walls, do not exceed **1-1/4 inches in 10 feet (32 mm in 3 m)**, **3 inches (75 mm)** maximum.
- B. Variation from Indicated Batter: For slope of wall face, do not vary from indicated slope by more than **1-1/4 inches in 10 feet (32 mm in 3 m)**.
- C. Variation from Indicated Wall Line: For walls indicated as straight, do not vary from straight line by more than **1-1/4 inches in 10 feet (32 mm in 3 m)**.
- D. Maximum Gap between Units: **1/8 inch (3 mm)**.

**3.5 FIELD QUALITY CONTROL**

- A. Testing Agency: **[Owner will engage]** **[Engage]** a qualified testing agency to perform tests and inspections.
- B. Comply with requirements in Section 312000 "Earth Moving" for field quality control.
  - 1. In each compacted backfill layer, perform at least one field in-place compaction test for each **[150 feet (45 m)]** **<Insert dimension>** or less of segmental retaining wall length.
  - 2. In each compacted backfill layer, perform at least one field in-place compaction test for each **[24 inches (600 mm)]** **<Insert dimension>** of fill depth and each **[50 feet (15 m)]** **<Insert dimension>** or less of segmental retaining wall length.

**3.6 ADJUSTING**

- A. Remove and replace segmental retaining wall construction of the following descriptions:
  - 1. Broken, chipped, stained, or otherwise damaged units. Units may be repaired if Architect approves methods and results.
  - 2. Segmental retaining walls that do not match approved Samples **[ and mockups]**.
  - 3. Segmental retaining walls that do not comply with other requirements indicated.
- B. Replace units so segmental retaining wall matches approved Samples and mockups, complies with other requirements, and shows no evidence of replacement.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 32 33 00 - SITE FURNISHINGS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:

1. Seating.
2. Tables.
3. Bicycle racks.
4. Bicycle lockers.
5. Trash receptacles.
6. Ash receptacles.
7. Planters.
8. Bollards.

- B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for **[installing pipe sleeves cast] [installing anchor bolts cast] [formed voids]** in concrete footings.
2. Section 312000 "Earth Moving" for excavation for installing concrete footings.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.  
B. Sustainable Design Submittals:

1. [<Double click to insert sustainable design text for recycled content.>](#)
2. [<Double click to insert sustainable design text for certified wood.>](#)

- C. Samples: For each exposed product and for each color and texture specified.  
D. Samples for Initial Selection: For units with factory-applied finishes.  
E. Samples for Verification: For each type of exposed finish, not less than **6-inch- (152-mm-)** long linear components and **4-inch- (102-mm-)** square sheet components.

1. Include full-size Samples of **[bench] [table] [bicycle rack] [trash receptacle] [ash receptacle]** **<Insert product>**. Approved samples may be incorporated into the Work.

- F. Product Schedule: For site furnishings.[ Use same designations indicated on Drawings].

**1.4 INFORMATIONAL SUBMITTALS**

- A. Material Certificates: For site furnishings manufactured with preservative-treated wood.
1. Indicate type of preservative used and net amount of preservative retained. **[ For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.]**

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For site furnishings to include in maintenance manuals.

**1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Bench Replacement **[Slats] [Planks]**: No fewer than **[two]** <Insert number> full-size units for each size indicated.
  2. Trash Receptacle Inner Containers: **[Five]** <Insert number> full-size units for each size indicated, but no fewer than **[two]** <Insert number> units.
  3. Anchors: <Insert type and number>.

**PART 2 - PRODUCTS****2.1 SEATING** <Insert drawing designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Frame: [Cast aluminum] [Cast iron] [Steel] [Stainless steel] [Wrought iron] [Cedar] [Teak] <Insert material>.
- C. Seat[ and Back]:
1. Material:
    - a. Aluminum Sheet: **[Perforated] [Expanded]** metal.
    - b. **[Painted]** Steel: **[Perforated metal] [Expanded metal] [Evenly spaced, parallel flat straps or bars] [Evenly woven, flat straps or bars] [Edge framed, evenly spaced, parallel rods or rolled bars]** <Insert description>.
    - c. Stainless Steel: **[Perforated metal] [Expanded metal] [Evenly spaced, parallel flat straps or bars] [Evenly woven, flat straps or bars] [Edge framed, evenly spaced, parallel rods or rolled bars]** <Insert description>.
    - d. Wood: **[Douglas fir] [Pine] [Cedar] [Redwood] [Teak]** <Insert species>; formed into **[evenly spaced parallel slats] [planks]** <Insert description>.
    - e. **[Recycled] [Plastic] [Fiberglass]** Planks: **[Evenly spaced, parallel]** <Insert description>.
    - f. **[Recycled] [Plastic] [Fiberglass]** Sheet: **[Solid] [Perforated]**.
  2. Seat Height: **[As indicated]** <Insert dimension>.
  3. Seat Surface Shape: **[Flat] [Contoured or dished]**.

4. Overall Height: **[As indicated]** <Insert dimension>.
  5. Overall Width: **[As indicated]** <Insert dimension>.
  6. Overall Depth: **[As indicated]** <Insert dimension>.
  7. Arms: **[None]** **[One, as indicated]** **[Two, one at each end]** **[Three, one at each end and in center]** <Insert requirements>.
    - a. Arm Material: Match **[frame]** **[seat]** <Insert component>.
  8. Weight: <Insert weight>.
  9. Seating Configuration: Multiple units **[as indicated]**.
    - a. **[Straight]** **[Angled]** **[Curved]** shape.
    - b. Closed **[hexagon]** **[circle]** **[shape indicated]** around a **[tree trunk]** **[planter]** **[light post]** <Insert central element>.
- D. Aluminum Finish: **[Mill finish]** **[Color coated]**.
1. Color: **[As indicated by manufacturer's designation]** **[Match Architect's samples]** **[As selected by Architect from manufacturer's full range]** **[As indicated in a site furnishing schedule]** <Insert color>.
- E. Steel Finish: **[Galvanized and]** **[color]** **[PVC-color]** coated.
1. Color: **[As indicated by manufacturer's designation]** **[Match Architect's samples]** **[As selected by Architect from manufacturer's full range]** **[As indicated in a site furnishing schedule]** <Insert color>.
- F. Stainless Steel Finish: **[ASTM A480/A480M, No. 6]** <Insert description>.
- G. Wood Finish: **[Unfinished]** **[Factory-applied transparent finish]** **[Factory-applied stain and transparent finish]** **[Factory-applied opaque finish]** **[Manufacturer's standard finish]**.
1. Stain: **[Manufacturer's standard]** <Insert stain type and color>.
- H. **[Fiberglass]** **[HDPE]** Color: **[As indicated by manufacturer's designation]** **[Match Architect's samples]** **[As selected by Architect from manufacturer's full range]** **[As indicated in a site furnishing schedule]** <Insert description>.
- I. Graphics: **[Surface-applied]** **[Engraved]** **[Attached brass plaque with engraved]** copy, content, and style **[according to manufacturer's standard]** **[as indicated on Drawings]**.

## 2.2 TABLES <Insert drawing designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Frame: **[Cast aluminum]** **[Cast iron]** **[Steel]** **[Stainless steel]** **[Wrought iron]** **[Cedar]** **[Teak]** <Insert material>.
- C. Table Top:
  1. Material:
    - a. Aluminum Sheet: **[Perforated]** **[Expanded]** metal.
    - b. **[Painted]** **[Steel]**: **[Perforated metal]** **[Expanded metal]** **[Evenly spaced, parallel flat straps or bars]** **[Evenly woven, flat straps or bars]** **[Edge framed, evenly spaced, parallel rods or rolled bars]** <Insert description>.

- c. Stainless Steel: [Perforated metal] [Expanded metal] [Evenly spaced, parallel flat straps or bars] [Evenly woven, flat straps or bars] [Edge framed, evenly spaced, parallel rods or rolled bars] <Insert description>.
  - d. Wood: [Douglas fir] [Pine] [Cedar] [Redwood] [Teak] <Insert species>; formed into [evenly spaced parallel slats] [planks] <Insert description>.
  - e. [Recycled] [Plastic] [Fiberglass] Planks: [Evenly spaced, parallel] <Insert description>.
  - f. [Recycled] [Plastic] [Fiberglass] Sheet: [Solid] [Perforated].
- 2. Surface Shape: [Round] [Hexagon] [Shape indicated] <Insert shape>.
  - 3. Feature: [Center umbrella hole] <Insert feature>.
- D. Aluminum Finish: [Mill finish] [Color coated].
- 1. Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert color>.
- E. Steel Finish: [Galvanized and] [color] [PVC-color] coated.
- 1. Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert color>.
- F. Stainless Steel Finish: [ASTM A480/480M, No. 6] <Insert description>.
- G. Wood Finish: [Unfinished] [Factory-applied transparent finish] [Factory-applied stain and transparent finish] [Factory-applied opaque finish] [Manufacturer's standard finish].
- 1. Stain: [Manufacturer's standard] <Insert stain type and color>.
- H. [Fiberglass] [HDPE] Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.
- I. Graphics: [Surface-applied] [Engraved] [Attached brass plaque with engraved] copy, content, and style [per manufacturer's standard] [as indicated on Drawings].

### 2.3 BICYCLE RACKS <Insert drawing designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Bicycle Rack Construction:
- 1. Frame: [Aluminum] [Steel] [Galvanized steel] [Stainless steel] [Steel and redwood] [Steel and pine] <Insert description>.
    - a. [Pipe] [Tubing] OD: Not less than [1-5/8 inches (41 mm)] [2-3/8 inches (60 mm)] [2-7/8 inches (73 mm)] [4-1/2 inches (115 mm)] <Insert dimension>.
    - b. Locking Bars: Solid round bar, not less than [3/4 inch (19 mm)] [1 inch (25 mm)] in diameter.
  - 2. Style: [Single-side parking] [Double-side parking] [Bollard] [As indicated] <Insert description>.
    - a. Overall Height: [As indicated] <Insert dimension>.
    - b. Overall Width: [As indicated] <Insert dimension>.

- c. Overall Depth: **[As indicated]** <Insert dimension>.
  - d. Capacity: Designed to accommodate no fewer than **[two]** **[three]** **[four]** <Insert number> bicycles.
3. Security: Designed to lock **[wheel]** **[and]** **[frame]**.
  4. Accessories: **[Base covers for each pipe and tubing anchored end]** **[Wheel stops]** <Insert accessory>.
  5. Installation Method: **[Freestanding]** **[Surface flange anchored at finished grade to substrate indicated]** **[Surface flange anchored below finished grade to substrate indicated]** **[Cast in concrete]** **[Bolted to cast-in anchor bolts]** **[Wall mounted]** **[As indicated]**.
- C. Aluminum Finish: **[Mill finish]** **[Color coated]**.
1. Color: **[As indicated by manufacturer's designation]** **[Match Architect's samples]** **[As selected by Architect from manufacturer's full range]** **[As indicated in a site furnishing schedule]** <Insert description>.
- D. Steel Finish: **[Galvanized]** **[Color coated]**.
1. Color: **[As indicated by manufacturer's designation]** **[Match Architect's samples]** **[As selected by Architect from manufacturer's full range]** **[As indicated in a site furnishing schedule]** <Insert color>.
- E. Stainless Steel Finish: **[ASTM A480/A480M, No. 4]** <Insert description>.
- F. Wood Finish: **[Unfinished]** **[Manufacturer's standard finish]**.

## 2.4 BICYCLE LOCKERS <Insert drawing designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Bicycle Locker Construction:
1. Locker: **[Molded one-piece fiberglass]** **[Steel sheet, 0.053 inch (1.4 mm) thick]** **[Steel sheet, 0.053 inch (1.4 mm) thick, with perforated metal sides]** **[with welded tubular steel frame]** <Insert material>.
  2. Door: **[Molded one-piece fiberglass]** **[Steel sheet, 0.053 inch (1.4 mm) thick]** **[with tubular steel frame]** **[Match locker]** <Insert material>.
  3. View **[Window]** **[Grille]**: **[Lexan, 12 inches (305 mm) square]** **[Perforated metal]**.
  4. Lock: **[Manufacturer's standard]** **[Key lock with internal locking bar]** **[Coin/token lock]** <Insert description>.
    - a. Provide **[four]** <Insert number> keys.
  5. Overall Height: **[As indicated]** <Insert dimension>.
  6. Overall Width: **[As indicated]** <Insert dimension>.
  7. Overall Depth: **[As indicated]** <Insert dimension>.
  8. Capacity: Designed to accommodate **[one]** **[two]** bicycle(s).
  9. Installation Method: **[Locker anchored at finished grade to substrate indicated]** **[Locker anchored below finished grade to substrate indicated]** **[As indicated]**.
  10. Locker Configuration: **[Multiple]** **[Four]** <Insert number> units **[as indicated]**, in **[straight row]** **[curved shape]** **[shape indicated]** <Insert description>.
- C. Steel Finish: Color coated.

1. Color: **[As indicated by manufacturer's designation]** **[Match Architect's samples]** **[As selected by Architect from manufacturer's full range]** **[As indicated in a site furnishing schedule]** **<Insert description>**.

D. Fiberglass Color: **[As indicated by manufacturer's designation]** **[Match Architect's samples]** **[As selected by Architect from manufacturer's full range]** **[As indicated in a site furnishing schedule]** **<Insert description>**.

## 2.5 TRASH RECEPTACLES **<Insert drawing designation>**

A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

B. Aluminum Facing Surrounds: **[Aluminum sheet]** **[Perforated aluminum sheet]** **[Grid in tubular frame]** **[Evenly patterned, parallel flat aluminum straps, bars, or tubular shapes]** **[Match benches]** **<Insert material and description>**.

C. Steel Facing Surrounds: **[Steel sheet]** **[Perforated-steel sheet]** **[Evenly patterned, parallel flat steel straps, bars, or tubular shapes]** **[Evenly patterned, parallel round steel rods, bars, or tubular shapes]** **[Grid in tubular frame]** **[Match benches]** **<Insert material and description>**.

D. Stainless Steel Facing Surrounds: **[Steel sheet]** **[Perforated-steel sheet]** **[Evenly patterned, parallel flat steel straps, bars, or tubular shapes]** **[Evenly patterned, parallel round steel rods, bars, or tubular shapes]** **[Grid in tubular frame]** **[Match benches]** **<Insert material and description>**.

E. Wood Facing Surrounds: **[Evenly spaced, Douglas fir slats]** **[Evenly spaced pine slats]** **[Evenly spaced cedar slats]** **[Redwood panels]** **[Evenly spaced redwood slats]** **[Teak panels]** **[Evenly spaced teak slats]** **[Match benches]** **<Insert wood type and description>**.

F. Fiberglass Facing Surrounds: **Molded fiberglass shape.**

G. Plastic Facing Surrounds: **[Molded HDPE shape]** **[Evenly spaced HDPE slats]** **[Evenly spaced, recycled HDPE slats]** **[Match benches]** **<Insert plastic type and description>**.

H. Support Frames: **[Steel]** **[Galvanized steel]**; welded.

I. Trash Receptacles:

1. Receptacle Shape and Form: **[Round cylinder]** **[Round cylinder with tapered funnel top]** **[Round, tapered column]** **[Square column]** **[Rectangular column]** **[As indicated]** **<Insert shape and form>**; with opening for depositing trash in **[lid or top]** **[side of lid or top]** **[receptacle side]**.

2. Lids and Tops: **[Matching facing panels]** **[Aluminum]** **[Steel]** **[HDPE]** **[Recycled HDPE]** **<Insert material and description>** secured by cable or chain, hinged, swiveled, or permanently secured.

a. Description: **[Flat rim ring lid with center opening]** **[Dome top]** **[Arched top]** **[Elevated flat or shallow dome rain-cap lid]** **[Combination ash sand pan and rim lid]** **[Combination ash sand pan and dome top]** **[Combination ash sand pan and elevated flat or shallow dome rain-cap lid]** **<Insert description>**.

b. Opening for depositing trash covered by **[self-closing, spring-loaded-hinged, push-in]** **[rotating]** weather flap.

3. Receptacle Height: **[As indicated]** **<Insert dimension>**.

4. Overall Width: **[As indicated]** **<Insert dimension>**.

5. Weight: **<Insert weight>**.

6. Inner Container: **[Aluminum]** **[Galvanized-steel sheet]** **[Perforated-metal]** **[Fiberglass]** **[Rigid plastic]** container with **[drain holes]** **[lift-out handles]**; designed to be removable and reusable.

7. Disposable Liners: Provide receptacle designed to accommodate disposable liners.

8. Capacity: Not less than **[22 gal. (83 L)]** **[28 gal. (106 L)]** **[30 gal. (114 L)]** **[32 gal. (121 L)]** **[40 gal. (151 L)]** **[55 gal. (208 L)]** **<Insert value>**.

9. Service Access: [**Removable lid or top**] [**Fixed lid or top, side access**]; inner container and disposable liner lift or slide-out for emptying[; **lockable with padlock hasps**] [; **keyed lock with two keys per receptacle**] [; **self-latching hinge**].
  10. Post Mount: [**Color-coated steel pipe; color to match receptacle**] [**Galvanized-steel pipe**] [**Wood**]; for mounting [**one**] [**two**] [**three**] receptacle(s).
- J. Aluminum Finish: [**Mill finish**] [**Color coated**].
1. Color: [**As indicated by manufacturer's designation**] [**Match Architect's samples**] [**As selected by Architect from manufacturer's full range**] [**As indicated in a site furnishing schedule**] <Insert description>.
- K. Steel Finish: [**Galvanized and**] [**color**] [**PVC-color**] coated.
1. Color: [**As indicated by manufacturer's designation**] [**Match Architect's samples**] [**As selected by Architect from manufacturer's full range**] [**As indicated in a site furnishing schedule**] <Insert description>.
- L. Stainless Steel Finish: [ASTM A480/A480M, No. 6] <Insert description>.
- M. Wood Finish: [Unfinished] [Factory-applied transparent finish] [Factory-applied stain and transparent finish] [Factory-applied opaque finish] [Manufacturer's standard finish].
1. Stain: [**Manufacturer's standard**] <Insert stain type and color>.
- N. [Fiberglass] [HDPE] Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.
- O. Graphics: [Surface-applied] [Engraved] [Attached brass plaque with engraved] copy, content, and style [according to manufacturer's standard] [as indicated on Drawings].
1. Copy: [**Litter**] [**Trash**] [**Waste**] [**Recycle**] <Insert term>.

## 2.6 ASH RECEPTACLES <Insert drawing designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Aluminum Facing Surrounds: [Aluminum sheet] [Perforated aluminum sheet] [Grid in tubular frame] [Evenly patterned, parallel flat aluminum straps, bars, or tubular shapes] [Match benches] <Insert material and description>.
- C. Steel Facing Surrounds: [Steel sheet] [Perforated-steel sheet] [Evenly patterned, parallel flat steel straps, bars, or tubular shapes] [Evenly patterned, parallel round steel rods, bars, or tubular shapes] [Grid in tubular frame] [Match benches] <Insert material and description>.
- D. Stainless Steel Facing Surrounds: [Steel sheet] [Perforated-steel sheet] [Evenly patterned, parallel flat steel straps, bars, or tubular shapes] [Evenly patterned, parallel round steel rods, bars, or tubular shapes] [Grid in tubular frame] [Match benches] <Insert material and description>.
- E. Fiberglass Facing Surrounds: Molded fiberglass shape.
- F. Support Frames: [**Steel**] [**Galvanized steel**]; welded.
- G. Ash Receptacles:
1. Receptacle Shape and Form: [**Round cylinder**] [**Round cylinder with tapered funnel top**] [**Round, tapered column**] [**Square column**] [**Rectangular column**] [**As indicated**] <Insert shape and form>; with opening for depositing trash in [**lid or top**] [**side of lid or top**] [**receptacle side**].



2. Function: [Uncovered receptacle with sand pan] [Uncovered receptacle with bowl and funnel] [Covered receptacle with sand pan] [Covered receptacle with bowl and screen] [Covered receptacle with slots] [Uncovered receptacle with sand pan attaching to side of trash receptacle] <Insert description and accessories> for depositing cigarette butts; fire-proof design; bowl and pan removable for cleaning.
  3. Lids and Tops: [Matching facing panels] [Aluminum] [Steel] [HDPE] [Recycled HDPE] <Insert material and description> secured by cable or chain, hinged, swiveled, or permanently secured.
    - a. Description: [Flat rim ring lid with center opening] [Dome top] [Arched top] [Elevated flat or shallow dome rain-cap lid] [Combination ash sand pan and rim lid] [Combination ash sand pan and dome top] [Combination ash sand pan and elevated flat or shallow dome rain-cap lid] <Insert description>.
  4. Receptacle Height: [As indicated] <Insert dimension>.
  5. Overall Width: [As indicated] <Insert dimension>.
  6. Weight: <Insert weight>.
  7. Post Mount: [Color-coated steel pipe; color to match receptacle] [Galvanized-steel pipe] [Wood]; for mounting [one] [two] [three] receptacle(s).
  8. Accessories: [Sand sifter] [Butt stub-out] <Insert accessory>.
- H. Aluminum Finish: [Mill finish] [Color coated].
1. Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.
- I. Steel Finish: [Galvanized and] [color] [PVC-color] coated.
1. Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.
- J. Stainless Steel Finish: [ASTM A480/A480M, No. 6] <Insert description>.
- K. [Fiberglass] [HDPE] Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.

## 2.7 PLANTERS <Insert drawing designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Aluminum Facing Surrounds: [Aluminum sheet] [Perforated aluminum sheet] [Grid in tubular frame] [Evenly patterned, parallel flat aluminum straps, bars, or tubular shapes] [Match benches] <Insert material and description>.
- C. Steel Facing Surrounds: [Steel sheet] [Perforated-steel sheet] [Evenly patterned, parallel flat steel straps, bars, or tubular shapes] [Evenly patterned, parallel round steel rods, bars, or tubular shapes] [Grid in tubular frame] [Match benches] <Insert material and description>.
- D. Stainless Steel Facing Surrounds: [Steel sheet] [Perforated-steel sheet] [Evenly patterned, parallel flat steel straps, bars, or tubular shapes] [Evenly patterned, parallel round steel rods, bars, or tubular shapes] [Grid in tubular frame] [Match benches] <Insert material and description>.
- E. Wood Facing Surrounds: [Evenly spaced, Douglas fir slats] [Evenly spaced pine slats] [Evenly spaced cedar slats] [Redwood panels] [Evenly spaced redwood slats] [Teak panels] [Evenly spaced teak slats] [Match benches] <Insert wood type and description>.



- F. Fiberglass Facing Surrounds: Molded fiberglass shape.
- G. Plastic Facing Surrounds: [Molded HDPE shape] [Evenly spaced HDPE slats] [Evenly spaced, recycled HDPE slats] [Match benches] <Insert plastic type and description>.
- H. Support Frames: **[Steel]** **[Galvanized steel]**; welded.
- I. Planter Shape and Form: [Round cylinder] [Round cylinder with tapered funnel top] [Round, tapered column] [Square column] [Rectangular column] [As indicated] <Insert shape and form>.
- J. Style: [To match benches] [As indicated by manufacturer's designation].
- K. Overall Height: [As indicated] <Insert dimension>.
- L. Overall [Diameter] [Width]: [As indicated] <Insert dimension>.
- M. Overall Depth: [As indicated] <Insert dimension>.
- N. Weight: <Insert weight>.
- O. Inner Container: [Aluminum] [Galvanized-steel sheet] [Fiberglass] [Rigid plastic] container [with drain holes].
- P. Capacity: Not less than **[22 gal. (83 L)] [28 gal. (106 L)] [30 gal. (114 L)] [32 gal. (121 L)] [40 gal. (151 L)] [55 gal. (208 L)]** <Insert value>.
- Q. Installation Method: [Freestanding] [Freestanding with weighted base] [Anchored to substrate indicated on Drawings] [Wall mounted] [Post mounted] [Mounted on elevated leg angles anchored at finished grade to substrate indicated on Drawings] [Mounted on elevated leg angles anchored below finished grade to substrate indicated on Drawings] [As indicated on Drawings].
1. Post Mount: **[Color-coated steel pipe; color to match receptacle]** **[Galvanized-steel pipe]** **[Wood]**; for mounting **[one]** **[two]** **[three]** planter(s).
- R. Aluminum Finish: Color coated.
1. Color: **[As indicated by manufacturer's designation]** **[Match Architect's samples]** **[As selected by Architect from manufacturer's full range]** **[As indicated in a site furnishing schedule]** <Insert description>.
- S. Steel Finish: **[Galvanized and]** **[color]** **[PVC-color]** coated.
1. Color: **[As indicated by manufacturer's designation]** **[Match Architect's samples]** **[As selected by Architect from manufacturer's full range]** **[As indicated in a site furnishing schedule]** <Insert description>.
- T. Stainless Steel Finish: [ASTM A480/A480M, No. 6] <Insert description>.
- U. Wood Finish: [Unfinished] [Factory-applied transparent finish] [Factory-applied stained and transparent finish].
1. Stain: <Insert stain type and color>.
- V. [Fiberglass] [HDPE] Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.
1. Finish: **[Smooth]** **[Textured]**.

## 2.8 BOLLARDS <Insert drawing designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Bollard Construction:

1. **[Pipe] [Tubing] [Cast Iron]** OD: Not less than **[4-1/2 inches (115 mm)]** <Insert dimension>[, **fluted**].
    - a. Steel: **[Schedule 40] [Schedule 80]** pipe.
    - b. Aluminum: **[Extruded pipe and tubes] [Castings]**.
    - c. Stainless Steel: **[Tubes] [Pipe]**.
    - d. Cast Iron: **[Tapered] [As indicated]**.
  2. **[Round] [Square]** Wood: **[Cedar]** <Insert material>, **[8 inches (203 mm) square] [10 inches (254 mm) in diameter]**.
  3. Style: **[Manufacturer's standard] [Chamfered top] [Dome top] [Ornamental cap] [As indicated]** <Insert description>.
  4. Overall Height: **[As indicated]** <Insert dimension>.
  5. Overall Width: **[As indicated]** <Insert dimension>.
  6. Overall Depth: **[As indicated]** <Insert dimension>.
  7. Accessories: **[Eye bolts]** <Insert accessory>.
  8. Installation Method: **[Surface flange anchored at finished grade to substrate indicated] [Surface flange anchored below finished grade to substrate indicated] [Cast in concrete] [Bolted to cast-in anchor bolts] [As indicated]**.
- C. Aluminum Finish: **[Mill finish] [Color coated]**.
1. Color: **[As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule]** <Insert description>.
- D. Steel Finish: **[Galvanized] [Color coated]**.
1. Color: **[As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule]** <Insert description>.
- E. Cast-Iron Finish: **[Manufacturer's standard] [Galvanized] [Color coated]**.
1. Color: **[As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule]** <Insert description>.
- F. Stainless Steel Finish: **[ASTM A480/A480M, No. 4]** <Insert description>.
- G. Wood Finish: **[Unfinished] [Manufacturer's standard finish]**.

## 2.9 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes and complying with the following:
1. Rolled or Cold-Finished Bars, Rods, and Wire: **ASTM B211 (ASTM B211M)**.
  2. Extruded Bars, Rods, Wire, Profiles, and Tubes: **ASTM B221 (ASTM B221M)**.
  3. Structural Pipe and Tube: **ASTM B429/B429M**.
  4. Sheet and Plate: **ASTM B209 (ASTM B209M)**.
  5. Castings: **ASTM B26/B26M**.
- B. Steel and Iron: Free of surface blemishes and complying with the following:

1. Plates, Shapes, and Bars: ASTM A36/A36M.
  2. Steel Pipe: Standard-weight steel pipe complying with ASTM A53/A53M, or electric-resistance-welded pipe complying with ASTM A135/A135M.
  3. Tubing: Cold-formed steel tubing complying with ASTM A500/A500M.
  4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A513/A513M, or steel tubing fabricated from steel complying with ASTM A1011/A1011M and complying with dimensional tolerances in ASTM A500/A500M; zinc coated internally and externally.
  5. Sheet: Commercial steel sheet complying with ASTM A1011/A1011M.
  6. Perforated Metal: From steel sheet not less than **[0.075-inch (1.9-mm)] [0.090-inch (2.3-mm)] [0.120-inch (3.0-mm)]** <Insert dimension> nominal thickness; manufacturer's standard perforation pattern.
  7. Expanded Metal: Carbon-steel sheets, deburred after expansion, and complying with ASTM F1267.
  8. Malleable-Iron Castings: ASTM A47/A47M, grade as recommended by fabricator for type of use intended.
  9. Gray-Iron Castings: ASTM A48/A48M, Class 200.
- C. Stainless Steel: Free of surface blemishes and complying with the following:
1. Sheet, Strip, Plate, and Flat Bars: ASTM A240/A240M or ASTM A666.
  2. Pipe: Schedule 40 steel pipe complying with ASTM A312/A312M.
  3. Tubing: ASTM A554.
- D. Wood: Surfaced smooth on four sides with eased edges; kiln dried, free of knots, solid stock of species indicated.
1. Wood Species: **[Manufacturer's standard.]**
    - a. Douglas Fir: Clear Grade, vertical grain.
    - b. Pine: Southern pine; No. 2 or better; **preservative treated, kiln dried after treatment**.
    - c. **[Eastern White] [Red] [Yellow]** Cedar: Select Grade or better.
    - d. Redwood: **[Clear all heart] [Construction heart or better]**, free-of-heart center.
    - e. Teak (Tectona Grandis): Clear Grade.
    - f. **<Insert wood species>**: **<Insert grade, if applicable, and other requirements>**.
- E. [<Double click to insert sustainable design text for certified wood.>](#)
1. Finish: Manufacturer's standard **[stain] [and] [transparent sealer] [transparent wood-preservative treatment and sealer]** **<Insert treatment or finish>**.
- F. Fiberglass: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and with manufacturer's standard finish.
- G. Plastic: Color impregnated, color and UV-light stabilized, and mold resistant.
1. Polyethylene: Fabricated from virgin plastic HDPE resin.
  2. [<Double click to insert sustainable design text for recycled polyethylene>](#)
- H. Anchors, Fasteners, Fittings, and Hardware: **[Stainless steel] [Brass] [Galvanized steel] [Zinc-plated steel] [Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials]; commercial quality[, tamperproof, vandal and theft resistant] [, concealed, recessed, and capped or plugged].**

1. Angle Anchors: For inconspicuously bolting legs of site furnishings to **[on]** **[below]**-grade substrate; **[one per leg]** **[extent as indicated]** **<Insert extent>**.
  2. Antitheft Hold-Down Brackets: For securing site furnishings to substrate; **[two per unit]** **[extent as indicated on Drawings]** **<Insert extent>**.
- I. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M; recommended in writing by manufacturer, for exterior applications.
  - J. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.
  - K. Galvanizing: Where indicated for steel and iron components, provide the following protective zinc coating applied to components after fabrication:
    1. Zinc-Coated Tubing: External, zinc with organic overcoat, consisting of a minimum of **0.9 oz./sq. ft. (0.27 kg/sq. m)** of zinc after welding, a chromate conversion coating, and a clear, polymer film. Internal, same as external or consisting of 81 percent zinc pigmented coating, not less than **0.3 mil (0.0076 mm)** thick.
    2. Hot-Dip Galvanizing: According to ASTM A123/A123M, ASTM A153/A153M, or ASTM A924/A924M.

## 2.10 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment: Pressure-treat wood according to AWPA U1, Use Category UC3b, and the following:
  1. Use preservative chemicals acceptable to authorities having jurisdiction and containing no arsenic or chromium. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
  2. Kiln-dry lumber and plywood after treatment to a maximum moisture content, respectively, of 19 and 15 percent. Do not use materials that are warped or do not comply with requirements for untreated materials.

## 2.11 FABRICATION

- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.
- B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
- C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Preservative-Treated Wood Components: Complete fabrication of treated items before treatment if possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces.

- E. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
- F. Factory Assembly: Factory assemble components to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

## **2.12 GENERAL FINISH REQUIREMENTS**

- A. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## **2.13 ALUMINUM FINISHES**

- A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

## **2.14 STEEL AND GALVANIZED-STEEL FINISHES**

- A. Powder-Coat Finish: Manufacturer's standard polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.
- B. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

## **2.15 IRON FINISHES**

- A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

## **2.16 STAINLESS STEEL FINISHES**

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run directional finishes with long dimension of each piece.
  - 2. Directional Satin Finish: ASTM A480/A480M, No 4.
  - 3. Dull Satin Finish: ASTM A480/A480M, No. 6.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and **[securely anchored] [positioned]** at locations indicated on Drawings.
- D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
- E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and **3/4 inch (19 mm)** larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with **[nonshrink, nonmetallic grout] [or] [anchoring cement]**, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.
- F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with **[nonshrink, nonmetallic grout] [or] [anchoring cement]**, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 32 84 00 - PLANTING IRRIGATION****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes valves, piping, sprinklers, accessories, controls, and wiring for automatic irrigation systems.
- B. Extent of underground irrigation system is shown on the Drawings and in Schedules.
- C. Provide all labor, materials and equipment required by or inferred from the Drawings and Specifications to complete the Work of this Section.
  - 1. Provide a complete and operable system for the irrigation of all landscaped areas on the project site, unless indicated otherwise. The Drawings and specifications are intended to include all items obviously necessary and requisite for the proper irrigation of the Project. The Contractor is responsible to furnish any additional labor, materials and equipment required for a proper system.
  - 2. Contractor shall be responsible for adjusting head location, head/nozzle type and size, and any other system components so that irrigation system layout is coordinated with actual field conditions. Such adjustments shall be made at no cost to the Owner except, when authorized in writing, such adjustments which will be compensated for at an agreed upon cost.

**1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specifications, apply to this Section.
- B. Specification Sections that are related to Irrigation Work:
  - 1. Specification Sections 32 9100 – “Planting Preparation”
  - 2. Specification Sections 32 9300 – “Plants”

**1.3 QUALITY CONTROL**

- A. Qualifications:
  - 1. Installer Qualifications: Engage a firm or firms specializing in irrigation installation. Installer shall have successfully completed five projects similar in material, size, scope and complexity to that indicated for this Project that have resulted in construction with a record of successful in-service performance.
    - a. Firm Experience Period: Five (5) years of experience.
    - b. Field Foreman Experience: Five (5) years of experience with installing firm.
- B. Codes and Standards: Perform the work in compliance with applicable requirements of governing authorities having jurisdiction. County regulations supersede these specifications. Notify the Architect in writing of all discrepancies immediately.
  - 1. American Society for Testing and Materials (ASTM):
    - a. C 33-99 - Specification for Concrete Aggregates.
    - b. C 150-99a - Specification for Portland Cement.
    - c. D 1785-96b - Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
    - d. D 2241-96b - Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

- e. D 2464-96b - Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
  - f. D 2466-94a - Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
  - g. D 2467-96b - Specification for Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
  - h. D 2564-96a - Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
  - i. D 2672-94 - Specification for Joints for IPS PVC Pipe Using Solvent Cement.
  - j. D 2774-94 - Practice for Underground Installation of Thermoplastic Pressure Piping.
  - k. D 2855-96 - Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
  - l. D 3139-96a - Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- 2. National Fire Protection Association (NFPA):
    - a. 70 - National Electrical Code.
  - 3. National Electrical Manufacturer's Association (NEMA):
    - a. 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. Do Not Make Substitutions: If the Contractor desires to make substitutions of materials, sufficient descriptive literature and material samples must be furnished to establish the material as an equal substitute. In addition, the Contractor must state his reasons for desiring substitute materials. Submit this request and information to the Architect.
  - D. Approval and Selection of Materials and Work: The selection of all materials and the execution of all operations required under the Drawings and Specification is subject to the approval of the Owner and Architect. They have the right to reject any and all materials and any and all Work which, in their opinion, does not meet the requirements of the Contract Documents at any stage of the operations. Remove rejected Work and or materials from project site and replace promptly.
  - E. Workmanship: Install materials and equipment in a neat and professional manner following manufacturer's recommendations.

#### 1.4 DEFINITIONS

- A. Supply Piping: Piping from water source to connection to irrigation system pressure piping. Piping is under same pressure as water supply.
- B. Pressure Piping: Piping downstream from supply piping to and including control valves. Piping is under irrigation system pressure. Piping in this category includes pressure regulators, water meters, and backflow preventers, when used.
- C. Circuit Lateral Piping: Piping downstream from control valves to irrigation system sprinklers, emitters, devices and drain valves. Piping is under pressure during flow.
- D. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile - butadiene - styrene plastic.
  - 2. NP: Nylon plastic.
  - 3. PE: Polyethylene plastic.
  - 4. PTFE: Polytetrafluoroethylene plastic.
  - 5. PVC: Polyvinylchloride plastic.

#### 1.5 SYSTEM PERFORMANCE REQUIREMENTS

- A. The Drawings are diagrammatic and generally indicate the Work to be installed. The Drawings do not indicate all offset fitting, and sleeves. The Contractor shall furnish such items as may be required to complete the work.
- B. Location of Sprinklers and Devices: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards.

- C. Minimum Water Coverage: Not less than:
  - 1. Turf Areas: 100 percent
  - 2. Other Planting Areas: 80 percent

## 1.6 SUBMITTALS

- A. Section Cross Reference: Refer to Division 1 Submittals Section for general requirements.
- B. As Built Drawings: Any changes in the layout and/or arrangements of the proposed irrigation system, or any other differences between the proposed system and actual installed conditions are to be recorded by the Irrigation Contractor in the form of an "As Built" Drawing. Provide the Owner and the Architect with a copy of the As Built Drawings before Work under this Contract will be considered for Acceptance. All automatic and manual valves, hose bibs or quick couplers, and wire splice locations shall be shown with actual dimensions to reference points so they may be located easily in the field.
- C. Product Data: Submit, for information only, manufacturer's specifications, product data, installation instructions and general recommendations for ALL components of the irrigation system. Individual copies of product data shall be submitted with the specific product name and model number visibly identified with specific product and model number being identified using a highlighter, asterisk or underlining.
- D. Installer Certification: Submit written documentation certifying that Installer complies with requirements of "Installer Qualifications" above.
- E. Five sets of a site map showing the individual zones using numbers and color code of the installed irrigation system. One of the site maps is to be laminated and placed in the door of the irrigation control clock for on-site reference.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and equipment in such a manner as to not damage the parts or decrease the useful life of equipment.
- B. Store materials away from detrimental elements. Coordinate with Owner or General Contractor to secure a safe staging area. Security of stored materials shall be provided by the contractor at all times.
- C. Handle, load, unload, stack and transport materials for irrigation system carefully to avoid damage. Handle pipe in accordance with manufacturer's recommendations.

## 1.8 PROJECT CONDITIONS

- A. The site irrigation system is comprised of an irrigation distribution and sprinkler system. The Contractor shall connect the distribution network to the domestic water meter.
- B. Obtain all required permits and pay all required fees, at no additional cost to the Owner. Any penalties imposed due to failure to obtain permits or pay fees are the responsibility of the Contractor.
- C. Irrigation system water source will be provided by wells, 3 separate systems, installed by others. Irrigation contractor is responsible for connection to irrigation wells.
- D. Provide and maintain all passageways, guard fences, warning lights and other protection devices required by the local authorities.
- E. Existing Grades: Existing grades will be within .2 feet of grades shown on the Civil Engineering Drawings at time of irrigation work. Determine condition of existing grades prior to beginning the Work. When irregular or incomplete grading conditions are encountered, notify the Owner in writing before beginning the Work. Determine location of existing drainage patterns and maintain patterns in completed Work. Perform Work in a manner which will avoid damage to finished grading and drainage patterns. All damage to finished grading and drainage resulting from Work covered in these Contract Documents shall be repaired at the Contractor's expense.
- F. Existing Utilities: Determine location of underground utilities. Perform Work in a manner which will avoid possible damage. Excavate as required. Maintain grade stakes set by others unless

- removal is mutually agreed upon by parties concerned. All damage to utilities resulting from Work covered in these Contract Documents shall be repaired at the Contractor's expense.
- G. Existing Conditions: Perform irrigation Work in the Tree Protection zones and in existing or previously completed landscape areas to avoid damage and disturbance to these areas. Limit work in these areas to only that necessary to perform work specified herein and shown on the Drawings. Return and repair and areas damaged or disturbed while performing the Work to the existing conditions encountered prior to the Work.
  - H. Existing Site Improvements: Perform Work in a manner which will avoid possible damage to other work. The Contractor is responsible for any damage of mechanical nature as well as damage resulting from leaks in the irrigation system whether due to negligence or otherwise.
    - 1. Protect improvements on adjoining properties and on Owner's property.
    - 2. Restore damaged improvements to their original condition at the Contractor's expense.
  - I. Existing Trees: Perform Work in a manner which will avoid damage to existing trees to remain and critical root zone of existing trees.
    - 1. All work should avoid critical root zone of existing trees as much as possible.
    - 2. Work that is done within the critical root zone of existing trees shall be done by hand, no mechanical equipment is to be used.
    - 3. All tree roots 2-inches and large shall not be cut.
  - J. Test Water Conditions: The Contractor shall check the pressure downstream of the irrigation well discharge and confirm minimum operating pressure noted in this Specification. If minimum operating pressure cannot be obtained, notify the Architect.\
  - K. Damages resulting from irrigation installation to work of other trades must be repaired at the expense of the Irrigation Contractor in a timely fashion.
  - L. Make minor adjustments to system layout as may be required and requested at no additional cost to the Owner.
  - M. Keep project site clean and orderly at all times during construction.

## PART 2 - PRODUCTS

### 2.1 PIPES AND FITTINGS

- A. Polyvinyl Chloride (PVC) Plastic Pipe: ASTM D 2241; PVC 1120 compound, SDR 21 of the following size and class:
  - 1. Irrigation Sleeves: PVC Sch 40.
  - 2. Irrigation Main Line: PVC Sch 40.
  - 3. Irrigation Lateral Line: PVC Class 200.
- B. Polyvinyl Chloride (PVC) Plastic Pipe: Exposed pipe; ASTM D 1785, PVC 1120 compound, Schedule 80, 250 psig (1725 kPa) minimum pressure rating for eight (8) inch and smaller sizes, with plain and threaded ends.
- C. Pipe three (3) inch and larger shall be PVC pipe with bell and rubber ring gasket, unless otherwise indicated.
- D. Pipe smaller than three (3) inch shall be solvent weld PVC pipe.
- E. Fittings for integral bell rubber ring gasketed pipe (three (3) inch and larger) shall have the gasket type ductile iron fittings with joint restraints.
- F. Solvent weld PVC pipe shall be rigid PVC pipe and shall be assembled using appropriate PVC pipe cleaner/primer and solvent cement in accordance with the manufacturer's recommendations. Solvent cement shall be No. 717 NSF approved.
- G. All solvent weld firings shall conform to Schedule 40 or Schedule 80 PVC dimensions and specifications for solvent weld fittings.
- H. Expansion Joints: Shall consist of integral bell and rubber gasket coupling, install every three hundred (300) feet of solvent weld piping.

- I. Runs of pipe over twenty (20) feet length must be installed with standard twenty (20) feet length sections.
- J. PVC Pipe Couplings located Within Sleeves: Four (4) inches and smaller shall be solve weld. Six (6) inches and larger shall be mechanical joints. Upon exiting sleeves, pipe solvent weld or integral bell and rubber gasket, as specified.
- K. Polyvinyl Chloride (PVC) Plastic Pipe Fittings: ASTM D 2466, Schedule 40, socket-type.
- L. Exposed Pipe: Polyvinyl Chloride (PVC) Plastic Pipe Fittings: ASTM D 2467, Schedule 80, socket-type.

## 2.2 JOINING MATERIALS

- A. Solvent Cement: ASTM F 656 primer and ASTM D 2564 solvent cement in color other than orange.
- B. Gaskets for Plastic Flanged Joints: Materials recommended by plastic pipe and fittings manufacturer.

## 2.3 ELECTRIC WIRING

- A. 120 Volt AC Wiring: 120-volt service to controller shall consist of three wires: one black, one white, and one ground. Electrical service to be provided by Contractor.
- B. Splices in the field control wiring shall be waterproof UL listed for 600 volts.
  - 1. Acceptable Manufacturers:
    - a. 3M
    - b. Paige
- C. Control wiring shall be 600-volt solid single conductor wire U.L. approved for direct burial in ground. Minimum wire size: 14 gauge. Control wiring and wiring connections from the controller to the valves is included in this Contract.
  - 1. Acceptable Manufacturers:
    - a. Paige Electric Co.
    - b. King Wire and Cable
    - c. Regency Wire Corporation

## 2.4 MASTER VALVES

- A. Valves for isolation purposes shall be brass manually operated globe valves, normally closed, durable construction for dirty water applications.

## 2.5 CONTROL VALVES

- A. Description: Manufacturer's standard control valves for irrigation zones, of type and size indicated, and as follows: Valves are to be constructed of a glass filled nylon material with a self-cleaning stainless-steel screen. The control valve shall be considered to be a "contamination resistant style valve" with flow/low pressure operating capabilities. Flow .25 to 200 GPM; Pressure: 20 to 200 PSI. Valves to conform to Manufacturer's Specifications concerning performance and at pressure provided. Operation will occur through a 24-volt pulse to the AC solenoid.
  - 1. Acceptable Manufacturers:
    - a. Hunter Industries, Inc.
    - b. Approved equal.

**2.6 VALVE BOXES**

- A. Plastic Valve Boxes: Box and cover, with open bottom and opening for piping; designed for installing flush with grade.
  - 1. Control Valves: Shall be in a twelve (12) by eighteen (18) inch standard valve box with non-hinged cover.
  - 2. Backflow Preventer & 1 ½", 2" Drip Valve Assemblies: Shall be in a twenty (20) by thirty four (34) inch valve box with non-hinged cover.
  - 3. Isolation Valves, Wire Splices and Quick Coupling Valves: Shall be in a ten (10) inch round valve box with cover.
- B. All valve boxes are to be green or black with matching colored covers.
- C. Acceptable Manufacturers:
  - 1. Rain Bird
  - 2. Carson Industries, Inc.
  - 3. Armor Access Boxes

**2.7 SPRINKLERS**

- A. Rotary Heads: The sprinkler shall be four (4) inch pop-up with matched precipitation rates. Rotary heads shall have nozzles with adjustable arc and radius.
- B. Full or Part Circle Pop-Up Spray Sprinkler: The sprinkler body. Stem, nozzle and screen shall be constructed of heavy-duty, ultra-violet resistant plastic. It shall have a heavy-duty stainless steel retract spring for positive pop-up and a ratcheting system for easy alignment of the pattern.
  - 1. The sprinkler shall have soft elastomer pressure activated co-molded wiper seal for cleaning debris from the pop-up stem as it retracts into the case to prevent the sprinkler.
  - 2. Spray Sprinklers shall also include a check valve and an internal pressure-regulating device. These units shall be identifiable from the top with markings on the cap.
  - 3. The check valve shall prevent low head drainage of up to ten (10) feet of head. The pressure-regulating device shall prevent high pressure fogging of the nozzle stream by regulating the nozzle pressure to 30 psi for inlet pressure from 35 to 70 psi. Below 35 psi the pressure loss shall not exceed 6 psi. These models shall utilize the bottom inlet only.
- C. All spray sprinkler bodies are to be produced by the same manufacturer a mix of product manufacturer's is not acceptable.
- D. Acceptable Manufacturers and Products: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hunter Industries, Inc.
  - 2. Approved equal.

**2.8 AUTOMATIC CONTROLLER**

- A. Provide an electronic controller system capable of fully automatic and manual operation of the system, made for control of irrigation system automatic control valves and flow sensors. Controller housing shall be wall mounted, as indicated on the Drawings, in a weatherproof and lockable cabinet.
- B. Provide controller, which operates on a minimum of 120 VAC power input and is capable of operating 24 volt AC electric remote control valves, with a reset circuit breaker to protect from overload. Contractor is responsible for connection to 120 VAC power to controller.
- C. Each station shall have a time setting which can be set for variable timing in increments from 0 to 60 minutes, or set to omit the station from the irrigation cycle.
- D. The controller shall have a calendar for setting the programmed start-days, and a 24-hour clock for programming the irrigation cycle start time. A master "on-off" switch shall allow the valve power output to be interrupted without affecting the controller.

- E. The controller shall be constructed so that all internal parts are accessible through the controller door without disturbing the cabinet installation.
- F. The controller will be equipped with a commercial grade remote control capabilities either as a manufacturers option or a peripheral produced by a reputable manufacturer that their equipment interfaces with controller that has been installed.
- G. The controller location must be easily accessible for maintenance. Provide for the possibility of making minor timing adjustments to the controller in the field.
- H. The controller will have optional WiFi capability.

## **2.9 WATER HAMMER ARRESTERS**

- A. Water Hammer Arresters: ASME A112.26.1M, ASSE 1010, or PDI WH-201, bellows or piston-type with pressurized cushioning chamber. Sizes are based on water-supply fixture units, ASME A112.26.1M and PDI WH-201 Sizes "A" to "F".

## **2.10 INDENTIFICATION**

- A. Provide plastic underground warning tape for pipe location, install as per manufacturer's recommendation.

## **2.11 SLEEVES**

- A. Schedule 40 PVC Pipe Type: Size as indicated on Drawings.

## **2.12 LIGHTING AND SURGE PROTECTION EQUIPMENT**

- A. Provide lightning arrestor for controllers not equipped with primary surge protection. Protection to be installed as per manufacturer's recommendations.

## **2.13 MISCELLANEOUS SYSTEM COMPONENTS**

- A. Provide risers, reducers, couplings, adapters, fittings as necessary to complete the irrigation system.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Observation of Work in Progress: During the installation, the Landscape Architect and Irrigation Consultant will make regular site visits and reject any work and materials which do not meet the requirements called for in the Contract Documents.
- B. Inspect project site prior to start of Work to determine that all site conditions are acceptable for Work to begin. Inform the Architect of unsuitable conditions. Do not proceed with installation of irrigation system until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
- C. Locate all existing underground utilities prior to trenching and/or boring operations and protect them against damage during the Work. Obtain utility locations from Owner and/or General Contractor and utilize utility locating services when necessary.

### **3.2 EXAMINATION**

- A. Investigate and determine available water supply, water pressure and flow characteristics.

- B. When unanticipated utilities that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the Owner for action.

### 3.3 PREPARATION

- A. Layout of Mains and Laterals: Layout sprinkler mainlines and perform line adjustments and site modifications to laterals prior to execution.
- B. Coordinate all installation with landscape planting work, especially fine grading, and soil preparation for planting areas.
- C. Coordinate and cooperate with all other contractors to enable the work to proceed as rapidly and efficiently as possible.
- D. Layout of Sprinkler Heads: Stake sprinkler head locations and check for uniformity of coverage and correctness of pattern. Minor adjustments to layout should be made based on actual field conditions. If there is a discrepancy of the actual site configuration that may cause sprinklers to cast precipitation into any public roads or walks that were not indicated on the drawings, notify the Architect and the Irrigation Consultant so revisions can be made.
- E. Valve Location: Locate valves to assure ease of access for maintenance and that no physical interference with other elements of the project that are existing or planned. Valve boxes shall be placed a minimum of five (5) feet from walkways and roads. Valve boxes shall be located in mulched planting beds and away from view of pedestrians. If there are no mulched areas within forty feet of a proposed valve location valves may be located in turf areas provided no more than two valve boxes are located next to each other.
- F. Furnish temporary support, adequate protection and maintenance of all underground and surface utilities, structures, drains, sewers and other obstructions encountered in the progress of the work.
- G. Contractor shall acquaint himself with all site conditions. Should utilities not shown on the plans be found during excavations, Contractor shall promptly notify the Owner for instructions as to further actions. Failure to do so will make Contractor liable for any and all damage thereto rising from his operations subsequent to discovery of such utilities not shown on the Drawing.
- H. Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduit, ducts, pipe branch connections to sewer mains, main drains, water services, etc., the obstruction shall be permanently supported, relocated, removed, or reconstructed by the Contractor in cooperation with the Owner of such utility. No deviation from the required line or grade shall be made without the written direction of the Architect.

### 3.4 EXCAVATION

- A. All excavation is unclassified and includes all materials encountered that are not classified as rock excavation.
- B. Report exceptions to the Architect before excavation. An adjustment in price will be established which includes removal and disposal of the unsuitable material, and the acquiring of additional backfill material.
- C. Excavation in Newly Sodded Areas: Prior to excavation, remove sod, preserve and replace after backfilling is completed.
- D. Excavation in Established Grass or Newly Seeded Areas: After excavation and backfilling is completed, re-grade trenched area consistent with surrounding area and re-seed, or re-sod with 100 percent pure seed of grass type existing. Mulch with straw and water.
- E. Excavation through existing asphalt, cutting, removal and replacement of asphalt, as noted on the Drawing, is the responsibility of the Irrigation Contractor.
- F. Excavation through critical root zone of existing trees shall be done by hand. Avoid damage to tree roots and roots 2-inches and larger shall NOT be cut.



**3.5 BACKFILL**

- A. Backfill material shall be free from rocks, large stones, and other unsuitable substance which could damage the pipe or create unusual settling problems. Backfill in six (6) inch layers and tamp after each layer to prevent excessive settling.
- B. Backfill trenches containing plastic pipe when pipe is cool to avoid excessive contraction in cold water. Such backfilling can be done in early morning hours or the pipe may be water cooled prior to backfilling procedures.
- C. Minimum depth of cover of all pipe is as follows:
  - 1. Irrigation Lateral Line - minimum depth cover is 12 inches.
  - 2. Irrigation Main Line - minimum depth cover is 18 inches.
  - 3. Irrigation Sleeve - minimum depth is 18 inches.

**3.6 SLEEVING**

- A. Locate sleeving as shown on the Drawings. Contractor to make adjustments necessary to accommodate existing vegetation, utilities and other existing conditions.
- B. Repair of damage to existing utilities, structures or other construction resulting from installation of sleeves is the responsibility of the Contractor.

**3.7 PIPING INSTALLATION**

- A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, and in other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.
- B. Install piping free of sags and bends.
- C. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- D. Install underground thermoplastic piping according to ASTM D 2774 and ASTM F 690.
- E. Lay piping on solid subbase, uniformly slopes without humps or depressions.
- F. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, boring or jacking.
- G. Install piping under sidewalks and paving in sleeves.
- H. Main Line: Install according to Manufacturer's Recommendations. Provide concrete thrust blocks at all directional changes on all pipe 3-inches and larger that is of the gasketed variety, as per drawings.
- I. Lateral Lines and Risers:
  - 1. Install according to Manufacturer's Recommendations using standard techniques.
  - 2. Combine lateral lines and main supply lines in common trenches wherever possible.
  - 3. Plug lines immediately upon installation to minimize infiltration of foreign matter.
  - 4. Flush lateral lines and risers prior to installation of sprinkler heads.

**3.8 JOINT CONSTRUCTION**

- A. Polyvinyl Chloride (PVC) Piping Solvent-Cemented Joints: Construct joints according to ASTM D 2672 and ASTM D 2855.
  - 1. Use PVC pipe cleaner/primer and solvent cement according to pipe manufacturer's recommendations.
  - 2. Dissimilar Materials Piping Joints: Construct joints using adapters that are compatible with both piping materials, outside diameters, and system working pressure.

**3.9 VALVE INSTALLATION**

- A. Valves: Install underground valves in valve boxes or pits.

1. Install according to manufacturer's recommendations, and as indicated on the Drawings. Position boxes at a height that will not cause them to interfere with maintenance machinery (e.g., mowers) and such that soil and mulch do not wash into the box. Locate valve box in mulched or natural areas one (1) foot inside the bed line. Where no mulched areas or natural areas exist within forty (40) feet of proposed valve box locations install valve box in turf area. Install no more than two (2) valve boxes together.
2. Install surge protection equipment, grounding, and lightning protection as per manufacturer's recommendations.

### **3.10 SPRINKLER INSTALLATION**

- A. Pop-up Sprinkler Heads: Install in such a manner that top is one (1) inch above finish grade. Where finish grade has not been established extend a riser a minimum of twelve (12) inches above existing grade to mark location of head. After finish grade is established, install heads as shown on Drawings.
- B. All spray sprinklers installed below grade should be accessed through the bottom inlet so as not to void the internal check valve feature.
- C. Backfill around sprinkler head assembly in such a manner as to stabilize the sprinkler head so that no lateral motion is exhibited during operation.

### **3.11 CONTROL WIRE INSTALLATION**

- A. Install control wires in orderly fashion, locate in main line trench. Bundle wires together and tape at ten (10) foot intervals. Position wires to the right of the water supply line in the direction of the water flow.
- B. Provide looped slack at directional changes in supply line to allow for contraction of wires.
- C. Keep wires splices to a minimum and provide ten (10) inch round valve box at each splice location.
- D. Pass wires under existing or future paving, construction, etc., through PVC sleeves.
- E. For each open station on any given controller, there shall be spare wires to the furthest two (2) control valves located in diametrically opposed directions from the controller, plus one (1) additional spare wire.

### **3.12 AUTOMATIC CONTROL SYSTEM INSTALLATION**

- A. Install controllers according to manufacturer's written instructions and as indicated.
  1. Install surge protection equipment, grounding, and lightning protection as per manufacturer's recommendations.
- B. Controller location to be coordinated with Owner and manufacturer's representative for best location for central control communication.

### **3.13 CONNECTIONS**

- A. Connect piping to sprinklers, devices, valves, control valves, specialties, and accessories.
- B. Electrical Connections: Connect to power source, controllers, and automatic control valves.

### **3.14 FIELD QUALITY CONTROL**

- A. Leak Test: Leakage shall be defined as the evidence of water moving through the pressurized mainline when no irrigation is taking place. After installation, charge system and test for leaks. If leakage is noted, leaks shall be found and repaired. Retest until no leaks exist.
  1. Upon completion of the irrigation system, and after head installation, test the entire system for proper operation. Flush all air from the system and check components for proper operation.

**3.15 BALANCING AND ADJUSTING**

- A. Balance and adjust the various components of the sprinkler system so that the overall operation of the system is most efficient. This includes synchronization of the controllers, adjustments to pressure regulators, part circle sprinkler heads, and individual station adjustments on the controllers.
- B. Adjust automatic control valves to provide flow rate of rate of operating pressure required for each sprinkler circuit.
- C. Carefully adjust lawn sprinklers so they will be flush with, or not more than one-half (1/2) inch above, finish grade after completion of landscape work.
- D. Upon completion of the irrigation system, perform a coverage test with the Owner's representative to determine if the irrigation coverage is adequate. Correct any inadequacies.
- E. Adjust settings of controllers and automatic control valves.

**3.16 CLEANUP AND PROTECTION**

- A. Flush dirt and debris from piping before installing sprinklers and other devices.
- B. Upon completion of Work, clear grounds of debris, superfluous materials and all equipment. Remove from site to the satisfaction of the Architect.
- C. Protect the Work and materials from damage due to irrigation operations, operations by other contractor and trades and trespassers. Maintain protection until Date of Substantial Completion.
- D. Cover all openings into the system as it is being installed to prevent obstructions in the pipe and the breakage, misuse or disfigurement of the equipment.
- E. Theft: Irrigation Contractor is responsible for theft of equipment and material at the job site before, during and after installation, until Date of Substantial Completion of the Work in total.

**3.17 OWNER ORIENTATION**

- A. Upon completion of the Work and at a time and place acceptable to the Architect and Owner, the Irrigation Contractor is responsible for the orientation of the Owner's maintenance personnel in the operation, maintenance, and repair of the system. Furnish copies of all available parts lists, troubleshooting lists and specification sheets, to the Architect.
  - 1. Operating and Maintenance Manuals shall constitute the basis of orientation.
- B. Set the initial watering schedules and programming of the automatic controllers at direction of Landscape Contractor.

**3.18 WARRANTY**

- A. Warranty all Work for a period of one year and 20 days, starting on the Date of Final Completion, against defects in materials, equipment, workmanship and any repairs required resulting from leaks or other defects of workmanship, material or equipment.
- B. Emergency repairs may be made by the Owner without relieving the Contractor of his warranty obligations.
- C. Repair settling of backfilled trenches occurring during the warranty period, including restoration of damaged plantings, paving or improvements resulting from settling of trenches or repair operations.
- D. Respond to Owner's request for repair work within ten (10) days. If not, Owner may proceed with such necessary repairs at the Contractor's expense.

**3.19 OBSERVATION AND ACCEPTANCE**

- A. Periodic site visits will be made by the Architect or Irrigation Consultant to review the quality and progress of the work. Work found to be unacceptable must be corrected within five (5) calendar days. Remove rejected materials promptly from the project.

- B. Upon completion of the work, the Architect or Irrigation Consultant will issue a punch list for work to be corrected. Where work does not comply with requirements, replace rejected Work.
- C. It will be the responsibility of the Irrigation Contractor to provide a reliable communication system (i.e.: Two-way radios or remote radio control activation system) for Substantial Completion and all periodic site visits.
- D. If a site visit to verify Substantial Completion has been scheduled and the Architect or Irrigation Consultant arrives at the site and determines that the irrigation system is not substantially complete (all system components in place, operational and checked) the Contractor shall be responsible for all costs incurred by the Architect or Irrigation Consultant to visit the site. Reimbursable expenses include but are not limited to the following: Mileage, airfare, consultants time, parking fee, meals, rental car, etc. All incurred expenses will be deducted from the final contract amount.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 32 84 23 – IRRIGATION WORK****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The general provisions of the Contract, including General and Supplementary Conditions, and General Requirements apply to the work specified in this Section.
- B. Section 02900 – Landscape Work

**1.2 DESCRIPTION OF WORK**

- A. Furnish all labor, materials, equipment and services necessary for the complete installation of the landscape irrigation system as drawn and specified. The irrigation system for Phase 1 needs to accommodate expansion of system into Phase 2 plaza and building. The work includes, but is not limited to:
  - 1. Trench, backfill and compaction for irrigation lines.
  - 2. Automatically controlled landscape irrigation system; backflow preventer; pressure reducing valve; isolation gate valves; piping and sleeves under paving; repair of paving, main and lateral lines; electrical valves and wiring; valve boxes and controllers; sprinklers; couplings; connectors; fittings; and if needed, tape and meter.
  - 3. Test all systems and make operative.
  - 4. Submit Record Drawings and Maintenance Manual.
  - 5. One-year Guarantee Period.
  - 6. Maintain and operate for 1-year beyond Date of completion of Substantial Completion punch list.

**1.3 QUALITY CONTROL**

- A. Installer Qualifications: Firm shall hold Alabama General Contractors License for Specialty Construction, Subclassification - Landscaping or Other Specialty Construction (specified as Irrigation). Firm experienced in the successful installation of a minimum of five (5) projects within the past five (5) years similar in scope, quality, and contract value to that indicated for this project. Firm shall have sufficient manpower, equipment and financial resources to complete the Work of this Section.
- B. The Owner and the Landscape Architect reserve the right to reject any and all materials and workmanship, which they deem to be not in accordance with Drawings and Specifications. Rejected materials and work shall be removed from site immediately and replaced with that of the specified quality.
- C. Applicable Standards:
  - 1. ASTM:
    - a. D1785: Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40.
    - b. D2464: Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Threaded, Schedule 40.
    - c. D2466: Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Socket Type, Schedule 40.
    - d. D2564: Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- D. Applicable Codes:
  - 1. Most current edition of Uniform Plumbing Code.
  - 2. Applicable Building Code.

3. All applicable local codes and ordinances.
  4. National Electrical Code.
  5. Should Specification's requirements differ from local requirements, consider Contract Document requirements to be the minimum acceptable and comply with any more stringent local requirements.
- E. Permits and Fees:
1. Obtain all permits and pay required fees to any agency having jurisdiction over the work.
  2. Arrange inspections required by local ordinances during the course of construction.
  3. Upon completion of the work, furnish satisfactory evidence to show that all work has been installed in accordance with the ordinances and code requirements.
- F. Testing:
1. Perform testing and inspections required by specifications and by regulating authorities.
  2. Give 24-hour notice that such tests are to be conducted.
- G. Contractor is responsible for verifying all utility locations. Owner is not responsible for damages that may occur as a result of unverified or non-mapped utility locations.

#### 1.4 SUBMITTALS

- A. Qualification data for firms specified in "Quality Control" article to demonstrate their capabilities and experience. Include a list of a minimum of 5-similar projects completed within the last 5-years with project name, address, names of Architects and Owners, overall description of scope of work and contract value.
- B. Shop Drawings:
1. Submit with Shop Drawings manufacturer's catalog sheet showing full specifications of each type sprinkler proposed including discharge of GPM, minimum allowable operating pressure at sprinkler, maximum allowable spacing and distance of throw (coverage).
- C. Record Drawings:
1. Prepare and submit a reproducible Record Drawing showing deviations from the Contract Documents made during construction affecting the main line pipe, controller location, valve locations, and all sprinkler head locations. Record Drawings shall also indicate and show approved substitutions of size, material, and manufacturer's name and catalog number and name.
  2. Deliver Record Drawings with request for inspection and acceptance.
  3. Deliver one (1) set of record drawings, reduced in size and laminated. Drawings should be suitable for mounting adjacent to irrigation controller.
- D. Maintenance Manual:
1. Prepare and submit irrigation system maintenance and operating instructions, with relevant manufacturer's literature. Include complete parts list covering all operating equipment.
  2. Submit in a hardcover, 3-ring binder.
  3. Include full name, address, and telephone number of Installer.

#### 1.5 COORDINATION

- A. Coordinate and cooperate with the Architect and other contractors and trades to enable the work to proceed as rapidly and efficiently as possible, and to be completed on schedule.
- B. Anticipate last minute delays, which may necessitate overtime work to complete the work on schedule. Sleeves under paving shall be placed by Site Contractor. Coordinate with other trades on site for sequencing of work.



**1.6 SITE INSPECTION**

- A. Become familiar with all site conditions.
- B. Should utilities not shown on plans be found during excavations, promptly notify the Architect for instructions as to further action.
- C. Make necessary adjustments in the layout as may be required:
  - 1. To connect to existing stubouts (should such stubs not be located exactly as shown); or
  - 2. To work around existing work. Such adjustments shall be made with no increase in cost to the Owner.
  - 3. To avoid existing utilities.

**1.7 PROTECTION OF EXISTING CONDITIONS**

- A. Take necessary precautions to protect site conditions to remain.
- B. Should damage be incurred, repair the work to its original condition at no additional cost to the Owner.

**PART 2 - PRODUCTS****2.1 PVC PIPE - (POLYVINYL CHLORIDE PIPE)**

- A. PVC pipe shall be manufactured in accordance with standards noted herein.
- B. Marking and Identification: PVC pipe shall be continuously and permanently marked with the following information:
  - 1. Manufacturer's name, pipe, size, type of pipe and material, SDR number, ASTM standard number and NSF (National Sanitation Foundation) seal.
- C. Irrigation Water Piping:
  - 1. Main Lines: ASTM D-1785, Schedule 40.
  - 2. Lateral Lines: ASTM D-1785, Class 200.
  - 3. Sleeves: ASTM D-1785, Schedule 40.
- D. This Contractor is responsible for determining if sleeves were installed prior to submitting a bid. If not installed, boring under paving, and/or hand excavation is required.
- E. All main lines to have 14-gauge tracer wire.

**2.2 PIPE FITTINGS**

- A. PVC: Meeting specified standards, Schedule 40, Standard Weight, at PVC pipe; joints solvent welded as recommended by manufacturer, except swing joints and riser to head, which shall be threaded with Teflon Tape. Swing joints shall be Schedule 80.

**2.3 SOLVENT CEMENT**

- A. Meeting ASTM D-2564 and of proper consistency.

**2.4 RISERS**

- A. Spray Heads in all areas use swing pipe. Submit sample of swing joint for approval.
- B. Rotor heads use triple elbow swing joint, submit sample of swing joint for approval.

**2.5 VALVES**

- A. Electric Remote-Control Valve: Glass filled nylon material normally closed, globe configuration.
- B. Master Valve: Highly durable brass construction, globe configuration, pressure regulating.

**2.6 VALVE BOX AND COVER**

- A. Plastic Valve Boxes: Box and cover with open bottom and opening for piping, designed for installing flush with grade and with provision for locking.
- B. All valve boxes are to be Carson Heavy Duty standard rectangle box, green or black in color.
- C. Wire splices, grounding rods, or other components are to be placed in 6" round boxes.
- D. All valve boxes shall have a minimum of 24-36" of control wire for trouble shooting and maintenance.

**2.7 SPRINKLERS**

- A. Spray Sprinkler Heads: Sprinkler shall be four (4) or twelve (12) in pop-up with fixed arc.
  - 1. Sprinkler to be constructed of heavy-duty, ultra-violet resistant plastic with a heavy-duty stainless steel retract spring for positive pop-up and a soft elastomer pressure activated c-molded wiper seal for cleaning debris from pop-up stem as it retracts.
  - 2. Sprinkler shall have a check valve to prevent low head drainage and pressure regulation
- B. Rotary Sprinkler Heads: Sprinkler shall be four (4) inch pop-up with adjustable arc nozzle, matched precipitation rates, and reducible water radius.
  - 1. Sprinkler to be constructed of heavy-duty, ultra-violet resistant plastic with a heavy-duty stainless steel retract spring for positive pop-up and a soft elastomer pressure activated c-molded wiper seal for cleaning debris from pop-up stem as it retracts.
  - 2. Sprinkler shall have a check valve to prevent low head drainage and pressure regulation.
- C. Rotor Sprinklers: Sprinkler shall be four (4) inch pop-up, part and full circle nozzles with matched precipitation rates and reducible watering radius.

**2.8 WATER METER AND BACKFLOW PREVENTER**

- A. Contractor is responsible for coordinating the installation of new water meter and new backflow preventer with site work. Refer to Civil Plans.

**2.9 AUTOMATIC CONTROLLER**

- A. Provide two-wire decoder controller capable of fully automatic and manual operation of irrigation system automatic control valves. Controller housing shall be wall or pedestal mounted, in a weatherproof and lockable cabinet.
- B. Controller to have WiFi capability.
- C. Provide controller, which operates on a minimum of 110 volts AC power input and is capable of operating 24-volt AC electric remote-control valves, with a reset circuit breaker to protect from overload. Contractor is responsible for connection to 120 VAC power to controller.
- D. Each station shall have a time setting which can be set for variable timing in increments from 0 to 60 minutes, or set to omit the station from the irrigation cycle.
- E. The controller shall have a calendar for setting the programmed start-days, and a 24-hour clock for programming the irrigation cycle start time. A master "on-off: switch shall allow the valve power output to be interrupted without affecting the controller.

- F. The controller shall be constructed so that all internal parts are accessible through the controller door without disturbing the cabinet installation.
- G. Controller location to be verified by Owner.
- H. Provide all lightning and surge protection as per manufacturer's recommendations.

## **2.10 LIGHTNING AND SURGE PROTECTION EQUIPMENT**

- A. Provide as per manufacturer's recommendations and requirements.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Verify existing and proposed locations of all site utilities (i.e. gas, water, electric, telephone) prior to any trenching and laying of pipe.
- B. Coordinate all irrigation work with that of all other site work trades and contractors.
- C. All piping to be installed directly behind curb where possible and in all cases to be routed around existing or proposed site elements, including root balls of proposed trees and shrubs. Refer to the landscape planting Drawings for approximate tree locations and closely coordinate work and schedule with grading and planting work.
- D. Contractor is responsible for full and complete coverage of all areas designated on the Drawings to be irrigated and shall make any necessary adjustments at any time, at no additional cost to the Owner.
- E. Exact location and configuration of islands and other features may vary from that shown on these Drawings. Verify location and configuration at the site prior to trenching for sleeves and piping under paving, and make any minor adjustments to irrigation systems layout. Notify Architect of substantial changes.
- F. Maintain all warning signs, barricades, bracing, flares, and red lanterns as required by safety regulations and local ordinances.

### **3.2 INSTALLATION**

- A. General:
  - 1. Lay out according to site coordinates and actual field dimensional controls; verify piping and sleeve locations before trenching.
- B. Excavating and Trenching:
  - 1. Perform all excavation required for installation of the work included under this Section, including shoring and bracing of earth banks to prevent cave-in.
  - 2. Restore all surfaces and existing underground installations damaged or cut as a result of the excavations, to their original condition and in a manner approved by the Owner.
  - 3. All excavation shall be unclassified. Trenches shall be 4-inches wide and to the depth required as specified herein and shown in the Drawings.
  - 4. Over-excavation shall be backfilled at the Contractor's expense with cushion sand. Remove all unsuitable or excess material from the site.
  - 5. Dewater excavations as required for dry work including both surface and ground water.
  - 6. Trenches shall have sides as nearly vertical as possible and bottoms shall be shaped to provide continuous bedding of each section of pipe along its entire length in undisturbed soil or thoroughly compacted fill.

7. Trenches for piping shall be of sufficient depths to provide 12-inches minimum cover for pipes from finished grade. In Public Right-Of-Way, provide 18-inches minimum cover over top of main and lateral lines, or greater depth if required by local authorities.
- C. Pipe Installation:
1. Pipe installation includes all irrigation piping required for water and electrical wiring to complete the automatic irrigation system.
  2. Provide firm, uniform bearing for entire length of each pipeline to prevent uneven settlement. Wedging or blocking of pipe will not be permitted. Remove foreign matter or dirt from inside of pipe before joining and keep piping clean by approved means during and after laying of pipe.
  3. Assemble pipe and solvent weld. Clean joint thoroughly of dust, dirt, and moisture before applying solvent with non-synthetic bristle brush.
  4. Install all pipe and wiring under paving in sleeves as specified, whether or not shown on Drawings. Pressure test all piping under paving prior to paving. All mains and piping under pavement to be pressure tested and activated immediately.
  5. Pipe depth is expected to be between 12-18" below grade for all main and lateral lines.
- D. Pipe Fitting:
1. Solvent: Use only solvent recommended by manufacturer to make solvent welded joints. Thoroughly clean pipe and fittings of dirt, dust and moisture before applying solvent.
  2. PVC to Metal Connection: Work metal connection first. Use a TEFLON pipe fitting tape on threaded PVC to metal joints. Use only light wrench pressure.
  3. Threaded PVC Connections: Where required, use threaded PVC adapters into which pipe may be welded.
- E. Irrigation Heads:
1. Prior to installation, verify configuration of planting areas and tree locations, and stake head layout accordingly. Obtain approval of staked head locations from Landscape Architect before proceeding.
  2. Rotor and Pop-up Spray Heads: Attach sprinkler as specified. Adjust riser height after planting.
- F. Wiring:
1. Supply #14 UL listed single strand U.F. direct burial wire from automatic controllers to the valves in accordance with the Specifications. Use PVC conduit for all locations of wire under paving; in landscaped areas, the Contractor may add conduit for wires at his option, in lieu of tucking wire under main lines and lateral lines.
  2. Control wire to be double jacketed, no stranded or twisted 2-wire types will be accepted.
  3. Secure all wire-to-wire connections by approved means.
  4. All wire from controllers to valves shall be tucked under piping.
  5. Test wires prior to backfilling to ensure continuity from valve location to controller location. Any wire not indicating continuity shall be repaired or replaced immediately.
- G. Controller:
1. Coordinate controller location with Architect and Contractor.
  2. Coordinate with Alabama Power Company to provide temporary power to controller location. This Contractor shall make power available for system.
  3. Pull valve wires, program controller, and put controller in operations.
- H. Electrical Valves: Supply and install in accordance with the materials list and the manufacturer's recommendations; set in a level position.
- I. Valve Boxes: Set flush with finish grade (adjust as necessary); set over all valves.
- J. Drainage: Place a minimum 12-inches depth of crushed stone under each box containing either water meter, pressure regulator, valve or backflow preventer.

### 3.3 TESTING

- A. Conduct test in presence of Architect. Notify Architect 48-hours in advance of testing date and time:
  - 1. Thoroughly flush out all water lines before installing heads and valves.
  - 2. Operational Test: After backfilling and adjusting heads to final positions, show that system meets coverage requirements and controls function properly. Adjust heads to be not more than ½-inches above finish grade.

### 3.4 BACKFILL AND COMPACTING

- A. Do not backfill until pipe systems have been hydrostatic tested and approved.
- B. After system is operating and required tests and inspections have been made, backfill excavations and trenches as follows:
  - 1. Backfill Under Paving:
    - a. Backfill for full depth of excavation with the specified crushed stone. Compact in lifts. Backfill shall be free of debris, large clods, roots or other deleterious material.
    - b. Place backfill material evenly in lifts not to exceed 6-inches and compact to 100-percent of maximum density.
    - c. Contractor is responsible for establishing compaction in trenches equal to or exceeding overall compaction of paving base. Leave top of trench ready for asphalt by others.
  - 2. Backfill in Landscape Areas:
    - a. Backfill trenches with material removed during excavation and compacted to 85-percent except where rock is encountered. In this case lay pipe in a cushion sand bed surrounding the pipe, a minimum of 4-inches deep.
    - b. Compact all excavation to prevent settling. Hand rake excavation areas and adjoining areas to leave grade at the previous elevation and in a good or better condition than before installation. Water-floor compaction will not be permitted.
    - c. Repair settled areas throughout Guarantee Period, including repair of affected landscape work.

### 3.5 FINAL ADJUSTMENT

- A. After planting and irrigation installation has been completed, make final adjustment to irrigation system prior to the Architect's final inspection.
- B. The system shall be completely flushed to remove any and all debris from the lines by removing nozzles from all heads on ends of lines and turning on the system.
- C. Check all heads for correct operation, alignment, and direction of throw.
- D. Check each section of spray heads for operating pressure, and balance in relation to all other sections by use of the flow adjustment on top of each valve.
- E. Check nozzles for complete coverage. Prevailing wind or other conditions may indicate the arc or angle of spray should be other than as shown on plan. In this case, revise nozzle degree to provide correct coverage, at the Contractor's expense.
- F. Adjust head and valve heights as necessary. Make any other adjustments determined necessary by the Landscape Architect to provide complete and uninterrupted coverage.

**3.6 CLEAN-UP**

- A. Keep site clean on a daily basis by removing trash and debris resulting from construction operation.
- B. Keep all walks, roads, and circulation routes free from debris, materials, and equipment at all items.
- C. Upon completion of the irrigation work, clean up all work and storage areas by removing trash piles, surplus material, or other material from site.
- D. Restore pavement, curbs, ground, and any other disturbed surface to its original condition.

**3.7 MAINTENANCE AND COMPLETION OF THE WORK**

- A. Complete the irrigation system as specified and operate and maintain same from time of installation until Substantial Completion and for a period of 1-year beyond Substantial Completion.
- B. Instruct Owner's personnel in complete operation and maintenance of irrigation system.

**PART 4 - ACCEPTANCE AND GUARANTEE****4.1 SUBSTANTIAL COMPLETION**

- A. Submit request for inspection for Substantial Completion to the Landscape Architect at least 24-hours prior to anticipated date of inspection and testing (refer to Paragraph 3.3 TESTING, herein).
- B. Submit Record Drawings and Maintenance Manual to the Landscape Architect with request for inspection (refer to Paragraph 1.4 SUBMITTALS, C. and D., herein).
- C. Review the work jointly with the Owner and Landscape Architect for Substantial Completion.
- D. Upon completion of repairs and replacements found necessary at time of review, the Owner and Architect will confirm the date of Substantial Completion of the work.
- E. The date of completion of repairs and replacements found necessary at time of Substantial Completion, will constitute the beginning date of the 1-Year Guarantee.

**4.2 GUARANTEE**

- A. Guarantee all work, products, equipment, and materials for 1-year, beginning at date of completion of punch list from Substantial Completion.
- B. During the period of the Guarantee, replace immediately, with no additional compensation, all work not functioning correctly; make adjustments as necessary to maintain complete coverage; make good any other damage, loss, destruction, or failure. Repairs and replacements shall be done promptly and at no additional cost to the Owner.
- C. Repair damage to grade, plants, and other work or property as necessitated due to irrigation defects, repairs, replacement, or adjustment.
- D. If the replacement is not acceptable during or at the end of the Guarantee Period, the Owner may elect either subsequent replacement or credit. Replacement products shall have a similar 1-year guarantee from time of replacement.
- E. Guarantee applies to all losses with the exception of those due to Acts of God, Vandalism, or Owner neglect, as determined by the Landscape Architect.

**4.3 FINAL INSPECTION AND ACCEPTANCE**

- A. At end of Guarantee Period and upon request for inspection, jointly review all guaranteed work for Final Acceptance.
- B. Submit written request for inspection for Final Acceptance to the Landscape Architect at least 2-weeks prior to anticipated date of inspection; include list of work provisionally accepted and list of work replaced during Guarantee Period.
- C. Upon completion by the Contractor of all required repairs and replacements; the Owner and the Landscape Architect will confirm the date of Final Acceptance of the Work.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 32 90 00 - PLANTING (LANDSCAPE WORK)****PART 1 - GENERAL****1.1 RELATED DOCUMENTS:**

- A. The general provisions of the Contract, including General and Supplementary and General Requirements apply to the work specified herein.

**1.2 DESCRIPTION:**

- A. Provide all labor, equipment, materials and services necessary to complete the Work of this Section, including:
  - 1. Providing, placing, grading topsoil and/or sand for landscape grading as indicated in the Drawings.
  - 2. Providing and installing trees, shrubs, ground covers, and solid sod for landscape planting.
  - 3. Maintenance for thirty days after Substantial Completion.

**1.3 SUBMITTALS:**

- A. Qualification Data for firms specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include a list of a minimum of five (5) similar projects completed with the last five (5) years with project name, address, names of Architects and Owners, overall description of scope of work, and contract value.
- B. Materials Lists:
  - 1. Within ten (10) days of award of Contract, submit a complete list of materials and unit prices demonstrating source, availability, and complete conformance with requirements specified.
  - 2. Substitutions not permitted unless proof is submitted to the Landscape Architect's satisfaction that the material is unavailable as specified.
- C. Certificates: Deliver all certificates of inspection to the Engineer.
- D. Product Data:
  - 1. Submit manufacturer's product literature, instructions and guaranteed analysis for fertilizer.

**1.4 DEFINITIONS:**

- A. Trees, shrubs, and groundcovers are plant materials listed in Plant Schedule on Drawings.

**1.5 JOB CONDITIONS:**

- A. Coordinate the Work of this Section with that of other trades.
- B. Examine conditions under which Work is to be performed and notify Landscape Architect and Landscape Architect in writing of unsatisfactory conditions.
- C. Do not perform Work until conditions are satisfactory and acceptable.

- D. Notify utility companies, prior to digging, for locations of underground utilities (electrical power, telephone, cable, water, sewer and gas) and perform Work in a manner which will avoid all possible damage. Hand excavate as required.
- E. Maintain stakes or other location markers and controls set by others until removal is mutually agreed upon by all parties.

## 1.6 QUALITY ASSURANCE:

- A. Codes and Standards:
  - 1. Applicable Sections of Alabama Highway Department (ALDOT) Standard Specifications for Highway Construction, latest Edition as amended.
  - 2. All plant materials to comply with State and Federal laws relating to inspection for disease and insect control.
  - 3. Plant material quality to conform to American Standard for Nursery Stock, American Association of Nurserymen, Inc., 1986, ANSI Z-60.1.1.
  - 4. Plant Material nomenclature to conform to:
    - a. *Hortus Third*, a Concise Dictionary of Plants Cultivated in the United States and Canada, MacMillan Publishing Company, Inc., New York, 1976 Edition.
    - b. Names not listed in the above standard to comply with those most commonly used in the trade.
    - c. In all cases, botanical names take precedence over common names.
- B. Installer Qualifications: Firm shall hold Alabama General Contractor's License for Classification S - Specialty Construction, Subclassification 4 - Landscaping. Firm experienced in the successful installation of a minimum of five (5) projects within the past five (5) years similar in scope, quality, and contract value to that indicated for this project. Firm shall have sufficient manpower, equipment and financial resources to complete the Work of this Section.
- C. Personnel: Use adequate numbers of skilled workmen trained and experienced in the Work and familiar with requirements and methods needed for performance of the Work. At all times during planting operations, have on the site a person knowledgeable in horticultural practices as a superintendent.
- D. Inspection and Approval:
  - 1. All plant material is subject to inspection and approval in the field or nursery before digging, by the Landscape Architect.
  - 2. All plant materials and other materials are subject to inspection and/or rejection at the site before planting or placing, or at any other time.
  - 3. Attach secure, durable, legible waterproof labels, stating correct botanical and common names as specified, to a least one (1) plant, bundle or container of each plant variety.
  - 4. Remove from site plant materials or other materials not complying with specified requirements within 5 days of rejection.
  - 5. Approval is for visual qualities only and does not relieve the Contractor of his obligation to provide materials and workmanship in full compliance with the requirements of the Contract Documents.

## 1.7 1.7 PRODUCT DELIVERY, STORAGE and HANDLING:

- A. Deliver packaged materials in manufacturer's original containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at the site.
- B. Deliver all non-packaged or non-containerized materials to site in a manner that will prevent loss, damage, deterioration or contamination.

- C. Store all materials in approved locations to prevent loss, damage, deterioration or contamination.
- D. Deliver, storage and handling of all plant materials shall conform to ALDOT Specifications and the following:
  - 1. Deliver freshly dug plants, which have not been in cold storage or heeled-in.
  - 2. Do not prune prior to delivery.
  - 3. Do not bend or bind trees or shrubs in such a manner as to damage bark, break branches or destroy natural shape.
  - 4. Provide necessary protective covering during transport and delivery.
  - 5. Deliver plants after preparations for planting have been completed and approved, and plant immediately.

### 1.8 SITE MAINTENANCE:

- A. Keep roads, paving and structures adjacent to maintenance operations clean and free of obstructions, mud and debris at all times.
- B. Do not permit flushing of roads or disposal of dirt or debris into sewers or drainage ditches.
- C. Control dust from maintenance operations.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS:

- A. Topsoil:
  - 1. This Contractor shall furnish topsoil in sufficient quantity, to complete grading and planting operations as specified.
  - 2. Characteristics of topsoil to be furnished:
    - a. Fertile, friable, naturally occurring. Free of stones, clay, lumps, hardpan, roots, stumps, branches, sticks and other debris larger than two (2) inches in any dimension; free of noxious weeds, grasses, seeds, plants, extraneous matter and any substance harmful to plant growth. Topsoil from open fields will not be accepted.
    - b. Ph: 5.0 to 7.0
    - c. Organic Matter: 5% to 10%
    - d. Sand: 50% to 70%
    - e. Silt: less than 30%
    - f. Clay: 10% to 25%
    - g. Permeability Rate of 5 x 10 <sup>-3</sup> centimeters or greater at 85% compaction.
  - 3. Notify Engineer of location of proposed topsoil for his inspection before testing or transporting to site.
  - 4. Topsoil testing for furnished topsoil: Sample and test, minimum of three (3) samples, for compliance with specified characteristics. Tests to be performed by soil testing lab approved in advance by Engineer, by this Contractor at his expense. Submit Soil Test Reports to Landscape Architect for approval before transporting topsoil. Amend per recommendations of Soil Test Report and as approved to meet specified characteristics.

### 2.2 SOIL AMENDMENTS:

- A. Fertilizer:
  - 1. Characteristics:

- a. Uniform in composition.
  - b. Dry and free-flowing.
  - c. Commercially available.
  - d. Conforming to the State of Federal Fertilizer Laws.
2. Of the formulation recommended in the Soil Test Report as specified.
- B. Lime:
1. Ground or crushed agricultural lime.
  2. Containing not less than 85% of total carbonates.
  3. 90% passing 20-mesh screen.
  4. Not less than 50% passing a 60-mesh screen.
  5. Dry and free-flowing.
  6. Apply at rate specified in Soil Test Report.

### 2.3 LANDSCAPE PLANTING MATERIALS:

- A. Water:
1. Provide fresh water, free of impurities or any substance harmful to plant growth.
  2. Provide all hose, attachments, and accessories necessary to complete the Work as specified.
- B. Topsoil: Refer to Paragraph 2.1.A, this Section, for specified topsoil for use in all planting operations.
- C. Topsoil Mix:
1. Prepare all topsoil mix used in tree and shrub pits and ground cover beds in the following proportions:
    - a. 2 parts by volume topsoil as specified. 2.1.A.
    - b. 1 parts by volume decomposed organic matter, 2.3.E.
  2. Add three (3) pounds of 12-6-6 fertilizer to each cubic yard of topsoil
- D. Decomposed Organic Matter:
1. Well rotted organic matter.
  2. Containing no weeds, grasses or plants, their seeds, or any substance harmful to plant growth.
  3. Of uniform composition.
  4. Acceptable Materials:
    - a. Mushroom Compost
    - b. Ground pine bark
    - c. Approved equal.
- E. Chemical Weed Control
1. Pre-Emergent (in bed areas):
    - a. Selective pre-emergent with no residual soil activity. Active ingredient: Trifluralin.
    - b. Commercially available.
    - c. Adhere to manufacturer's recommendations for strength, rate, and method of application.
    - d. Acceptable Manufacturers:
      - 1) Elanco: Treflan
      - 2) Approved substitution.
  2. Herbicide:

- a. Non-selective post-emergent with no residual soil activity. Active ingredient: Isopropylamine salt of Glyphosate.
  - b. Commercially available.
  - c. Adhere to manufacturer's recommendations for strength, rate and method of application.
  - d. Acceptable Manufacturers:
    - 1) Monsanto Agricultural Products Company: Round Up.
    - 2) Approved substitution.
- F. Mulch:
1. Pine straw on slopes: Free from leaves, twigs, insects, grasses, weeds, plants and their seeds, other foreign material and any substances harmful to plant growth.
  2. Ground Pine bark: Free from leaves, twigs, insects, grasses, weeds, plants and their seeds, other foreign material and any substances harmful to plant growth.
- G. Solid Sod:
1. Obtain solid sod from sources having growing conditions similar to the area to be planted.
  2. Sod shall be true to name and type of the species named in the plant Schedule.
  3. Sod shall be 100 percent of the type specified and shall contain no other grasses.
  4. Sod shall be well cultivated and weed, disease and insect-free, of good texture, and free from extraneous roots, stones and other foreign material. The presence of nutgrass or other weeds shall be cause for rejection and replacement prior to Substantial completion, or during the Guarantee Period.
  5. Contractor shall lay sod within 24 hours of harvesting. Contractor shall not lay sod if dormant or if ground is frozen or muddy.
- H. Seed (If shown on plans):
1. Use Winter Rye Grass as a temporary grass during the cool months, defined as October to March. Seed is to meet purity standards as outlined in AHD Section 860.01a.
  2. Use Cynodon Dactylon (Common Bermuda) for seeding during the warm months, defined as April through September. Seed is to meet purity standard as outlined in the AHD Section 860.01a. Seed at a rate of 50 lbs. per acre.
  3. Do not broadcast or drop seed when wind velocity exceeds 10 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
  4. Sow seed at a total rate of 1.5 lb/1000 sf (Common Bermuda).
  5. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- I. Plant Material:
1. Definition: Trees and shrubs listed in the Plant Schedule in the Drawings.
  2. General:
    - a. Species, sizes, manner in which to be planted, and approximate quantities to complete the planting as indicated are included in the Plant Schedule.
    - b. Scientific and common plant names conform to those given in *Hortus Third*, or are those generally accepted in the nursery trade.
  3. Quality:
    - a. Conform to the standards set forth in *American Standard for Nursery Stock*.
    - b. Standard quality and first-class representatives of their species or variety and true to name and type.
    - c. Nursery-grown, unless specified otherwise.
    - d. In compliance with State and Federal laws relating to disease and insect infestation; file certificates with Landscape Architect.

- e. Having normal, well-developed branches and vigorous root systems, free from defects, decay, disfigurements, sun scaled, bark abrasions, plant diseases, insect pests or eggs, borers and any and all infestations.
4. Rejection of plants for:
    - a. Lack of compactness or proper proportion;
    - b. Weak, thin growth in rows too close together;
    - c. Cut back from larger stock to meet specified requirements;
    - d. Undersized, dry, cracked or broken balls, or plants that are loose in their balls;
    - e. Root bound within container or ball;
    - f. Lacking proper proportion as to height and spread and specified characteristics or plant material;
  5. Size:
    - a. Sizes and proportions of all plant materials shall equal those recommended by the *American Standard for Nursery Stock* for specified grades.
    - b. Measure plants before pruning, with branches in normal position.
    - c. Equal or exceed measurements specified in Plant Schedule, which are the minimum acceptable; provide 50-percent of plant material maximum size specified.
    - d. Height and spread dimensions: General body mass of plant, not from branch tip to tip.
    - e. Well-proportioned as to height; reject plants which meet specified measurements but do not possess an overall balance.
    - f. Take caliper measurement on trunk six-inches above natural ground level up to and including four-inch caliper size; twelve-inches above natural ground level for larger sizes.
    - g. B&B plants shall have firm natural balls of a diameter and depth not less than that recommended in *American Standard For Nursery Stock*.
    - h. Container-grown plants: Conform to standards set forth in *American Standard For Nursery Stock* for container-grown plants.
  6. Quantity: Furnish plants in sufficient quantity to satisfy the intent of the Drawings and Specifications. Locate in sufficient quantity to that time is not lost if some plants are rejected.
- J. Guying and Staking Materials:
1. Wood Stakes:
    - a. Pressure-treated Southern Yellow Pine, or other approved wood, 2-inches x 4-inches x length specified in the Drawings, pointed at one end.
    - b. Free from insects and fungi.
  2. Wire: Pliable #10 or #12 gauge galvanized steel wire, doubled and twisted.
  3. Turnbuckles: As detailed and approved by Landscape Architect.
  4. Protective Hose:
    - a. Reinforced fiber-bearing rubber hose.
    - b. Black.
    - c. May be second-hand.
    - d. Not less than 2-inches inside diameter.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION:

- A. Planting Season:

1. A period of acceptable weather conditions, during seasons in which satisfactory results can be expected as determined by acceptable practice in the locality and approved by the Landscape Architect.
  2. Commence planting operations as soon as portions of the site are available, as approved by the Landscape Architect.
- B. Site Inspection:
1. Examine areas and conditions under which Work is to take place.
  2. Inform Landscape Architect in writing, prior to planting, of conditions existing which could be considered detrimental to the successful planting and growth of any plant material, including but not limited to, subsurface drainage conditions, utility locations, subgrade compaction, percolation rate and elevations.
- C. Site Preparation:
1. Topsoil (4" in sod areas and 6" in shrub and groundcover beds) shall be spread by the Contractor and fine graded. Topsoil, regardless of the source, shall meet all requirements of the paragraph above.  
  
Stockpile material that does not meet the minimum requirements, may, at the option of the contractor, be improved by screening and the addition of organic matter and chemical admixtures.  
  
Do not place or spread topsoil in an area until subgrade is approved by Landscape Architect and is acceptable to this Contractor.
  2. Remove all vegetative growth from topsoil by approved means before commencing with planting operations.
  3. Remove all unwanted vegetative growth from areas designated to receive new planning or sod with chemical herbicide or by other approved means, prior to scarifying and placing topsoil.
  4. Remove extraneous matter measuring 1-2-inch or larger in any dimension from top 4-inches of placed topsoil.
  5. Uniformly grade areas including adjacent transition areas to line and grade shown on Drawings.
  6. Obtain approval of finished grades before proceeding with planting operations; eliminate irregularities and ponding.
  7. Protect stockpiled or spread topsoil from erosion by force of wind, water, or other force; re-establish eroded, rutted or settled grades to proper finished grade.
- D. Plant Location Staking and Excavating Compacted Subgrade Tree Pits:
1. Stake plant locations and areas for approval prior to planting.
  2. Do not dig plant pits prior to obtaining Landscape Architect's approval of plant locations.
  3. Make adjustments in plant locations as directed.
  4. If underground obstructions are encountered in planting areas that would prevent the installation of the plant material, contact the Landscape Architect immediately. Alternate locations may be selected by the D & D at no additional cost to the Owner.
  5. All locations where trees are to be installed shall have the topsoil broken up to an 18" depth and 10' radius (if space allows) with a mini excavator.
- E. Topsoil Mix:
1. Prepare topsoil mix to specification 2.3.C off site, using approved topsoil.
  2. Obtain approval of topsoil mix before delivery to site, and prior to commencing planting operations. Do not mix in place with placed topsoil.

3. Place topsoil mix as backfill for tree and shrub pits and beds as drawn. Place 2-inches of topsoil mix in all shrub beds unless otherwise indicated on the Drawings.
4. Protect stockpiled topsoil mix from erosion by force of wind of water, or damaged by traffic.

F. Planting:

1. Place plants comprising a planting composition in approved staked locates for approval by Landscape Architect.
2. Planting pits and beds:
  - a. Drainage:
    - 1) This Contractor is responsible for achieving and maintaining adequate drainage from all planting beds. Use specified drainage system, or other approved means, in all tree pits.
    - 2) 48-hours prior to planting, test each plant pit for adequate drainage.
    - 3) Owner reserves the right to test tree or plant pits at any time, before or after planting, for adequate drainage. Correct immediately any inadequate drainage encountered.
  - b. Pits are generally circular in outline with vertical sides.
  - c. Tree pits: 3-feet greater in diameter than ball or root spread.
  - d. Shrub pits: 1-foot greater in diameter than ball or root spread.
  - e. Excavate to specified dimensions and dispose of excavated material off site.
  - f. Prepare as specified in detail Drawings.
3. Setting plants:
  - a. Set plants uniformly 2-inches to 4-inches higher than surrounding grade or as necessary to provide adequate positive drainage away from roots. Slope soil gradually from saucer.
  - b. Cut rope, wire or string from top of ball after plant has been set; turn down and bury burlap.
4. Backfilling plants:
  - a. Backfill to 2/3 full with specified topsoil mix.
  - b. Water thoroughly to eliminate air pockets and settling before filling to grade.
  - c. Form shallow saucer at plant pit edge to hold water.
  - d. Water in thoroughly.
5. Pre-Emergent application:
  - a. Apply per manufactures instructions.
6. Staking:
  - a. Inspect tree trunks for injury, improper pruning and insect infestation; take corrective measure.
  - b. Immediately after planting, stake trees as detailed.
7. Pruning:
  - a. Do not prune plants without approval.
  - b. Prune after plants are in place and *ONLY* at the direction of Landscape Architect.
  - c. Main leaders of trees to remain intact.
  - d. Paint all cuts over 2-inch diameter with approved tree wound dressing.
8. Finished Grading: Handgrade and rake planting areas so that grades conform to surrounding areas and surface water drains freely.
9. Mulching:
  - a. Mulch all plant pits and beds with 4-inch deep specified mulch.
  - b. Spread mulch solid in planting beds.



- c. Thickness is uniform throughout.
  - d. Mulch for trees shall be eight (8) feet in diameter from base of tree.
- G. Solid Sod:
  - 1. Procure and handle sod per ALDOT Section 654, 2018 Edition.
  - 2. Preparation of Sod Bed:
    - a. Spread and scarify amended topsoil as specified.
    - b. Rake and otherwise manipulate to form smooth-draining grades, remove all stones and clay lumps 1-inch in diameter or larger.
    - c. Leave the surface of the topsoil 1- 1/2-inches below finished grade.
    - d. Do not move heavy objects over areas to be sodded after the soil has been prepared. Planting in compacted areas will not be permitted.
    - e. The finished surface of the areas to be sodded shall be approved by the Landscape Architect prior to sod placement.
  - 3. Solid Sod Placement:
    - a. Lay sod when sod bed is not excessively wet or frozen, but when soil is damp for a depth of 4-inches.
    - b. Immediately upon approval of bed preparation, lay sod smoothly, edge-to-edge, with staggered joints.
    - c. Press firmly into contact with sod bed by tamping or rolling by approved means to eliminate all air pockets, providing a true and even surface, and assuring knitting.
    - d. Fill cracks between sod blocks with strips of living sod, topsoil, or humus.
    - e. Water thoroughly by use of sprinkler or spray, without erosive force.
- H. Seeding: (may not be applicable if Seeding specification is included)
  - 1. Furnish, sow, establish and maintain an acceptable growth of specified grass over all disturbed areas not otherwise designated to receive planting, mulch or sod.
  - 2. Ground Preparation: Spread and scarify amended topsoil as specified. Ground preparation shall consist of cultivation to loose depth approximately four (4) inches (minimum). The plowing, harrowing, cultivating, and all other operations shall be performed with proper equipment and in such a manner as to break up all clods, lumps or earth balls, and remove all boulders, stumps, large roots, or other particles which will interfere with the Work. The resultant surface is to be smooth, uniform, loose, well broken, and fine grained soil providing a suitable bed for seed grass. The ground shall be plowed to the required depth, then cultivated with a rotary tiller and/or disc harrow, in both directions if feasible, until approved. In small or inaccessible areas use of hand tools will be permitted. After removal of all large particles which cannot be broken, the surface shall then be harrowed and tilled. Add sufficient water to wet the soil in order to prepare the ground.
  - 3. Sowing:
    - a. Sowing seed shall follow promptly after the addition of the fertilizer in a uniform manner at the rates specified by Soil Test Reports.
    - b. Sowing shall be done by approved mechanical seeders. Without prejudice to power equipment or seeders of other types and makes, hand operated cyclone sowers, in sufficient number, will be considered mechanical seeders. No sowing shall be done during windy weather, or when the prepared surface is crusted, or when the ground is frozen, wet or otherwise in a non-tillable condition.
    - c. Care shall be exercised during covering operations to preserve the line, grade and cross-section of the seeded areas and to see that areas adjacent to pavement, curbs, etc., are not left higher than the paved surface. Unless otherwise directed, after seed has been sown the seedbed shall be compacted immediately by means of a cultipacker, light roller or approved drag.

4. Mulching: Spread hay or straw mulch to seeded areas at specified rate within 24 hours after the area has been seeded.
5. Care During Construction:
  - a. Water, fill washes, and otherwise protect and maintain the seeded areas including any mulch or cover used until the Work is accepted.
  - b. Repair damage caused by pedestrian and/or vehicular traffic, or other causes.
6. Satisfactory Stand:
  - a. The acceptance of areas designated to be seeded under this Section will be based on verification of a satisfactory stand of grass as determined by an on-site observation by the Landscape Architect.
  - b. A satisfactory stand is defined as a cover of living grass of specified species, after true leaves are formed in which no gaps larger than five (5) inches square occur. Areas viewed by the Landscape Architect to be solid rock will be exempt from this requirement.
  - c. If a satisfactory stand is not established in any area, the area shall be reseeded until a satisfactory stand is established, without additional compensation.
7. Should the site be ready for seeding during a season when, in the opinion of the Landscape Architect, the specified grass will not form a satisfactory cover, establish a cover of Winter Rye and reseed specified grass at earliest time when acceptable growth can be established at no additional cost to the Owner.

### **3.2 LANDSCAPE MAINTENANCE:**

- A. See Section 32 9005 Landscape Maintenance

### **3.3 SUBSTANTIAL COMPLETION and GUARANTEE:**

- A. Substantial Completion and Payment:
  1. Submit written requests for inspection for Substantial Completion to Landscape Architect at least three calendar days prior to anticipated date of inspection and testing.
  2. Substantial Completion cannot be granted and at the same time no further applications for payment shall be for more than 85 percent of Contract until
  3. there has been a walk - thru for planting at which time a "punch list" will be written consisting of items to be addressed and corrected by Landscape Contractor immediately. Depending on extent of work on "punch list", Landscape Architect will determine job to be "substantially complete" or pending the completion of punch list".
  4. Submit Record Drawings and Maintenance manuals to Landscape Architect with written request for inspection.
  5. Review "punch list" work jointly with Owner and Landscape Architect for
  6. Substantial Completion of total (contract) work.
  7. Upon completion of repairs and replacements found necessary at time of review, Owner and Landscape Architect will confirm date of Substantial Completion and issue written notice of Substantial Completion if items on punch list have been completed. If necessary, another punch list will be written to itemize deficiencies still existing and will be attached to written notice of substantial completion. Landscape Contractor shall complete all "punch list" items if possible within 30 days while continuing maintenance.
  8. Date of Substantial Completion will constitute beginning date of One - Year Guarantee. This date also constitutes beginning of warranty responsibilities and acceptance by Owner and Landscape Architect.
- B. Guarantee:
  1. Guarantee all materials and workmanship for a period of 1-year from the Date of Substantial Completion.

2. During the period of the Guarantee, replace with no additional compensation, and as soon as weather permits, all dead plant materials and all materials not in a thriving condition; replace all other workmanship and materials which are unsatisfactory in the opinion of the Landscape Architect; make good any other damage, loss, destruction, or failure to flourish sufficiently as the result of inferior or defective materials or workmanship, including, but not limited to inadequate drainage.
3. All replacement material shall match the size attained by original materials at the time of the replacement.
4. Remove dead or dying material from the site within 5 days of notice, refer to section 1.6 paragraph D(4).
5. Repair grades and other Work necessitated due to planting replacements.
6. If the replacement is not acceptable during or at the end of the Guarantee Period, the Owner may elect either subsequent replacement or credit. Replacements shall have a similar 1-year Guarantee from date of replacement.
7. Guarantee applies to losses or damage other than those due to vandalism, Owner neglect, or Acts of Nature, as determined by the Landscape Architect. Acts of Nature, but may not be limited to, high winds of hurricane or tornado force, sleet, hail, freezing rain, and extreme cold (as determined by the Landscape Architect). Contractor agrees to replace losses due to Acts of Nature at fifteen percent (15%) less than original contract price for the damaged work.

#### **3.4 FINAL INSPECTION and ACCEPTANCE:**

- A. Contractor is responsible for contacting the Landscape Architect at the end of the Guarantee Period to schedule final inspection. Should the Contractor fail to contact the Landscape Architect at this time, the Guarantee Period is automatically extended until he does so.
- B. At the end of the Guarantee Period, submit request for inspection for Final Acceptance to Landscape Architect at least 1-week prior to anticipated date of inspection; include list of Work substantially accepted and list of Work replaced during Guarantee Period.
- C. Upon request for inspection, jointly review with Landscape Architect all guaranteed Work for Final Acceptance.
- D. Remove tree staking apparatus and saucers from all trees, unless otherwise directed; replace mulch to specified thickness.
- E. Upon completion by the Contractor of all required repairs and replacements, the Landscape Architect will confirm the date of Final Acceptance of the Work.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 32 90 05 – LANDSCAPE MAINTENANCE****PART 1 - GENERAL****1.1 RELATED DOCUMENTS:**

- A. The general provisions of the Contract, including General and Supplementary Conditions, and General Requirements, apply to the work specified herein.
- B. General specifications for Landscape Work and Irrigation Work.

**1.2 DESCRIPTION AND SCOPE OF WORK:**

- A. Provide all labor, products, equipment and services necessary to maintain site landscape work for one year (365 days) beyond Substantial Completion of the Landscape Work, or other date agreed upon by the Owner, Landscape Architect, and Contractor.
  - 1. Provide pricing for 1 year of landscape maintenance.
- B. Maintenance includes maintaining all landscape and site work as described herein; it does not include sweeping, hosing or cleaning of walks, parking lots or other areas to remove trash, litter, debris, etc. However, the removal of trash, litter, blowing paper, debris, dust and mud from landscape areas and other areas littered as a result of maintenance operations is included.
- C. Maintain all plants in a growing, well formed, healthy, and thriving condition, by watering, fertilizing, pruning, spraying, weeding, straightening, replacement, or by other necessary maintenance operations.

**1.3 SUBMITTALS:**

- A. Qualification data for firms specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include a list of a minimum of five (5) similar projects completed within the last five (5) years with project name, address, names of Architects and Owners, overall description of scope of work, and contract value.
- B. Product Data:
  - 1. Submit manufacturer's product literature, instructions and guaranteed analysis for fertilizer.
- C. Maintenance Manual: In a 3-ring binder, typewritten schedule and procedures for annual landscape maintenance program and procedures, with monthly maintenance guidelines, by Contractor.

**1.4 DEFINITIONS:**

- A. Trees, shrubs, groundcovers and perennials are plant materials listed in the Plant Schedule on the Drawings.

**1.5 JOB CONDITIONS:**

- A. Coordinate the Work of this Section with that of other trades.
- B. Examine conditions under which Work is to be performed and notify Owner in writing of unsatisfactory conditions.
- C. Do not perform Work until conditions are satisfactory and acceptable.
- D. Maintain stakes set by others until all parties mutually agree upon removal.

- E. Determine the extent of underground utilities and impact on proposed installation and maintenance operations.

## 1.6 QUALITY ASSURANCE:

### A. Codes and Standards:

1. All plant materials to comply with State and Federal laws relating to inspection for disease and insect control.
2. Plant material quality to conform to *American Standard for Nursery Stock*, American Association of Nurserymen, Inc., 1986, ANSI Z-60.1.
3. Plant Material nomenclature to conform to:
  - a. *Hortus Third*, a Concise Dictionary of Plants Cultivated in the United States and Canada, MacMillan Publishing Company, Inc., New York, 1976 Edition.
  - b. Names not listed in the above standard to comply with those most commonly used in the trade.
  - c. In all cases, botanical names take precedence over common names.
4. Applicable Sections of the Alabama Department of Transportation (ALDOT) Standard Specifications for Highway Construction, 2001 edition.

### B. Contractor Qualifications:

1. Alabama General contractors License for Classification S - Specialty Construction, Sub-classification 4 - Landscaping.
2. Firm experienced in the successful installation of a minimum of five (5) projects within the past five (5) years similar in scope, quality, and contract value to that indicated for this project. Firm shall have sufficient manpower, equipment and financial resources to complete the Work of this Section.

### C. Supervision:

1. Scheduling, operations, installation, and maintenance shall be supervised by a person(s) having one or more of the following qualifications:
  - a. Is a Certified Nurseryman.
  - b. Is a Licensed Horticulturist.
  - c. Has a State Setting and Maintenance License.

### D. Inspection and Approval:

1. All plant material is subject to inspection and approval by the Landscape Architect in the field prior to digging, in the nursery in containers, before planting and installation, any time during the installation and completion of this phase of work.
2. Immediately remove from site plant materials or other materials not complying with specified requirements.
3. Approval is for visual qualities only and does not relieve the Contractor of his obligation to provide materials and workmanship in full compliance with the requirements of the Contact Documents.

## 1.7 PRODUCT DELIVERY, STORAGE and HANDLING:

- A. Deliver packaged materials in manufacturer's original containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at the site.
- B. Deliver all non-packaged or non-containerized materials to site in a manner that will prevent loss, damage, deterioration or contamination.

- C. Store all materials in approved locations to prevent loss, damage, deterioration or contamination.
- D. Deliver, storage and handling of all plant materials shall conform to ALDOT Specification Section 860.06(c) and the following:
  - 1. Deliver freshly dug plants, which have not been in cold storage or heeled-in.
  - 2. Do not prune prior to delivery.
  - 3. Do not bend or bind trees or shrubs in such a manner as to damage bark, break branches or destroy natural shape.
  - 4. Provide protective covering during delivery.
  - 5. Deliver plants after preparations for planting have been completed and approved, and plant immediately.

### 1.8 SITE MAINTENANCE:

- A. Keep roads, paving and structures adjacent to maintenance operations clean and free of obstructions, mud and debris at all times.
- B. Do not permit flushing of roads or disposal of dirt or debris into sewers or drainage ditches.

## PART 2 - PRODUCTS

### 2.1 WATER:

- A. Owner provides potable water.
- B. Contractor provides necessary hose, attachments, and accessories.

### 2.2 TOPSOIL:

- A. Topsoil necessary to perform or complete maintenance operations, repair or replacement is to be provided by Contractor. Furnish from approved off-site source in sufficient quantity to complete all operations.
- B. Prepare all topsoil used in tree and shrub pits and ground cover beds in the following proportions:
  - 1. 2 parts by volume topsoil as specified.
  - 2. 1 part by volume decomposed organic matter.
- C. Add three (3) pounds of 12-6-6 fertilizer to each cubic yard of topsoil mix during the mixing process, for all plants.
- D. Test at least three (3) samples for compliance.
- E. Characteristics:
  - 1. Fertile, friable, naturally occurring. Free of stones, clay, lumps, hardpan, roots, stumps, branches, sticks and other debris larger than two (2) inches in any dimension; free of noxious weeds, grasses, seeds, plants, extraneous matter and any substance harmful to plant growth. Topsoil from open fields will not be accepted.
  - 2. pH: 5.0 to 7.0
  - 3. Organic Matter: 5% to 10%
  - 4. Sand: 50% to 70%
  - 5. Silt: less than 30%
  - 6. Clay: 10% to 25%
  - 7. Permeability Rate of 5 x 10 <sup>-3</sup> centimeters or greater at 85% compaction.

**2.3 SOIL AMENDMENTS:**

- A. Fertilizer:
1. Uniform in composition, dry and free flowing.
  2. Commercially available.
  3. Mixed per soil test report recommendations.
  4. Acceptable Manufacturers:
    - a. Sta-Green Plant Food Company; Nursery Special.
    - b. O.M. Scott and Sons, Inc.; Scott's.
    - c. W.R. Grace & Company; Peter's 20-20-20 (for deep root feeding trees).
    - d. Approved substitution.
- B. Lime:
1. Ground or crushed agricultural lime.
  2. Containing not less than 85% of total carbonates.
  3. 90% passing 20-mesh screen.
  4. Not less than 50% passing a 60-mesh screen.
  5. Dry and free flowing.
  6. Apply at rate specified in Soil Test Report.
- C. Decomposed Organic Matter:
1. Well rotted.
  2. Containing no weeds, grasses or plants, their seeds, or any substance harmful to plant growth.
  3. Of uniform composition.
  4. Acceptable Manufacturers:
    - a. Klumb Company; "Soil Conditioner."
    - b. Approved equal.

**2.4 MULCH:**

- A. Pine straw.
1. Free from wood, cambium, sawdust, leaves, twigs, insects, grasses or weeds, their seeds, other foreign material and any substance harmful to plant growth.
- B. Ground pine park
1. Free from wood, cambium, sawdust, leaves, twigs, insects, grasses or weeds, their seeds, other foreign material and any substance harmful to plant growth

**2.5 PLANT MATERIALS:**

- A. Plant Material:
1. Trees, shrubs and ground covers as shown and scheduled. Provide and install species, sizes and quantities shown and scheduled; standard quality, first-class representatives of each species or variety, true to name and type; nursery-grown, unless otherwise shown or scheduled.
  2. Conforming to standards in American Standard for Nursery Stock.
  3. Having normal, well-developed branches and vigorous root systems.
  4. Complying with State and Federal laws for disease and insect infestation.
  5. Healthy, vigorous, free from defects, decay, disfigurements, sun-scald injuries, abrasions of the bark, plant diseases, insect pests or eggs, borers, and all forms of infestations or objectionable disfigurements.
  6. Reject plants lacking compactness or proper proportions, plants that are weak, thin or injured from too-close planting in nur



7. Plants which have been cut back from larger grades to meet certain specified requirements will be rejected.
8. Plants with undersized, dry, cracked, or broken balls, or which are loose in their balls will be rejected.
9. Balled and burlapped material: Root-pruned within last two (2) years.
10. Container-grown material: Grown for one (1) growing season in the container in which it is delivered; free from weeds and grasses. Root-bound material will be rejected.
11. Size:
  - a. In accordance with *American Standard for Nursery Stock*.
  - b. Measure plants before pruning, with branches in normal position.
  - c. All replacement material shall match the size attained by original materials at the time of replacement.
  - d. Height and spread dimensions: General body mass of plant, not from branch tip to tip.
  - e. Well-proportioned as to height; reject plants which meet specified measurements but do not possess an overall balance.
  - f. Take caliper measurement on trunk six-inches above natural ground level up to and including four-inch caliper size; twelve-inches above natural ground level for larger sizes.
  - g. Balled and burlapped plants shall have firm natural balls of a diameter and depth not less than per American Standard for Nursery Stock.

## 2.6 CHEMICAL WEED CONTROL:

- A. Pre-Emergent (in bed areas):
  1. Selective pre-emergent with no residual soil activity. Active ingredient: Trifluralin.
  2. Commercially available.
  3. Adhere to manufacturer's recommendations for strength, rate, and method of application.
  4. Acceptable Manufacturers:
    - a. Elanco: Treflan.
    - b. Approved substitution.
- B. Herbicide:
  1. Non-selective post-emergent with no residual soil activity. Active ingredient: Isopropylamine salt of Glyphosate.
  2. Commercially available.
  3. Adhere to manufacturer's recommendations for strength, rate and method of application.
  4. Acceptable Manufacturers:
    - a. Monsanto Agricultural Products Company: Round Up.
    - b. Approved substitution.

## 2.7 GUYING and STAKING:

- A. Wood Stakes:
  1. Pressure-treated Southern Yellow Pine or other approved wood, 2-inches x 4-inches x length specified in the Drawings, pointed at one end.
  2. Aboveground portion painted black.
  3. Free from insects and fungi.
- B. Wire: Pliable #10- or #12-gauge galvanized steel wire, doubled and twisted.
- C. Turnbuckles: As detailed and approved by Architect.
- D. Protective Hose:

1. Reinforced fiber-bearing rubber hose.
2. Black.
3. May be second-hand.
4. Not less than ½-inches inside diameter.

### **2.8 SHRUB BED DRAINAGE:**

- A. Washed pea gravel for drainage fill.
- B. Filter Fabric: SUPAC 5-P manufactured by Phillips Fibers Corporation, or approved substitution.
- C. Corrugated perforated drainage tubing: Four-inch diameter corrugated polyethylene drainage tubing, wrapped in filter fabric.
  1. Acceptable Product: ADS Drain Guard #472 manufactured by Advanced Drainage Systems, Inc.
  2. Approved substitution.

## **PART 3 - EXECUTION**

### **3.1 GENERAL:**

- A. Provide maintenance according to:
  1. Guideline performance specifications herein.
  2. Monthly maintenance guidelines herein.
  3. Accepted horticultural practices and techniques.
  4. Manufacturer's recommendations for material use.
  5. Applicable State laws and local ordinances.

### **3.2 WATERING:**

- A. General Watering:
  1. Water during early morning hours (2:00 am - 7:00 am).
  2. Should irrigation system, or any portion of that system, fail to function, hand water until system is made functional again.
  3. Do not over-water; water should never be allowed to stand in any areas for long periods of time.
  4. Maintain uniform moisture in all planting areas during winter, especially when a freeze is expected.
  5. Heavy clay soils hold moisture longer periods of time; sandy lighter soils drain rapidly and need to be watered more frequently.
- B. Trees: Deep water all newly planted trees once every week during the summer, and the winter as necessary. This schedule should be adjusted to the amount of rain. However, unless it has rained at least ½-inches in twenty-four (24) hours, continue to deep water. Check trees monthly to determine if root ball is well drained. Take permanent corrective measures.
- C. Shrubs: Water shrubs as necessary to maintain sufficient uniform moisture in bed; usually three (3) to four (4) times weekly or more frequently if needed during the summer.

### **3.3 FERTILIZING:**

- A. Fertilize trees, shrubs and lawns per manufacturer's recommended rates in accordance with the monthly maintenance guideline herein.

- B. Cultivate and water beds or pits thoroughly after application.
- C. Adjust fertilizer in accordance with interim Soil Test Reports.

**3.4 PRUNING:**

- A. Remove dead wood and sucker growth as it becomes evident.
- B. Do not top or remove terminal growing point or 'leader' of any plant.
- C. Review pruning practices with Architect before pruning any living portion of any plants.
- D. Crape myrtles will be pruned ONLY as directed by Landscape Architect or owner's representative.

**3.5 INSECT AND DISEASE CONTROL:**

- A. Maintain all plants and grass in a pest and disease-free condition by approved means.
- B. Observe all applicable laws, statues, and ordinances regulating the purchase, use, application, and licensing for all pesticides.
- C. Where possible, combine approved insecticide and fungicide to provide maximum protection for all plants.
- D. Follow manufacturer's recommendations.
- E. Observe all safety precautions.
- F. Trees: Inspect for pests and diseases. Spray for insect and disease control only as infestations are noted. Control shall be specific.
- G. Shrubs: If insect or disease infestation occurs, treat and continue treatment until complete eradication.

**3.6 WEEDING:**

- A. Keep all lawn and planting areas weed free on a continuous basis by approved means.
- B. Minimum weeding:
  - 1. Two (2) applications of chemical pre-emergent spray, approved.
  - 2. Five (5) applications (during growing season) of chemical contact spray (Round Up by Monsanto, or equal, approved).
  - 3. One (1) day per month hand weed during the period of March 1st through September 30th; remove all visible weeds.
  - 4. Weed to remove visible weeds during the winter.

**3.7 SELECTIVE CLEARING:**

- A. Maintain on-going spraying, pruning and mulching program, using approved means, to continually eliminate unwanted vegetation, sucker growth and sprouts from stumps.
- B. Selectively apply approved herbicide minimum of two (2) times per year during the growing season.

**3.8 SOD MAINTENANCE:**

- A. Mowing: Mow and edge lawn areas during the growing season, approximately April 1 through November 15 (year-round if overseeded with Winter Rye). Remove grass clippings from the site.

Adhere to the following mowing schedule:

1. Mow and edge sod areas weekly as needed.
  2. Change mowing directions to prevent rutting of grass.
  3. Mowing heights:
    - a. Bermuda -- 1"-1 ½"
    - b. Zoysia -- 1 ½"-2"
    - c. Fescue -- 2 ½"-3 ½"
- B. Thatch Removal: Thatch removal shall occur once each year at all sod areas or as required by the Owner. Thatch shall be generally removed during early spring or mid-autumn. De-thatch using approved equipment for this purpose.
- C. Core Aerating: Aeration of sod areas shall occur once each year during mid-spring or late summer using approved core aeration equipment, especially manufactured for this specific purpose. Remove cores from site.

### 3.9 MULCHING:

- A. Keep planting areas neat and uniformly mulched to specified depth on a continuous basis.
- B. In addition to replacing and re-spreading mulch as necessary, completely replenish pine straw mulch in all planting areas twice each year in March and November.

### 3.10 STRAIGHTENING:

- A. Maintain plants in their stable upright position and at the proper grade by straightening and tightening staking and guying apparatus, raising plants which have settled, and by other means.

### 3.11 CLEAN-UP:

- A. Keep all planting areas neat, weeded and uniformly mulched on a continuous basis.
- B. Clean-up adjacent walks and pavement where littered as a result of maintenance operations.
- C. Remove trash and debris from surface of planting areas, whether as a result of maintenance operations or otherwise.

### 3.12 MONTHLY MAINTENANCE GUIDELINES FOR LEVEL III (HIGHEST):

- A. January:
  1. Prune trees and shrubs that have become too large or out-of-shape.
  2. Inspect plants, shrubs and trees and remove any damaged or dead wood.
  3. Inspect planting areas and remove any debris or litter.
  4. Check staking and weather protection of first year plants.
  5. Remove leaf and litter on all lawn areas weekly.
  6. Mulch bed areas as needed to replenish mulch levels.
  7. Spray herbicides on winter weeds around January 15th.
  8. Take soil samples.
  9. Transplant any trees and shrubs.
  10. Replace any damaged or dead trees and shrubs.
  11. Prune boxwoods and fertilize boxwoods with cottonseed meal and cow manure.
  12. Check moisture level in all planted areas and water if necessary.
  13. Check drainage of planted areas, correct if excessive water persists.
  14. Fertilize pansies every two weeks or as needed to maintain heavy growth and flowering. Use nitrate based fertilizer.
  15. Protect plants susceptible to winter damage where possible during extreme cold periods.
  16. Mow lawn areas every ten days if overseeded with winter grass.

## B. February

1. Prune trees and shrubs that have become too large or out-of-shape.
2. Inspect plants, trees and shrubs and remove any damaged or dead wood.
3. Inspect planted areas and remove any debris or litter.
4. Check staking and weather protection for first year plants.
5. Remove leaf and litter on all lawn areas weekly.
6. Apply pre-emerge herbicides to lawn to prevent crabgrass.
7. Apply pre-emerge herbicides to beds to prevent weeds.
8. Replace any damaged or dead trees or shrubs.
9. Check moisture level in all planted areas and water if necessary (weekly).
10. Protect plants susceptible to cold damage during excessive cold periods if possible.
11. Mow lawn area every ten days if overseeded with winter grasses.
12. Remove any staking on one-year old plantings.
13. Spot spray any existing weeds with Round-Up.
14. Establish a good edge on all bed areas.
15. Completely replace and replenish mulch in all planting areas.

## C. March

1. Dethatch all lawn areas that have thatch build-up.
2. Mow and trim all lawn areas as needed.
3. Inspect plants, trees and shrubs and remove any damaged or dead wood.
4. Litter removal on all lawn areas.
5. Check moisture level in all planted areas and water if necessary (weekly).
6. Start pruning where necessary to maintain shape and form (do not shear).
7. All Liriope should be cut back to allow new growth to come out and remove winter damage to old growth.
8. Hand weed all bed areas as needed.
9. Deep-root feed all trees except pines (Peter's 20-20-20) as requested or approved by the Landscape Architect.
10. Completely replace and replenish mulch in all planting areas.

## D. April

1. Fertilize all lawn areas with 32-3-12 analysis, with 50% slow release nitrogen, or equal to soil sample reports.
2. Lime lawn areas as per soil sample reports.
3. Mow and edge lawn areas weekly.
4. Fertilize shrubs, trees, groundcover area with Nursery Special by Sta-Green or equal.
5. Cultivate and weed all planted areas.
6. Inspect all planted areas and remove any dead plants and replace.
7. Inspect all plant material (shrubs and trees) and prune any dead limbs.
8. Spot spray any weed problem areas.
9. Clean up any litter on lawn.
10. Inspect all areas for insect and disease damage and treat as necessary (weekly).
11. Prepare bed areas for any annual color and plant after mid-April.
12. Remove any winter and/or early spring color after blooming.
13. Water lawns and planted areas as needed.
14. Prune shrubs after they have bloomed.
15. Inspect all plants and trees for insects and/or diseases and treat as necessary.
16. Prune hedges to keep shape and form as necessary.
17. Hand weed all bed areas as needed.
18. Apply preventive spray for lacebug and leafminer.
19. Plant annual color beds for summer.

## E. May

1. Irrigate all planted and lawn areas as needed.

2. Mow and edge all lawn areas weekly.
  3. Spot spray for weeds in planted and natural areas with Round-Up.
  4. Weed all groundcover and bed areas as necessary.
  5. Clean up litter on lawn and hard surface areas (weekly).
  6. Inspect all lawn and planted areas for insects and/or disease and treat as necessary.
  7. Prune shrubs and hedges as necessary to keep shape and form.
  8. Apply selective herbicides for weed control particular to each variety of lawn.
  9. Prune any damaged plants.
- F. June
1. Irrigate all planted and lawn areas as needed.
  2. Mow and edge all lawn areas weekly.
  3. Trim all lawn areas as needed.
  4. Spot spray for weeds in all planted areas with Round-Up.
  5. Weed all groundcover and bed areas as necessary.
  6. Clean up litter on all lawn areas.
  7. Inspect all lawn and planted areas for insects and/or disease and treat as necessary.
  8. Prune shrubs and hedges as necessary to keep shape and form.
  9. Apply selective herbicides for weed control particular to each variety of lawn.
  10. Fertilize lawn areas except for Centipede.
  11. Fertilize all bed areas.
  12. Hand weed all bed areas as needed.
- G. July
1. Irrigate all planted and lawn areas as needed.
  2. Mow and edge all lawn areas weekly.
  3. Hand weed all bed areas as needed.
  4. Spot spray with Round-Up on weeds in all planted areas where applicable.
  5. Clean up litter on all hard surface and lawn areas weekly.
  6. Inspect all lawn and plant areas for insect and/or disease and treat as necessary.
  7. Prune shrubs and hedges as necessary to keep shape and form.
  8. Check all bed areas for mulch replacement as needed.
- H. August
1. Irrigate all planted and lawn areas as needed.
  2. Mow and edge all lawn areas weekly.
  3. Hand weed all bed areas as needed.
  4. Spot spray with Round-Up on weeds in all planted areas where applicable.
  5. Clean up litter on lawn areas weekly.
  6. Inspect all lawn and plant areas for insect and/or disease and treat as necessary.
  7. Prune shrubs and hedges as necessary to keep shape and form.
  8. Fertilize all lawn areas in late August-early September with 8-8-25 analysis (low nitrogen).
  9. Fertilize all groundcovers and bed areas.
  10. Check all bed areas for mulch replacement as needed.
- I. September
1. Irrigate all lawn and planted areas as necessary.
  2. Mow and edge all lawn areas weekly.
  3. Hand weed bed areas as needed.
  4. Clean up litter on lawn areas.
  5. Inspect all lawn and planted areas for insects and/or disease and treat as necessary.
  6. Prune shrubs and hedges as necessary to keep shape and form.
  7. Apply pre-emergent to all Bermuda or Zoysia lawns unless over seeding with Winter Rye.
  8. Apply pre-emergent to all bed areas.
  9. Apply lime if soil tests show pH is low on lawn areas.
  10. Fertilize fall color beds.

11. Remove any summer color beds and replace with fall color.
12. Take soil test if necessary for lime and fertilizer requirements.

J. October

1. Mow and edge all lawn areas weekly.
2. Monitor water needs.
3. Clean up litter on all lawn areas.
4. Inspect all lawn and planted areas for insects and/or disease and treat as necessary.
5. Prune any damaged plants.
6. Remove leaves from all planted and lawn areas.
7. Plant pansies for winter color.
8. Replace and/or plant any new trees or shrubs.
9. Dethatch all lawn areas that have thatch build-up.

K. November

1. Clean up all litter and leaves on lawns.
2. Mow, edge and trim all lawn areas where applicable.
3. Check mulch in beds and replace where necessary after fall leaf drop. Replenish pine straw mulch.
4. Check all planted areas for water requirements.
5. Weed and cultivate beds for winter.
6. Winterize irrigation system.

L. December

1. Clean up all litter and leaves on lawns.
2. Mow, edge and trim all lawn areas where applicable.
3. Check all planted areas for water requirements.
4. Fertilize winter color beds with liquid fertilizer two times.

**3.13 INSPECTION and ACCEPTANCE:**

A. Monthly Review:

1. Submit a request for inspection of Maintenance Work to the Landscape Architect once a month from April through September and every two (2) months from October through March.
2. Review the previous month's work jointly with the Landscape Architect.
3. Submit a written log of fertilizer applications, and chemical insect, disease or weed control applications with each Application for Payment. This log will be a complete account of each fertilizer and chemical application performed within the month covered by that Application for Payment including date, time, weather conditions, and specific purpose and product of each application.

B. Basis of Acceptance:

1. Contractor is responsible for landscape maintenance work as specified herein and in keeping with acceptable horticultural practices.
2. During the period of the maintenance contract, replace with no additional compensation, and as soon as weather permits, all dead plant materials and all materials not in a thriving condition; replace all other workmanship and materials which are unsatisfactory in the opinion of the Landscape Architect; make good any other damage, loss, destruction or failure to flourish sufficiently as the result of inferior or defective materials or workmanship, including, but not limited to, inadequate drainage.
3. All replacement material shall match the size attained by the original material at the time of replacement.
4. Remove dead or dying material from the site within one (12) week of notice from the Landscape Architect.

5. Repair grades and other work necessitated due to planting replacements.
6. If the replacement is not acceptable during or at the end of the maintenance period, the Owner may elect either subsequent replacement or credit.
7. Responsibility for replacement or repair work applies to losses or damage other than those due to vandalism, Owner neglect, or Acts of Nature, as determined by the Landscape Architect. Acts of Nature include, but may not be limited to, high winds of hurricane or tornado force, sleet, hail, freezing rain, and extreme cold (as determined by the Landscape Architect). Contractor agrees to replace losses due to Acts of Nature at fifteen percent (15%) less than original contract price for the damaged work.
8. The cost of mobilization (including the provisions of General Requirements and General and Supplementary Conditions) as specified herein is considered incidental to the Work and will not be counted as a separate item for payment.

**3.14 FINAL INSPECTION and ACCEPTANCE:**

- A. At the end of the maintenance period, submit request for inspection for Final Acceptance to the Landscape Architect at least one (1) week prior to anticipated date of inspection.
- B. Upon request for inspection, jointly review with Landscape Architect all Work for Final Acceptance.
- C. Remove tree staking apparatus and saucers from all trees, unless otherwise directed. Replace mulch to specified thickness.
- D. Submit Maintenance Manual (three [3] copies) for Owner's information and Landscape Architect's approval, containing full details for care and maintenance of landscape work, personnel and procedures, and weekly schedule for maintenance.
- E. Upon completion by the Contractor of all required repairs and replacements, the Landscape Architect will confirm the date of Final Acceptance of the Work.

END OF SECTION



**THIS PAGE INTENTIONALLY LEFT BLANK**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 32 91 13 - SOIL PREPARATION****PART 1 - GENERAL****1.1 SECTION INCLUDES:**

- A. Soil Preparation
- B. Existing Soil Modifications
- C. Planting Soil Mixes
- D. Fine Grading

**1.2 RELATED SECTIONS**

- A. 32 8000 - Irrigation
- B. 32 9300 - Planting

**1.3 REFERENCES**

- A. ASTM C 33: Washed Concrete Sand
- B. ASTM C 602: Agricultural Liming Materials
- C. US Composting Council - [www.compostingcouncil.org](http://www.compostingcouncil.org)
- D. Methods of Soil Analysis, published by the Soil Science Society of America - [www.soils.org](http://www.soils.org)

**1.4 DEFINITIONS**

- A. Modified Existing Soil: on-site soil that shall be used as Planting Soil after specified modifications.
- B. Subgrade: surface or elevation of subsoil remaining after completion of excavation, or top surface of a fill or backfill, before placing Planting Soil.
- C. Topsoil: naturally produced and harvested soil from the A horizon or upper layers of the pedosphere that have been stockpiled on site or imported.
- D. Planting Soil (Planting Soil Mix): soil mixes described in PART 2 and Modified Existing Soils that will be used to support the life and health of plants after installation.

**1.5 SUBMITTALS**

- A. Submit all product submittals eight weeks prior to the start of the soil work.
- B. Submit 2-gallon samples of each Planting Soil Mix, Coarse Sand, and Compost detailed below to the Landscape Architect. Label each sample with the product/soil type name, characteristics, and locations in the Work. Samples shall be submitted at the same time as the analysis and report of that material.
- C. Submit manufacturers or supplier's product data and certified analysis for standard products and bulk materials, complying with testing requirements and referenced standards and specific requested testing.
  - 1. For each Compost product submit the following analysis by a recognized laboratory:
    - a. pH
    - b. Moisture content %, wet weight basis
  - 2. For Coarse Sand product submit the following analysis by a recognized laboratory:
    - a. pH
    - b. Particle size distribution.

**D. Soil Testing Reports**

1. Submit soil test analysis for all Topsoils and Planting Soil Mixes included in Part 2 of this Section as well as for existing soils at the site.
  - a. If tests fail to meet the specifications, obtain other sources of material, retest and resubmit until accepted by the Landscape Architect.
  - b. Soil testing will be at the expense of the Contractor.
2. Provide the following soil properties:
  - a. Particle size analysis (% dry weight) and USDA soil texture analysis.
  - b. USDA gradation of gravel, coarse sand, medium sand, fine sand, silt, and clay.
  - c. pH and buffer pH.
  - d. Percent organic content by oven dried weight.
  - e. Nutrient levels by parts per million including: phosphorus, potassium, magnesium, manganese, iron, zinc, and calcium. Nutrient test shall include the testing laboratory recommendations for supplemental additions to the soil.

**1.6 QUALITY ASSURANCE**

- A. The installer shall be a firm having at least five years of experience in projects similar in scope to that required for the Work. The installer of the Work in Section 32 9300 will be the same firm installing the Work in this section.
  1. There shall be an experienced full-time supervisor, who can communicate in English, on site during the installation of this Section's Work.
- B. Soil testing laboratory shall be an independent laboratory, with experience and capability to conduct indicated testing and that specializes in USDA agricultural soil testing, soil mix testing, and other tests to be performed. Geotechnical engineering testing labs shall not be used.
- C. Planting Soils shall conform to the approved submittal's sample color, texture and approved test analysis.
  1. The Landscape Architect may request samples of delivered or installed soil for testing to confirm Planting Soils' conformity to approved material.
  2. Testing shall be performed by the same soil testing laboratory that performed the original soil testing.
  3. Testing results shall be within 10% of values measured in approved Planting Soil Mixes.
- D. Test soil compaction with a penetrometer following installation or modification of Planting Soil. Have a soil penetrometer and moisture meter on site at all times.

**1.7 PRE-CONSTRUCTION MEETING**

- A. Schedule a pre-construction meeting with the Landscape Architect at least two weeks before beginning work to discuss the Work, administrative procedures during construction, and project schedule.

**1.8 PERMITS AND REGULATIONS**

- A. Acquire all permits related to the Work. If a conflict exists between permit requirements and the work outlined in the contract documents, promptly notify the Landscape Architect in writing including a description of any necessary changes and the resulting changes to the contract price.
- B. Adhere to all Federal, State, and local laws and ordinances bearing on the operation or conduct of the work as drawn and specified. This includes but is not limited to all regulations relating to the inspection for disease and insect control.

**1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Do not mix, deliver, place or grade soils when frozen or with moisture above field capacity.
- B. Protect soil and soil stockpiles, including the stockpiles at the soil blender’s yard, from wind, rain and washing that can erode soil or separate fines and coarse material, and contamination by chemicals, dust and debris that may be detrimental to plants or soil drainage. Cover stockpiles with plastic sheeting or fabric at the end of each workday.
- C. Coordinate bulk material delivery and storage with Landscape Architect and confine materials to neat piles in areas acceptable to Landscape Architect.

**PART 2 - PRODUCTS**

**2.1 COMPOST**

- A. Blended and ground leaf, wood and other plant-based material.
  - 1. Commercially prepared and meets the US Compost Council STA/TMECC criteria.

**2.2 COARSE SAND**

- A. ASTM C-33 Fine Aggregate, with a Fines Modulus Index of 2.8 and 3.2
  - 1. Clean, sharp, natural coarse sands free of limestone, shale and slate particles with a pH lower than 7.0.
  - 2. Particle size distribution:

3/8 inch (9.5 mm)	100%
No 4 (4.75 mm)	95-100%
No 8 (3.36 mm)	80-100%
No 16 (1.18 mm)	50-85%
No 30 (0.60 mm)	25-60%
No 50 (0.30 mm)	10-30%
No 100 (0.15 mm)	2-10%
No 200 (0.75 mm)	2-5%

**2.3 TOPSOIL**

- A. Fertile, friable, naturally occurring soil containing less than 5% total volume of the combination of subsoil, refuse, roots larger than 1 inch diameter, heavy clay, stones larger than 2 inches, noxious weeds and seeds, sticks, brush, litter, or any substance that is harmful to plant growth.
  - 1. Complies with the following criteria:
    - a. Soil texture: USDA loam, sandy clay loam or sandy loam with clay content between 15% and 25%. Combined clay/silt content of no more than 55%.
    - b. pH value shall be between 5.5 and 7.0
    - c. Percent organic matter(OM): 5.0% - 10%, by dry weight.
    - d. Soil chemistry suitable for growing the plants specified.

2. Topsoil existing at the site may be acceptable if it meets the above criteria.

**2.4 PLANTING SOIL MIXES**

- A. PLANTING SOIL MIX 1 - Moderately slow draining soil for trees and shrub beds.

1. A mix of Imported Topsoil, Coarse Sand, and Compost. The approximate mix ratio shall be:

Imported Topsoil(unscreened)	45-50%
Coarse Sand	40-45%
Compost	10%

2. \*Mix component % by moist volume
3. Final tested organic matter between 2.75%-4% by dry weight.
4. Mix Coarse Sand and Compost first, then add Imported Topsoil. Mix with loader bucket, do not over mix. Do not use soil blending machine, do not screen the soil. Clumps of soil, Compost, and Coarse Sand will be permitted in overall mix.
5. Add fertilizer according to rates recommended by the soil tests at time of final grading.

**2.5 FERTILIZER**

- A. Fertilizer types and rates are determined upon the soil tests results. Recommended fertilizer shall be added to soil mixes prior to final screening and prior to delivery to project site.

**2.6 LIME**

- A. ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
  1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36 mm) sieve and a minimum of 75 percent passing through No. 60 (0.25 mm) sieve.
  2. Form: Provide lime in form of finely ground dolomitic limestone.

**2.7 PRE-EMERGENT HERBICIDES**

- A. Chemical herbicide designed to selectively prevent seeds from germinating. Exact type of herbicide shall be based on the specific plants to be controlled and the most effective date of application.
- B. Submit report of expected weed problems and recommendation of most effective control for approval by Landscape Architect. Provide manufacturer’s literature and material certification for recommended product.

**PART 3 - EXECUTION**

**3.1 SITE CONDITIONS**

- A. Coordinate the Work of this Section with that of other trades.
- B. Be aware of all surface and sub-surface conditions, including utilities, and notify the Landscape Architect, in writing, of any circumstances that would negatively impact the health of plantings. Do not proceed with work until unsatisfactory conditions have been corrected.

1. Notification of Local Utility Locator Service, 811, is required for all areas within project area: The Contractor is responsible for knowing the location and avoiding utilities that are not covered by the Local Utility Locator Service.
- C. Prior to installation of Planting
1. Confirm that surfaces receiving Planting Soils or modifications to existing soils are free of construction debris, refuse, compressible or biodegradable materials, stones larger than two inches in diameter, soil crusting films of silt or clay that hinders drainage into subsoils, and/or standing water. Remove unsuitable material from site.
  2. Confirm no adverse drainage conditions are present.
  3. Confirm that utility work has been completed as indicated in the Drawings.
  4. Confirm that Irrigation work, which is shown to be installed below prepared soil levels, has been completed.
- D. Notify the Landscape Architect immediately of unsatisfactory conditions.

### 3.2 EXISTING SOIL MODIFICATIONS

- A. Prepare area by removing existing vegetation and debris. Perform any minor preliminary grading.
- B. MODIFICATION C - SURFACE: MINOR TILLING
1. Spread 3-4 inches of Compost over surface of the soil and make necessary chemical adjustments as recommended by the soil tests.
  2. Till Compost into top 6 inches of soil.

### 3.3 PLANTING SOIL INSTALLATION

- A. Excavate to the proposed subgrade. Do not over excavate compacted subgrades of adjacent pavements or structures. Maintain a supporting 1:1 side slope of compacted subgrade material along edges of all paving and structures where the bottom of paving or structure is above bottom elevation of excavated planting area.
1. Prior to installing Planting Soil, the Landscape Architect shall approve the condition of the subgrade, subgrade preparation, and subsurface drainage.
  2. Slope subgrade elevations approximately parallel to finished grade elevations and/or towards the subsurface drain lines as indicated in the Drawings.
- B. Equipment used to install or grade Planting Soils shall be wide tracked or balloon tire machines rated with a ground pressure of 4 psi or less. All grading and soil delivery equipment shall have buckets equipped with 6-inch teeth to scarify any soil that becomes compacted.
- C. Scarify the subgrade material to a depth of 3-6 inches with the teeth of the back hoe, loader buckets, tiller or other suitable device.
1. If area becomes overly compacted, loosen again prior to installing the Planting Soil.
- D. Install Planting Soil in 12-18-inch lifts to required depths. Apply compacting forces to each lift as required to attain required compaction. Scarify the top of each lift 3-6 inches prior to adding another lift.
- E. Phase work such that equipment does not have to operate over previously installed Planting Soil.
- F. Where possible, place large trees first and fill Planting Soil around root ball.
- G. The depths and grades shown on the drawings are the final grades after settlement and shrinkage of the compost material. Install Planting Soil at a higher level to anticipate the reduction of volume.

**3.4 COMPACTION REQUIREMENTS FOR INSTALLED OR MODIFIED PLANTING SOIL**

- A. Soil compaction shall have a density between 75-250 psi as determined by a penetrometer at a soil moisture approximately midway between wilting point and field capacity.
  - 1. Existing Soil Modifications: compaction measured to depth of modification.
  - 2. Installed Planting Soil: compaction measured to depth of installation.
- B. Maintain moisture conditions within the Planting Soil during installation or modification to allow for satisfactory compaction. Suspend operations if Planting Soil becomes too wet, apply water if the soil is overly dry.
- C. Provide adequate equipment to achieve consistent and uniform compaction of the Planting Soils. Use the smallest equipment that can reasonably perform the task of spreading and compaction.
- D. Do not pass motorized equipment over previously installed and compacted soil except as authorized below:
  - 1. Light weight equipment such as trenching machines or motorized wheel barrows.
  - 2. Follow the requirements of Over Compaction Reduction if work after the installation of the Planting Soil compacts the Planting Soil to levels greater than the above requirements.

**3.5 OVER COMPACTION REDUCTION**

- A. Dig up and reinstall any soil that becomes compacted to a density greater than the specified density. This includes compaction caused by other subcontractors after the Planting Soil is installed and approved.
- B. Roto tilling shall not be considered adequate to reduce over compaction at levels six inches or below finished grade.

**3.6 INSTALLATION OF CHEMICAL ADDITIVES**

- A. Apply chemical additives following the installation of each soil and prior to fine grading as recommended by the soil test and as appropriate to the soil and plants to be installed.
- B. Types, application rates and methods shall be approved by the Landscape Architect prior to application.

**3.7 FINE GRADING**

- A. The Landscape Architect shall approve all rough grading prior to the installation of Compost, fine grading, planting, and mulching.
- B. Grade the finish surface of all planted areas to meet the grades indicated on the Drawings, allowing finished grades to remain higher (10-15% of soil modification depth) than the grades on the grading plan to anticipate settlement over first year.
- C. Utilize hand equipment, small garden tractors with rakes, small garden tractors with buckets with teeth for fine grading to keep surface rough without further compaction. Do not use float bottom of loader bucket.
- D. Provide for positive drainage from all areas toward inlets, drainage structures, and/or edge of planting beds. Adjust grades as directed to reflect actual constructed field conditions of pavements, walls, and inlet elevations. Notify the Landscape Architect if positive drainage is impossible to achieve.
- E. Provide smooth, rounded transitions between slopes of different gradients and direction.
- F. Fill all dips and remove any bumps in the overall plane of the slope.



**3.8 INSTALLATION OF COMPOST TILL LAYER**

- A. Spread 3-4 inches of Compost over the beds and rototill into the top 4-6 inches of the Planting Soil after Planting Soils are installed in planting bed areas and prior to installation of shrub & groundcover plantings.

**3.9 CLEAN-UP**

- A. Keep site free of trash, pavements reasonably clean and work area in an orderly condition at end of each day. Remove trash and debris from site no less than once a week.
- B. Protect adjacent walls, walks, and utilities from damage or staining by the soil.
- C. Wash all soil from pavements and structures after installation is complete and as needed to prevent damage or staining.
- D. Make all repairs to grades, ruts, and damage done to the Work.
- E. Remove and dispose of excess soils.

**3.10 PLANTING SOIL PROTECTION**

- A. Protect installed and/or modified Planting Soil from damage including contamination and over compaction due to other soil installation, planting operations, and operations by other contractors or trespassers.
  - 1. Repair or replace damage done by the Contractor to any part of the Work, existing features to remain on site, and features adjacent to the site at no expense to the Owner.
- B. Provide temporary erosion control as needed to stop soil erosion until the site is stabilized with mulch, plantings, or turf.

**3.11 SUBSTANTIAL COMPLETION ACCEPTANCE**

- A. The date of Substantial Completion of the Planting Soil is the same as the date of Substantial Completion for Section 32 9300 - Plants.

**3.12 FINAL ACCEPTANCE**

- A. The date of Final Acceptance follows the same criteria as outlined in Section 32 9300 - Plants in addition to the following:
  - 1. Restore any soil settlement and/or erosion areas to the grades shown on the drawings. Remove plants and mulch before adding soil and then restore planting. Do not add soil over the root balls of plants or on top of mulch.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 32 92 00 - TURF AND GRASSES****PART 1 - GENERAL****1.1 SCOPE**

- A. This section pertains to seeding work, including preparing the seedbed, furnishing and placing of topsoil, seed and other required materials for a complete installation to the limits of construction and specified herein. Seeding operations shall be performed on all newly graded earth areas not otherwise specified covered by structures, pavements and/or surfacings, riprap, sod, sprigging, walkways, and other items of a similar nature; on all cleared and/or grubbed areas which are to remain as finish grade surfaces and not to be excavated or embankments constructed thereon; on all existing off site and on site turfed earth surfaces which are disturbed by construction operations and which are to remain as finish grade surfaces; and at all other locations which may be designated on the drawings or specified herein. The contractor shall follow the ALDOT Standard Specifications for Highway Construction, latest edition (ALDOT, 2018) Section 650, 652, 654, 656, 659 and 665.SUMMARY

**1.2 RELATED WORK SPECIFIED ELSEWHERE**

- A. Erosion and Sedimentation Controls – Section 31 2500
- B. Sodding – Section 32 9223 (If Indicated on the Drawings)

**PART 2 - PRODUCTS****2.1 TOPSOIL**

- A. Topsoil for planting shall be a rich friable loam containing a large amount of humus and shall be original surface sandy loam, topsoil of good rich, uniform quality, free from any material such as hard clods, stiff clay, hardpan, partially disintegrated stone, pebbles larger than 1/2 -inch in diameter, lime, cement, bricks, ashes, cinders, slag, concrete, bitumen or its residue, boards, sticks, chips, or other undesirable material harmful or unnecessary to plant growth. Topsoil shall be reasonably free from perennial weeds and perennial weed seeds, and shall not contain objectionable plant material, toxic amounts of either acid or alkaline elements or vegetable debris undesirable or harmful to plant life. Bermuda grass roots in topsoil will not be accepted, unless otherwise approved by Engineer.
- B. Topsoil shall be natural topsoil without admixture of subsoil material, and shall be classifiable as loam, silt loam, clay loam, or a combination thereof.

**2.2 GRASS SEED**

- A. All seeds shall be labeled in accordance with the U.S.D.A. Rules and Regulations. Seeds shall be packaged in suitable containers in accordance with the Georgia Seed Laws, Rules and Regulations currently in effect. No seed shall be used which has become molded, wet or otherwise damaged. Seed shall be tested by the Alabama Department of Agriculture & Industries for the purity and germination within six months prior to the date of sowing.
  - 1. Grass seed on level or slightly sloping ground shall consist of the following for the planting dates specified:
  - 2. Grass seed on slopes 3:1 or steeper and frequently mowed areas shall consist of the following for the planting dates specified:

- a. March 1 to June 15
    - 1) Weeping Lovegrass: 5lbs./acre
    - 2) Sericea Lespedeza (scarified): 60lbs./acre
  - b. August 1 to November 15
    - 1) Tall Fescue: 50lbs./acre
    - 2) Sericea Lespedeza (unscarified): 75lbs./acre
  - c. November 1 to March 1
    - 1) Common Bermuda (unhulled): 10lbs./acre
    - 2) Sericea Lespedeza (unscarified): 75lbs./acre
- B. When as directed by the Engineer, an approved quick growing species of grass seed such as rye, Italian rye, millet or other cereal grass, shall be applied at a rate of 30 lbs./acre in conjunction with and in addition to the seed mixture specified above.

### 2.3 SPRIGS

- A. Bermuda, common, healthy living stolons native to locality of project. Plant on day of removal from growing location. Plant sprigs from March 15 to July 15.

### 2.4 MULCH

- A. Dry Mulch: Dry mulch shall be straw or hay, consisting of oat, rye or wheat straw, or of pangola, peanut, coastal Bermuda or Bahia grass hay. Only undeteriorated mulch which can be readily cut into the soil shall be used. Application rate shall be 2 ½ tons per acre.
- B. Mulch for hydroseeding: This material shall consist of wood cellulose fiber applied at 500 lbs./acre with dye color equal to Weyerhaeuser Company, or Conway Corporation material used for "hydroseeding" and suitable for this purpose.

### 2.5 FERTILIZER

- A. Fertilizer shall be a ready mixed material containing the soil nutrients as specified and in a suitable form compatible with the equipment used to achieve uniform distribution of the fertilizer. The fertilizer mixture shall contain the following nutrients expressed in per cent of the total weight: 6% nitrogen, 12% available phosphoric acid, and 12% water soluble potash (6-12-12) analysis. Container tags shall have the name and address of the manufacturer, the brand name, net weight, and chemical composition of analysis. Fertilizer shall be applied at 1500 lbs./acre.

### 2.6 LIME

- A. Agricultural lime shall be within the specifications of the Georgia Department of Agriculture. Ground limestone is calcitic or dolomitic limestone ground so that 90 percent of the material shall pass a 10-mesh sieve, not less than 50 percent will pass through a 50-mesh sieve and at least 25% shall pass a 100-mesh sieve. Lime shall be applied as indicated by soil test, or the rate of 1 to 2 tons per acre.

### 2.7 WATER

- A. The water used in the grassing operations may be obtained from any approved spring, pond, lake, stream or municipal water system. The water shall be free of excess and harmful chemicals, acids, alkalies, or any substance which might be harmful to plant growth or obnoxious to traffic.

### 2.8 SOD

- A. Shall be healthy living, disease and weed free grass that has been freshly cut.

**PART 3 - EXECUTION****3.1 HYDROSEEDING**

- A. The materials for grassing shall consist of a thoroughly mixed slurry of grass seed, fertilizer, lime and mulch as specified. The application rate for wood fiber mulch shall be approximately 500 lbs./acre. All materials shall be discharged within one hour after being combined in the hydroseeder.
- B. Each kind of leguminous seed shall be inoculated separately with the appropriate commercial culture according to instructions of the manufacturer of the material. All inoculated seed shall be protected from the sun and shall be planted the same day it is inoculated.
- C. Equipment for mixing and applying the slurry shall be especially designed for this purpose. It shall be capable of applying a uniform mixture over the entire area to be seeded. The slurry mixture shall be agitated during application to keep the ingredients thoroughly mixed. A suitable metering device to determine the rate of application and assist in obtaining uniform coverage of the grassed areas shall be incorporated as part of the equipment.
- D. Ground preparation for hydroseeding shall be the same as for conventional seeding.
- E. Hydroseeding shall not be performed when windy weather prevents even distribution; when the prepared surface is crusted; or when the ground is frozen, wet or otherwise in a non-tillable condition.

**3.2 CONVENTIONAL SEEDING**

- A. Grading and Shaping
  - 1. Grade and shape to finish contours and to allow practical use of equipment.
- B. Seedbed Preparation
  - 1. Broadcast Plantings:
    - a. Tillage as a minimum shall: adequately loosen the soil to a depth of 4 to 6 inches; alleviate compaction; incorporate lime and fertilizer; smooth and firm the soil; allow for the proper placement of seed, sprigs, or plants; and allow for the anchoring of straw or hay mulch if a disk is to be used.
    - b. Tillage may be done with any suitable equipment.
    - c. Tillage may be done on the contour where feasible.
    - d. On slopes too steep for the safe operation of tillage equipment. The soil surface will be pitted or trenched across the slope with appropriate hand tools to provide a place 6 to 8 inches apart in which seed may lodge and germinate.
  - 2. Individual Plants:
    - a. Where individual plants are to be set, the soil will be well prepared by excavating holes, opening furrows, or dibble planting.
    - b. For nursery stock plants, holes shall be large enough to accommodate roots without crowding.

**3.3 SPRIGS**

- A. Separate or shred and broadcast over area prepared for planting at 40 cu. ft. per acre. Harrow into ground with disc turned straight.

**3.4 LIME/FERTILIZER APPLICATION**

- A. Lime and fertilizer will be applied uniformly during land preparation so that it will be mixed with the soil during seedbed preparation. On steep surfaces, scarify slope prior to broadcasting lime and fertilizer.

**3.5 PLANTING**

- A. Seeding will be done on a freshly prepared and firmed seedbed. For broadcast planting, use a cultipacker-seeder, drill, rotary seeder, other mechanical seeder, or hand seeding to distribute the seed uniformly over the area to be treated. Cover the seed lightly with a cultipacker or other suitable equipment.
- B. No-till seeding is permissible into annual cover crops when planting is done following maturity of the cover crop or if the temporary cover stand is sparse enough to allow adequate growth of the permanent species.
- C. No-till seeding must be done with appropriate no-till seeding equipment. The seed must be uniformly distributed and planted at the proper depth.

**3.6 MULCHING**

- A. All seeded areas shall be mulched. Soil retention blankets, erosion control netting, and other manufactured materials may be required in addition to mulch on unstable soils and concentrated flow areas. Mulch shall be spread uniformly within 24 hours after seeding.

**3.7 WATER, MAINTENANCE, AND RESEEDING**

- A. Contractor shall be responsible for maintaining the proper moisture content of the soil to ensure adequate plant growth until a satisfactory stand of grass is obtained. Watering shall be performed to maintain an adequate water content in the soil.
- B. Contractor shall mow and maintain all seeded areas without additional payment until final acceptance of the work by the Owner, and any regrading, refertilizing, reliming, reseeding or remulching shall be done at his own expense. Seeding work shall be repeated on defective areas until a satisfactory uniform stand of grass is accomplished. A satisfactory stand of grass is defined as grass that covers at least 98% of the total area with no bare spots larger than one square foot and bare spots shall be scattered such that bare areas do not comprise more than 1/100 of any given area. Damage resulting from erosion, gulleys, washouts, or other causes shall be repaired by filling with topsoil, compacting, and repeating the seeding work at the Contractor's expense.

**3.8 SODDING**

- A. See Section 32 9223 Sodding for additional sod requirements. Smooth grade the specified area to be planted. Apply amendments and fertilizer requirements as determined in soil test. Planting area shall be free of stumps, roots, large stone over 4" diameter, and any other debris. Apply fertilizer and rake into the soil surface. Lightly wet soil surface if dry. Lay the sod at right angles to any major water flow. Sod shall be pinned and secured on slopes greater than 6:1. Sod joints shall be staggered between rows. Sod shall be watered after installation each day.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**THIS PAGE INTENTIONALLY LEFT BLANK**



**SECTION 32 9223 – SODDING****PART 1 - GENERAL****1.1 SCOPE**

- A. Sodding shall consist of establishing certain critical areas with sod as designed (on the Drawings) (or designated by the Engineer). Sodding is to be used as indicated on plans.

**PART 2 - PRODUCTS****2.1 SOD**

- A. Sod shall consist of a live, dense, well-rooted growth of turf grass species as noted on the Drawings. The sod shall be free from Johnson grass, nut grass and other obnoxious grasses and shall be of suitable character for the purpose intended and for the soil in which it is to be planted. It shall be uninjured at the time of planting.

**2.2 FERTILIZER**

- A. Fertilizer (10-10-10) used in connection with sodding, shall contain 10 percent nitrogen, 10 percent phosphoric acid and 10 percent potash. The fertilizer shall be furnished in standard containers with the name, weight and guaranteed analysis of the contents clearly marked. The containers shall ensure proper protection in handling and transporting the fertilizer. All commercial fertilizer shall comply with local, state and federal fertilizer laws.
- B. Ammonium nitrate shall be a standard commercial product, shall conform to the requirements for other commercial fertilizers as specified above, and shall have a minimum of 32-1/2 percent nitrogen.

**2.3 LIME**

- A. Agricultural lime shall be within the specifications of the Alabama Department of Agriculture & Industries. Ground limestone is calcitic or dolomitic limestone ground so that 90 percent of the material shall pass a 10-mesh sieve, not less than 50 percent will pass through a 50-mesh sieve and at least 25% shall pass a 100-mesh sieve. Lime shall be applied as indicated by soil test, or the rate of 1 to 2 tons per acre.

**2.4 WEATHER LIMITATIONS**

- A. Sod shall be planted only when the soil is moist and favorable to growth. No planting shall be done between October 1 and April 1 unless weather and soil conditions are considered favorable and permission is granted by the Engineer.

**PART 3 - EXECUTION****3.1 SODDING**

- A. The area to be sodded shall be constructed to the lines and grades indicated on the Drawings or as directed by the Engineer, and the surface loosened to a depth of not less than 3-inches with a rake or other device. If necessary, it shall be sprinkled until saturated at least 1-inch in depth and kept moist until the sod is place thereon. Immediately before placing the sod, the

fertilizer shall be uniformly applied at the rate of 40 pounds of Grade 10-10-10, or equivalent, per 1,000 square feet. Agricultural limestone shall be applied based on soil tests or at a rate of 10 to 20 pounds per 1,000 square feet.

- B. The entire area shall be thoroughly covered with sod. The sod shall be placed on the prepared surface with the edges in close contact and, as far as possible, with staggered joints. If any gaps are present after placement, the contractor shall fill these areas with sand at no additional cost to the owner.
- C. The sod shall be maintained moist from time of removal until reset but shall be placed as soon as practicable after removal from place where growing. Immediately after placing it shall be rolled with a lightweight roller or hand tamped to the satisfaction of the Engineer.
- D. Sod on slopes steeper than 3 to 1 shall be held in place by wooden pins about 1-inch square and 6-inches long, driven through the sod into the soil until they are flush with the top of the sod.

### **3.2 WATERING AND MAINTENANCE**

- A. The sod shall be watered as directed by the Engineer for a period of two weeks after which ammonium nitrate shall be applied at the rate of three pounds per 1,000 square feet and the sod given a final watering.
- B. The Contractor shall not allow any equipment or material to be placed on any planted area and shall erect suitable barricades and guards to prevent Contractor's equipment, labor or the public from traveling on or over any area planted with sod.
- C. It shall be the obligation of the Contractor to secure a satisfactory growth of grass before final acceptance of the Project.
- D. The Contractor shall mow and maintain all sodded areas without additional payment until final acceptance of the work by the Owner, and any regrading, refertilizing, reliming, resodding or mulching shall be done at his own expense. Sodding work shall be repeated on defective areas until a satisfactory uniform stand of sod is accomplished. Damage resulting from erosion, gulleys, washouts, or other causes shall be repaired by filling with topsoil, compacting, and repeating the sodding work at the Contractor's expense.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**SECTION 32 93 00 - PLANTS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Tree, shrub, ornamental grass, perennial, and groundcover installation.
- B. Post-planting fertilization.
- C. Landscape bed edging and mulch.
- D. Tree staking and guying.
- E. Interim landscape management.

**1.2 RELATED SECTIONS**

- A. 32 8400 – Planting Irrigation
- B. 32 9100 – Planting Preparation
- C. 32 9200 – Turf and Grasses

**1.3 REFERENCES**

- A. When the following referenced standards are in conflict with this specification, the requirements of this specification shall prevail.
  - 1. ANSI Z60.1 – American Standard for Nursery Stock, most current edition.
  - 2. ANSI A 300 – Standard practices for Tree, Shrub and other Woody Plant Maintenance, most current edition and parts.
  - 3. Reference the following documents for interpretation of plant names and descriptions. Botanical names take precedence over common names. Names not listed in the above standards shall comply with those most commonly used in the trade. Where the names or plant descriptions disagree between the several documents, the most current document shall prevail.
    - a. USDA – The Germplasm Resources Information Network (GRIN)
    - b. Manual of Woody Landscape Plants; Michael Dirr; Stipes Publishing, Champaign, IL, most current edition.
    - c. Hortus Third: A Concise Dictionary of Plants Cultivated in the United States and Canada, MacMillan Publishing Company, Inc., New York 1976 Edition.

**1.4 PRICE AND PAYMENT PROCEDURES**

- A. Allowances
- B. Unit Prices
- C. Alternates

**1.5 SUBMITTALS**

- A. Submit Proof of Contractor Qualifications as specified in “Quality Assurance” article of this Section including a list of the five completed projects with project name, address, names of Architects and Owners, overall description of scope work, and contract value.
- B. Submit list of plant materials and unit prices demonstrating source and availability within ten days of award of Contract.
  - 1. Include name and address of nurseries. Include quantities, botanical names, common names, and sizes of plant materials.
  - 2. Substitutions are not permitted unless proof is submitted to the Landscape Architect by the contractor that the plant is unavailable as specified. Request for substitution shall be

accompanied with a list of contacted nurseries (min. of 3 for each plant) and sources of potential substitutions (min. of 3 for each plant) that may be of a different size, habit, species and/or cultivar. The landscape architect will not assist with any substitutions and will not give approval of substantial completion without this information and effort from the contractor.

- C. Deliver all certificates of inspection to the Landscape Architect.

## **1.6 QUALITY ASSURANCE**

- A. Hold an Alabama General Contractor's License for Classification S - Specialty Construction, Subclassification 4 - Landscaping. Firm experienced in the successful installation of a minimum of five projects within the last five years similar in scope, quality, and contract value to that indicated for this project. Firm shall have sufficient manpower, equipment and financial resources to complete the Work of this Section.
- B. Use adequate numbers of skilled workmen trained and experienced in the Work and familiar with requirements and methods needed for performance of the Work. Have a person knowledgeable in horticultural practices as an onsite superintendent at all times.
- C. Observation of the Work:
  - 1. The Landscape Architect may observe the work at any time and shall be notified prior to the start of planting, at the completion of plant layout, and at the completion of the planting.
  - 2. The Landscape Architect shall be given the opportunity to tag and review trees in the field or nursery prior to digging.
  - 3. The Landscape Architect may review all plants for quality, character, form, and overall health. All plant material is subject to inspection and rejection at any time before, during, or after planting.
  - 4. Attach secure, durable, legible waterproof labels, stating correct botanical and common name to at least one plant of each plant variety.
- D. Re-execute any work that fails to conform to the requirements of the contract and shall remedy defects due to faulty materials or workmanship upon written notice from the Landscape Architect, at the soonest possible time that can be coordinated with other work and seasonal weather demands.

## **1.7 PRE-CONSTRUCTION MEETING**

- A. Schedule a pre-construction meeting with the Landscape Architect at least two weeks before beginning work to review any questions the Contractor may have regarding the work, administrative procedures during construction and project work schedule.

## **1.8 SELECTION, OBSERVATION, AND APPROVAL OF PLANTS**

- A. Purchase trees from the growing nursery. Do not use re-wholesale plant suppliers for trees unless the Contractor can certify that the required trees are not directly available from a growing nursery. Refer to Drawings for pre-approved nurseries (if provided).
- B. Remove all rejected plants from the site within five days and provide acceptable replacement plants at no expense to the Owner.

## **1.9 DEFINITIONS**

- A. End of Warranty Final Acceptance: The date when the Landscape Architect accepts that the plants and Work in this section meet all the requirements of the warranty. It is intended that the materials and workmanship warranty for Planting, Planting Soil, and Irrigation work run concurrent with each other.

- B. Healthy: Plants that are growing in a condition that expresses leaf size, crown density, color, and with annual growth rates typical of the species' and cultivar's horticultural description.
- C. Plants or plant materials: Any living, vegetative organism listed in the Plant Schedule within the Drawings.
- D. Planting Soil: Refer to Section 32 9100.
- E. Root ball: The mass of roots including any soil or substrate that is shipped with the tree within the root ball package.
- F. Root ball package. The material that surrounds the root ball during shipping. The root package may include the material in which the plant was grown, or new packaging placed around the root ball Planting shipping.
- G. Substantial Completion Acceptance: The date at the end of the Planting, Planting Soil, and Irrigation installation where the Landscape Architect accepts that all work in these sections is complete and the Warranty period has begun. This date may be different than the date of substantial completion for the other sections of the project.

#### **1.10 PERMITS AND REGULATIONS**

- A. Acquire all permits related to the Work. If a conflict exists between permit requirements and the work outlined in the contract documents, promptly notify the Landscape Architect in writing including a description of any necessary changes and the resulting changes to the contract price.
- B. Adhere to all Federal, State, and local laws and ordinances bearing on the operation or conduct of the work as drawn and specified. This includes but is not limited to all regulations relating to the inspection for disease and insect control.

#### **1.11 DELIVERY, STORAGE, AND HANDLING**

- A. Provide necessary protective covering during transport and delivery.
- B. Deliver packaged materials (non-plant materials) in manufacturer's original containers showing weight, analysis, and name of manufacturer.
- C. Deliver plants after preparations for planting have been completed and approved, and plant immediately.
- D. Deliver and store all materials in a manner that prevents loss, damage, deterioration, or contamination.

#### **1.12 PLANT WARRANTY**

- A. Plants are warrantied to meet all the requirements for plant quality at installation in this specification. Defective plants shall be defined as plants not meeting these requirements and will be replace by the Contractor.
- B. Plant Warranty Period shall begin on the date of Substantial Completion Acceptance and will continue for one year.
- C. Plants determined to be defective during Plant Warranty Period shall be removed immediately upon notification by the Landscape Architect and replaced at no cost to the Owner, as soon as weather conditions permit and within the specified planting period.
- D. Any work required by this specification or the Landscape Architect during the progress of the work, to correct plant defects including the removal of roots or branches, or planting plants that have been bare-rooted during installation to observe for and correct root defects will not be considered grounds to void any conditions of the warranty. In the event the Contractor decides that such remediation work may compromise future health of the plant, the plant in question shall be rejected and replaced with plants that do not contain defects that require remediation or correction.
- E. The Contractor is exempt from replacing plants, after Substantial Completion Acceptance and during the Plant Warranty Period, that are removed by others, lost or damaged due to occupancy of project, lost or damaged by a third party, vandalism, or any natural disaster.

**PART 2 - PRODUCTS****2.1 PLANTS: GENERAL**

- A. Provide plants of quantity, size, genus, species, and variety and/or cultivar as indicated in the Plant Schedule. Plants are to adhere to the recommendations outlined in ANSI Z60.1 and trees shall be sourced as specified above.
- B. Provide healthy stock, grown in a nursery or greenhouse and reasonably free of die-back, disease, insects, eggs, bores, and larvae. Plants are to have a root system, stem, and branch form that will not restrict normal growth, stability and health for the expected life of the plant.
  - 1. Plant quality above the soil line:
    - a. Trees shall have one central leader unless specified as multi-trunk.
    - b. Main branches are to be distributed along the central leader not clustered together. They shall form a balanced, proportional crown appropriate for the cultivar/species.
    - c. The attachment of the largest branches (scaffold branches) shall be free of included bark.
    - d. The tree trunk shall be free of wounds that penetrate to the wood (properly made pruning cuts, closed or not, are acceptable and are not considered wounds), sunburned areas, fungal fruiting bodies, wood cracks, sap leakage, signs of boring insects, galls, cankers, girdling ties, or mechanical injury.
  - 2. Plant quality at or below the soil line:
    - a. Roots shall be reasonably free of scrapes, broken or split wood, and free of injury from biotic agents.
    - b. The root collar shall be within the upper two inches of the substrate/soil.
    - c. The root system shall be reasonably free of stem girdling roots over the root collar or kinked roots from nursery production practices.

**2.2 PLANTS: ROOT BALL PACKAGE OPTIONS**

- A. The following root ball packages are permitted for trees, shrubs, ornamental grasses, perennials, and groundcovers. Specific root ball packages shall be required where indicated in the Plant Schedule located in the Drawings. Root ball packaging is to conform to the standards of ANSI Z60.1 unless otherwise indicated.
  - 1. BALL AND BURLAPPED(B&B):
    - a. B&B plants shall be field grown, and the root ball packaged in a burlap and twine and/or burlap and wire basket package.
    - b. Twine and burlap used for wrapping the root ball packages shall be natural, biodegradable material.
  - 2. CONTAINER PLANTS (BOXES AND PLASTIC POTS):
    - a. Container plants may be permitted for trees only when indicated in the Plant Schedule, in this specification, or as approved in writing by the Landscape Architect.
    - b. Plants shall be established and well rooted in removable containers.
  - 3. LANDSCAPE PLUGS
    - a. Landscape plugs refer to plant material grown in a tray of plug cells for direct planting in the landscape. Numerical designations of 50, 32, or 21 refer to the number of cells within a standard nursery or greenhouse flat.
    - b. Landscape Plug™(LP32 and LP50) is proprietary to North Creek Nurseries in Pennsylvania. Plant material with designated root ball packages of LP32 or LP50 may be sourced from other nurseries provided the substitution adheres to the following:
      - 1) Proposed container volumes fall between #SP1 and #SP2 as defined in ANSI Z60.1.
      - 2) Proposed container dimensions of the requested substitute closely correlate to the Landscape Plug™ sizes specified:
        - a) -LP32: 2.22 inches x 2.22 inches x 4 inches



- b) -LP50: 2 inches x 2 inches x 5 inches

### 2.3 PLANTS: SOLID SOD

- A. Obtain solid sod from sources having growing conditions similar to the area to be planted. Sod is to be:
1. True to name and type of species indicated in the Plant Schedule and contains no other grasses.
  2. Well cultivated and weed, disease and insect-free, of good texture, and free from extraneous roots, stones and other foreign material. The presence of weeds shall be cause for rejection and replacement prior to Substantial Completion, or during the Guarantee Period.

### 2.4 SOIL AND SOIL AMENDMENTS

- A. Refer to Section 32 9100 – Planting Preparation for soil types and definitions.

### 2.5 POST PLANTING AMENDMENTS

- A. Slow Release Planting Tablets
1. 20-10-5 Planting Tablets  
A.M. Leonard, Inc.  
PO Box 816  
Piqua, OH 45356  
937.773.2694
  2. Approved equal.

### 2.6 MULCH

- A. All mulch types to be free from leaves, twigs, insects, grasses, weeds, plants and their seeds, other foreign materials and any substances harmful to plant growth. Types include:
1. Pine straw – Longleaf Pine(P. palustris) needles.
    - a. Unless otherwise indicated, use on slopes greater than 3:1
  2. Shredded Pine Bark (nuggets will be rejected).
  3. Double Shredded Hard wood.

### 2.7 TREE STAKING AND GUYING MATERIAL

- A. Manufacturers:
1. Tree staking & guying to utilize the ArborBrace Tree Guying System ([www.treestaking.com](http://www.treestaking.com)):
    - a. Trees up to 4 inch caliper: ATG-R/ATG-HD
      - 1) ¾ inch polypropylene guy lines, olive drab in color.
      - 2) Nickel plated spring cam-lock tension clips.
      - 3) Arrowhead Anchors(4 inch by 3-3/4 inch)
    2. Trees 4 inch – 7 inch caliper: ATG-J
      - 1) 1 inch polypropylene guy lines, olive drab in color.
      - 2) Nickel plated spring cam-lock tension clip(1500 lb breaking strength)
      - 3) Arrowhead Anchors(5-1/2 inch by 4-1/2 inch)
  - B. Approved equal.

**PART 3 - EXECUTION****3.1 SITE CONDITIONS**

- A. Coordinate the Work of this section with that of other trades.
- B. Be aware of all surface and sub-surface conditions, including utilities, and notify the Landscape Architect, in writing, of any circumstances that would negatively impact the health of plantings. Do not proceed with work until unsatisfactory conditions have been corrected.
  - 1. Notification of Local Utility Locator Service, 811, is required for all areas within project area: The Contractor is responsible for knowing the location and avoiding utilities that are not covered by the Local Utility Locator Service.
- C. Section 32 9100 - Planting Preparation and Section 32 8400 - Irrigation work to be completed and accepted prior to the installation of any plants.
- D. Perform planting during those periods when weather and soil conditions are suitable for planting in accordance with locally accepted horticultural practices and as approved by the Landscape Architect.
  - 1. Do not install plants into saturated or frozen soils. Do not install plants during inclement weather, such as rain or snow or during extremely hot, dry, cold or windy conditions.
  - 2. Landscape plugs may require planting at a different time than trees or shrubs. See Plants: Root Ball Packages and Additional Requirements.

**3.2 SOIL PROTECTION DURING PLANT DELIVERY & INSTALLATION**

- A. Protect soil from compaction during the delivery of plants to the planting locations, the digging of planting holes, and the installing of plants.
  - 1. Where possible deliver and plant trees that require the use of heavy mechanized equipment prior to final soil preparation and tilling.
  - 2. Till to a depth of 6 inches, all soil that has been driven over during the installation of plants.

**3.3 LAYOUT AND PLANTING SEQUENCE**

- A. Notify the Landscape Architect one week prior to layout. Layout all individual tree and shrub locations. Place plants above surface at planting location or place a labeled stake at planting location. Layout bed lines with paint. Adjust plant layout as directed by the Landscape Architect.
- B. Do not begin planting installation until given approval by the Landscape Architect.
- C. When applicable, plant trees before other plants are installed.

**3.4 PLANTS: GENERAL INSTALLATION**

- A. No more plants shall be distributed about the planting bed area than can be planted and watered on the same day.
- B. Excavate the Planting Soil as indicated in the Landscape Details.
  - 1. For trees and shrubs planted in soil areas that are NOT tilled or otherwise modified to a depth of at least 12 inches over a distance of more than 10 feet radius from each tree, or 5 feet radius from each shrub, the soil around the root ball shall be loosened as defined below.
    - a. The area of loosening shall be a minimum of 3 times the diameter of the root ball at the surface sloping to 2 times the diameter of the root ball at the depth of the root ball.
    - b. Loosening is defined as digging into the soil and turning the soil to reduce the compaction. The soil does not have to be removed from the hole, just dug, lifted and turned. Lifting and turning may be accomplished with a tracked mini excavator, or hand shovels.

2. If an auger is used to dig the initial planting hole, the soil around the auger hole shall be loosened as defined above for trees and shrubs planted in soil areas that are NOT tilled or otherwise modified.
  3. The measuring point for root ball depth shall be the average height of the outer edge of the root ball after any required root ball modification.
- C. Set top outer edge of the root ball at the average elevation of the proposed finish unless otherwise indicated in the Planting Details. Set the plant plumb and upright in the center of the planting hole. The tree graft, if applicable, shall be visible above the grade. Do not place soil on top of the root ball.
- D. The Landscape Architect may request that a plant's orientation be rotated when planted based on the form of the plant.
- E. Brace root ball by tamping soil around the lower portion of the root ball. Place additional soil around base and sides in six-inch lifts. Lightly tamp each lift using foot pressure or hand tools to settle backfill, support the tree and eliminate voids. Do not over compact the backfill or use mechanical or pneumatic tamping equipment.
1. When the planting hole has been backfilled to three quarters of its depth, water shall be poured around the root ball and allowed to soak into the soil to settle the soil. Do not flood the planting space. If the soil is above field capacity, allow the soil to drain to below field capacity before finishing the planting. Air pockets shall be eliminated and backfill continued until the planting soil is brought to grade level.
  2. When backfilled to within 6-8 inches of finished grade, install slow-release planting tablets as directed by the manufacturer's directions.
- F. Thoroughly water the root ball and plantings pit immediately after planting.
- G. Remove all nursery plant identification tags, ribbons, ties, and trunk protection after planting except as described in Quality Assurance of this specification section.
- H. Prune plants only as directed by the Landscape Architect.

### 3.5 PLANTS: ROOT BALL PACKAGES AND ADDITIONAL REQUIREMENTS

- A. The following are additional planting requirements for the previously specified root ball packaging types and are to be followed during the planting process in addition to the above Plants: General Installation.
- B. **BALLED AND BURLAPPED PLANTS**
1. Remove all webbing, twine, and burlap from the top of the root ball after the root ball has been backfilled. Do not fold burlap down into the planting soil.
  2. Remove the top 6 - 8 inches of the wire baskets prior to the final backfilling of the tree.
- C. **CONTAINER PLANTS**
1. Shave and scarify the root ball after removing the container.
  2. Remove all substrate at the bottom of the root ball that does not contain roots.
- D. **LANDSCAPE PLUGS**
1. Coordinate with the Landscape Architect for scheduling the layout and installation of planting areas involving the use of landscape plugs. The Landscape Architect shall be present for the layout and supervision of planting.
  2. Landscape plugs are to be installed after the flush of spring growth has begun and with sufficient time within the growing season to establish. Contractor is to account for any additional mobilizations this requirement necessitates.
    - a. Areas to be planted with landscape plugs that require a postponement in planting are to be covered with 3 inches of mulch until weather permits planting.
  3. Water landscape plugs immediately prior to layout.
  4. Excavate planting holes using a 3" auger bit attached to a power drill or earth auger.
  5. Remove plugs from their trays by pushing up through the bottom of the liner. Do not pull the plant by its vegetation. Do not 'tease' the root system apart.
  6. Place plug in excavated hole and ensure that the planting soil evenly matches up to the top of the substrate of the landscape plug. Tamp in soil around the landscape plug and

water individual plugs immediately to reduce air pockets and maximize contact between roots and soil.

7. Do not apply mulch to areas utilizing landscape plugs.
8. Complete a secondary wave of planting at the direction of the Landscape Architect to address anticipated plant failure. Secondary wave of planting is to be anticipated by the Contractor and reflected in the original proposal by accounting for a 10% loss and replacement in landscape plugs.

### **3.6 PLANTS: SOLID SOD**

- A. Lay sod within 24 hours of harvesting. Contractor shall not lay sod if dormant or if ground is frozen or muddy.
- B. Water immediately after installation.

### **3.7 STAKING AND GUYING**

- A. Do not stake or guy trees unless specifically required by the Contract Documents, or in the event that the Contractor feels that staking is the only alternative way to keep particular trees plumb.
  1. The Landscape Architect has the authority to require trees are staked or to reject staking as an alternative way to stabilize the tree.
- B. Remove guy lines after one full growing season or at other times as required by the Landscape Architect.
- C. Utilize the tree staking and guying materials specified. Tie in such a manner as to prevent girdling. Refer to Planting Details for installation.

### **3.8 STRAIGHTENING PLANTS**

- A. Maintain all plants in a plumb position throughout warranty period. Straighten all trees that move out of plumb including those not staked. Plants to be straightened shall be excavated and the root ball moved to a plumb position, and then re-backfilled.
- B. Do not straighten plants by pulling the trunk with guys.

### **3.9 INSTALLATION OF FERTILIZER AND OTHER CHEMICAL ADDITIVES**

- A. Do not apply any soluble fertilizer to plants during the first year after transplanting unless soil test determines that fertilizer or other chemical additives is required. Apply chemical additives only upon the approval of the Landscape Architect.
- B. Apply control released fertilizers according to manufacturer's instructions and standard horticultural practices.

### **3.10 PLANTING BED FINISHING**

- A. Smooth out grades between plants after planting and before mulching.
- B. Separate the edges of planting beds and lawn areas with a smooth, formed edge cut into the turf with the bed mulch level slightly lower than the adjacent turf/sod or as directed by the Landscape Architect.
- C. Install metal edging as indicated in the Drawings.

### **3.11 MULCHING OF PLANTS**

- A. Apply mulch to the depth indicated in the Planting Details, covering the entire planting bed area unless otherwise directed. Install no more than 1 inch of mulch over the top of root balls. Taper mulch depth down to 2 inches when abutting pavement.

- B. For trees planted in lawn areas, the mulch shall extend to a 4-foot radius around the tree or to the extent indicated on the plans.
- C. Lift all leaves, low hanging stems, and other green portions of small plants out of mulch if covered.

### **3.12 WATERING**

- A. The Contractor shall be fully responsible to ensure that adequate water is provided to all plants from the point of installation until the date of Substantial Completion Acceptance. The Contractor shall adjust the automatic irrigation system, if available, and apply additional water, or adjust for less, using hoses as required.
- B. Hand water root balls of all plants immediately after planting to assure that the root balls have moisture above wilt point and below field capacity.
- C. The Contractor shall install and maintain 25 gallon watering bags for each tree for the duration of the warranty period.
  - 1. Watering bags shall remain the property of the Owner at the completion of the Work.

### **3.13 PROTECTION DURING CONSTRUCTION**

- A. Protect planting and related work and other site work from damage due to planting operations, operations by other Contractors or trespassers. Maintain protection during installation until Substantial Completion Acceptance. Treat, repair or replace damaged work immediately.
- B. Damage done by the Contractor, or any of their sub-contractors to existing or installed plants, or any other parts of the work or existing features to remain, including those on adjacent property, shall be cleaned, repaired, or replaced by the Contractor at no expense to the Owner. The Landscape Architect shall determine when such cleaning, repair, or replacement is satisfactory.

### **3.14 CLEAN UP**

- A. Keep site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the site no less than once a week.
  - 1. Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways and neighboring property.
- B. Wash all soil from pavements and other structures. Ensure that mulch is confined to planting beds and that all tags and flagging tape are removed from the site.
  - 1. Tags mentioned in Quality Assurance Article of this Section are to remain until End of Warranty and Final Acceptance.
- C. Make all repairs to grades, ruts, and damage by the plant installer to the work or other work at the site.
- D. Remove and dispose of all excess planting soil, subsoil, mulch, plants, packaging, and other material brought to the site by the Contractor.

### **3.15 INTERIM PLANT MANAGEMENT**

- A. Maintain all plants and planted areas during the project work period and prior to Substantial Completion Acceptance.
  - 1. Maintenance during the period prior to Substantial Completion Acceptance shall consist of pruning, watering, cultivating, weeding, mulching, removal of dead plant material, repairing/replacing/tightening of tree guying materials, resetting plants to proper grades and upright position, and furnishing and applying such sprays as are necessary to keep plantings reasonably free of damaging insects and disease, and in healthy condition. The threshold for applying insecticides and herbicides shall follow established Integrated Pest

Management (IPM) procedures. Mulched areas shall be kept reasonably free of weeds and grass.

### 3.16 SUBSTANTIAL COMPLETION ACCEPTANCE

- A. Upon written notice from the Contractor, the Landscape Architect shall review the work and decide if the work is substantially complete.
  - 1. Notify the Landscape Architect at least 7 days prior to the requested review date.
  - 2. The Landscape Architect may develop a "punch list" that describes the work to be completed or amended before Substantial Completion is granted. After the Contractor has completed the items on the punch-list, the Contractor may request another review by the Landscape Architect.
- B. The date of Substantial Completion of the planting shall be the date when the Landscape Architect accepts that all work in the following sections are complete:
  - 1. 32 8400 – Planting Irrigation
  - 2. 32 9100 – Planting Preparation
  - 3. 32 9200 – Turf and Grasses
  - 4. 32 9300 - Plants
- C. The Plant Warranty Period begins at the date of written notification of Substantial Completion from the Landscape Architect. The date of Substantial Completion for the Sections listed above may be different than the date of Substantial Completion for the other Sections of the Work.

### 3.17 END OF WARRANTY & FINAL ACCEPTANCE

- A. Contractor is responsible for contacting the Landscape Architect at the end of the Plant Warranty Period to schedule final inspection. Should the contractor fail to contact the Landscape Architect, the Plant Warranty Period is automatically extended until he/she does so.
- B. At the end of the Plant Warranty Period, submit request for inspection for Final Acceptance to Landscape Architect at least one week prior to anticipated date of inspection; include list of Work substantially accepted and list of Work replaced during Warranty Period.
- C. Upon request for inspection, jointly review with Landscape Architect all guaranteed Work for Final Acceptance.
- D. Remove tree guying apparatus and saucers from all trees, unless otherwise directed; replace mulch to specified thickness.
- E. Upon completion by the Contractor of all required repairs and replacements, the Landscape Architect will confirm the date of Final Acceptance of the Work.

END OF SECTION

**THIS PAGE INTENTIONALLY LEFT BLANK**

**THIS PAGE INTENTIONALLY LEFT BLANK**